MIT-WPU
॥ विश्वशान्तिर्ध्रुवं ध्रुवा ॥

National Scientists
NSRTC
Round Table Conference
विश्वकल्याणाय् विज्ञानम्।

1st NATIONAL SCIENTISTS ROUND TABLE CONFERENCE 2024
FOR VIKSIT BHARAT 2047 (NSRTC)

19th, 20th & 21st July 2024

ABSTRACT BOOK








The first round table conference of the Scientists of Bharat on **SCIENCE and TECHNOLOGY** for **ARTIFICIAL INTELLIGENCE, QUANTUM TECHNOLOGY, ADVANCED MATERIALS & MANUFACTURING, SUSTAINABILITY, HEALTH CARE, CLIMATE CHANGE, DIGITAL TRANSFORMATIONS, and SCIENCE & SPIRITUALITY** towards VIKSIT BHARAT

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Prof. Dr. Milind Pande
National Convener, NSRTC 2024
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Dr. Sanjay Kamtekar
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Chief Academic Officer, MIT-WPU

Prof. Dr. Bharat B. Kale, *FRSC*
National Convener, NSRTC 2024
Director CoE (Materials Science), MIT-WPU
Former DG, C-MET, Pune

Prof. Dr. techn. Murthy S.S.S. Chavali Yadav
Co-Convener, NSRTC 2024
Dean, Research & Development
MIT-WPU

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Dr. R. A. Mashelkar

Former Director General
CSIR, New Delhi

PREFACE

I want to congratulate our visionary leader Rahul Karad, Executive President of MITWPU, for organizing a unique National Scientists Round Table Conference (NSRTC-24) on science and technology.

India must lead in science that solves, technology that transforms and innovation that impacts. The rapidity of change in advancement of science and technology is mind boggling. Indeed, it is no exaggeration to say that we are on the edge of change comparable to the rise of human life on earth.

NSRTC-24 is focussing on eight themes that will drive our social and economic transformation like never before. These are Artificial intelligence, Advanced materials and processing, Agri-tech, Biotechnology, Health care, Climate change and Digital transformation.

As they say, science and spirituality are two sides of the same coin. While science helps us understand the physical world, spirituality guides us in understanding our inner world and our place in the universe. Therefore, we are also having an important session on science and spirituality.

In this unique round-table conference of science and technology, we will hear the views of thought and action leaders in science and technology, many of them are our young future leaders. The conference will enable a direct engagement between upcoming researchers and distinguished academicians, both national and international.

I am sure this first NSRTC-24 will set the mood and tone for the next conferences and indeed for NSRTC-24 and will become a key milestone in such dialogues on science and technology in our future.

Revered

Prof. Dr. Vishwanath D. Karad

Founder President, MIT-WPU

Creator - World Peace Dome, Pune

PREFACE

The pursuit of truth and understanding the fundamental nature of reality are central to both spirituality and science. A thorough grasp of the fundamental ideas underpinning the physical universe in all its manifestations is the aim of science. It is possible to be wholly true to the scientific method of investigation and integrity while still viewing it as a component of a larger discipline that encompasses all of your experiences as a human in this world of non-humans. The Science of Spirituality teaches people how to manage their time between practicing and growing spiritually and attending to their obligations to their families, jobs, and society. Investigating the nature of reality is one of the main areas where spirituality and science converge. While spiritual experiences can offer compassion and a moral compass, scientific temper can direct ethical decision-making through evidence-based understanding. Encouraging scientific literacy in addition to spiritual development helps build a society that is more knowledgeable, compassionate, and resilient.

As we aspire for Viksit Bharat 2047, science and spirituality need to be combined to envision a future in which ethical and spiritual development coexist with economic and technical achievements. India is poised to become a Vishwaguru, guiding the world with insight, creativity, and a strong dedication to everyone's well-being. This integrated strategy will enable India to serve as a role model for the world community, pointing it in the direction of a more equitable, peaceful, and prosperous future through comprehensive education, ecological practices, moral leadership, and cultural diplomacy. India's goal of becoming a "Vishwaguru" (world teacher) entails using both its modern innovations and rich history to impart knowledge and direction on a worldwide scale. The convergence of science and spirituality can play a pivotal role in this vision by demonstrating a holistic model of development that integrates technological progress with ethical and spiritual values.

I welcome you to join us at the National Scientists Round Table Conference 2024 (NSRTC 2024). Together, let us build a future where science and spirituality coalesce to create a Viksit Bharat that stands as a beacon of hope, innovation, and sustainable development for the entire world.

Padma Bhushan

Dr. Vijay P. Bhatkar

Founder Director

C-DAC

PREFACE

I am delighted to know that the National Scientists Round Table Conference (NSRTC-24), organized by MITWPU under the leadership of Shri. Rahul V. Karad. I warmly welcome all esteemed participants to this significant event. NSRTC-24 marks a pivotal moment in our journey towards scientific advancement and innovation in India. The brightest minds in the scientific community have gathered to share their knowledge and ground-breaking work in key areas vital to our nation's progress.

Our discussions will cover diverse topics including Artificial Intelligence, Advanced Materials and Processing, Agri-Tech, Biotechnology, Healthcare, Climate Change, Digital Transformations, and the interplay between Science and Spirituality. These subjects represent the multifaceted challenges and opportunities of our era, each holding the potential for transformative impact on our nation and the world.

This Conference serves as a platform to forge new collaborations, inspire innovative thinking, and chart a path forward for scientific research and development in India. Through our collective efforts, we can achieve remarkable breakthroughs and contribute significantly to the global body of knowledge. Let us engage in fruitful discussions, challenge each other's ideas, and inspire one another to push the boundaries of what is possible. Together, we can build a future where Science and Technology are the cornerstones of a prosperous, sustainable, and enlightened society and accomplish the goal of Viksit Bharat 2047, launched by our Hon'ble Prime Minister.

Thank you, and I look forward to seeing all of you.

Shri. Rahul V. Karad
Executive President
MIT-WPU

PREFACE

It is with immense pride and a profound sense of purpose that I welcome you to the National Scientists Round Table Conference 2024 (NSRTC 2024). This landmark event, the first round table conference by the esteemed Scientists of Bharat, is dedicated to exploring Topics of diversification including ethical considerations, mindfulness practices, and the philosophy of science to create the synergy between Science and Spirituality for a Viksit Bharat. Under the esteemed guidance of Padma Vibhushan Dr. Raghunath A. Mashelkar, Padma Bhushan Dr. Vijay P. Bhatkar, Prof. Dr. G.D. Yadav, and Dr. Shekhar C. Mande, who are Advisory Members of MIT-WPU, this conference aims to bring together around one hundred eminent scientists and academicians from across the country. We are also honored to invite Bhatnagar Awardees, whose contributions to science and technology are unparalleled.

Our aim is to foster a melting pot of knowledge and innovation, bringing together leading academic scientists, researchers, and scholars to exchange ideas and share their research across all aspects of Physical Sciences, Life Sciences, and Engineering & Technology. We envision NSRTC 2024 as a platform where interdisciplinary and international collaborations are debated, inspiring pathways to new discoveries, novel paradigms of development, and innovative methods of delivery, all empowered by science intertwined with behavioral science. Our goal is to drive progress at unparalleled speed and scale, with a steadfast commitment to sustainability. At NSRTC 2024, we are not only focused on technological advancements but also on the bigger purpose of creating an equitable, sustainable, and human-centric Viksit Bharat @100. We aspire to set a global example, showcasing how cutting-edge frontier technologies can be harnessed to build a society that upholds the highest values of humanity.

I invite you to join us at NSRTC 2024 and be a part of this transformative journey. National Scientists Round Table Conference 2024 (NSRTC 2024). Your participation and insights will be invaluable as we strive to merge scientific innovation with spiritual wisdom. Together, we can pave the way for a Viksit Bharat that serves as a global exemplar of hope, ethical progress, and sustainable development. Let us build a future where science and spirituality coalesce to create a Viksit Bharat that stands as a beacon of hope, innovation, and sustainable development for the entire world.

Dr. Ashok Joshi
Chairman, NSRTC 2024
Founder, Microlin Technologies
Founder, Clean Joule, USA

PREFACE

MIT World Peace University is proud to host the inaugural National Scientists Roundtable Conference (NSRTC) 2024 in Pune, India. This landmark event promises to be a confluence of brilliant minds, sparking critical discussions and charting a path toward a developed India – a "Viksit Bharat" – by the year 2047.

The conference theme resonates deeply with the founding principles of our nation – building a peaceful world fueled by progress. NSRTC 2024 recognizes the pivotal role of science and technology in achieving this vision.

This conference goes beyond the traditional scientific spectrum. NSRTC 2024 brings together seemingly disparate fields like Artificial Intelligence, Agri-Tech, Digital Transformation, and Climate Change, fostering a holistic conversation. The intriguing inclusion of Spirituality highlights its potential role in guiding scientific advancements towards a more balanced and sustainable future.

NSRTC 2024 is not just about presentations and discussions. It's about igniting a spark. The conference promises to be a highly enriching experience, particularly for faculty members, who will gain valuable insights from their peers and explore the potential for future collaborations.

By bringing together leading scientists, NSRTC 2024 aims to tackle pressing issues head-on and pave the way for advancements that benefit not just India, but the global scientific community.

I convey my regards and best wishes for this historic event to be a catalyst for shaping the future of science and technology for Viksit Bharat.

Prof. Dr. R. M. Chitnis
Co-Chairman, NSRTC 2024
Vice Chancellor, MIT-WPU

PREFACE

It is a great pleasure that MIT World Peace University is organising the first of its kind "National Scientists Roundtable Conference" (NSRTC) scheduled to take place in Pune – the knowledge hub of India. This prestigious event brings together some of the brightest minds in the scientific community, and we are honoured to host it.

The central theme of the conference "Viksit Bharat 2047", is of paramount importance in today's world, and the deliberations and discussions during this conference surely will lead to desired outcomes and collaborations. With a unique blend of topics like AI, Agri-Tech, Digital Transformation; as well as Spirituality and Climate Change; the churning of thoughts of wisdom of the scientists will be both – interesting as well as inspiring. Aligned with the founding principles of our nation Bharat of being constructive and progressive for building and propagating a peaceful world, the NSRTC will bring forth pathways to bring about positive changes in the scientific world for the betterment of the entire community.

I would like to extend my gratitude to the organizing committee for their tireless efforts in putting together a comprehensive program that includes keynote addresses, plenary sessions, and oral presentations.

Best wishes for a productive and enriching experience during the conference and we look forward to the meaningful proceedings of NSRTC 2024.

Dr. Sanjay Kamtekar
Secretary, NSRTC 2024
Chief Academic Officer, MIT-WPU

PREFACE

I am delighted by the initiative taken by MIT-WPU, especially Hon. Shri. Rahul Karad, Executive President of MIT-WPU, in organizing the National Scientists Round Table Conference (NSRTC-24) on science and technology. It is an honour to be part of this conference and to contribute to designing its theme, which focuses on the crucial need for next-generation research and innovation for a Viksit Bharat. The conference will cover eight key themes: Artificial Intelligence, Advanced Materials and Processing, Agri-tech, Biotechnology, Healthcare, Climate Change, Digital Transformation, and Science and Spirituality. These topics will be thoroughly discussed by top young scientists, addressing current problems and exploring solutions within these areas. This round-table conference is unique in bringing together leading minds to tackle pressing issues in science and technology. I am excited about the potential impact of this conference on all participants, particularly faculty members, as it promises to be a highly beneficial and transformative event.

Prof. Dr. Milind Pande
National Convener, NSRTC 2024
Pro Vice-Chancellor, MIT-WPU

PREFACE

Indian Scientists Roundtable Conference on Science & Technology" (NSRTC 2024) is the first of its kind to be organized at Dr. Vishwanath Karad MIT World Peace University, Pune. "The aim of this conference is to bring together leading academic scientists, researchers, and research scholars to exchange and share their experiences and research results on all aspects of Physical Sciences, Life Sciences, and Engineering & Technology." The participating scientists will provide new ideas and directions that will inspire academicians and researchers, particularly the budding young generation, to pursue Fundamental Research across emerging areas of science and technology.

New ways of interdisciplinary and international collaboration will be debated, with the aim of inspiring new discoveries and development paradigms, all empowered by science combined with behavioral science for unparalleled speed, scale, and sustainability. "The bigger purpose of NSRTC 2024 is to find new ways in advancing cutting-edge frontier technologies to create an equitable, sustainable, and human-centric Viksit Bharat @100 that will be a role model for the rest of the world." The conference features eight tracks covering domains like AI, Agri-tech, Spirituality, Digital Transformation, and Climate Change.

MIT WPU is actively engaged in cutting-edge scientific research across advanced materials, quantum, energy, bioengineering, pharma, health, and AI. In addressing the societal, industrial, technological, and environmental challenges of the country, MIT WPU is designing future research programs with a roadmap.

This conference, directed by Advisory Members Dr. Raghunath A Mashelkar, Dr. Vijay P Bhatkar, Prof. Dr. GD Yadav, and Dr. Shekhar C Mande, aims to bring together around one hundred eminent scientists and academicians on a unique platform for insightful discussion, collaborations, and guidance, laying the foundation for Viksit Bharat 2047. "Join us at NSRTC 2024 to collaborate, innovate, and lead towards a transformative future, setting a global benchmark for progress and sustainability."

Prof. Dr. Bharat B. Kale, *FRSC*
National Convener, NSRTC 2024
Director CoE (Materials Science), MIT-WPU
Former DG, C-MET, Pune

PREFACE

Dr. Vishwanath Karad MIT World Peace University (MIT-WPU) is taking glorious shape and progressing towards achieving top slot ranks published by NIRF. Thanks to Shri Rahul Karad, Executive President, MIT-WPU, for nucleation of this unique concept called as National Scientists Round Table Conference (NSRTC 2024) for Viksit Bharat 2047. In this conference, the distinguished academicians and research scientists of the Bharat have been invited and they are going to deliver a talk, discuss, and guide the country's next generation research and innovation to envision Viksit Bharat 2047. I am very happy to quote that renowned scientists who are in the top 2 % of the world ranking, Bhatnagar awardees, fellows of national academies, directors and vice-chancellors of academic and research institutions are going to discuss their research work in the areas like AI-ML, Advanced Materials and Processing, Agri-Tech, Biotechnology, Climate Change, Digital Transformations, Health Care, and Science, Scientific Temper & Spirituality.

Students and faculty members from different departments (schools) of MIT-WPU would be highly benefited during this rare meeting, which is one-of-a-kind, with the researchers of interdisciplinary and multidisciplinary expertise, with extremely good citations, many of whom I know them during my earlier academic-research collaborations. This convergence would eventually lead to future research collaborations which is an expected outcome. Hence, I am very curious about this First Round Table Conference of Top Scientists which is scheduled on 19–21 July 2024.

Prof. Dr. techn. Murthy S.S.S. Chavali Yadav
Co-Convener, NSRTC 2024
Dean, Research & Development
MIT-WPU

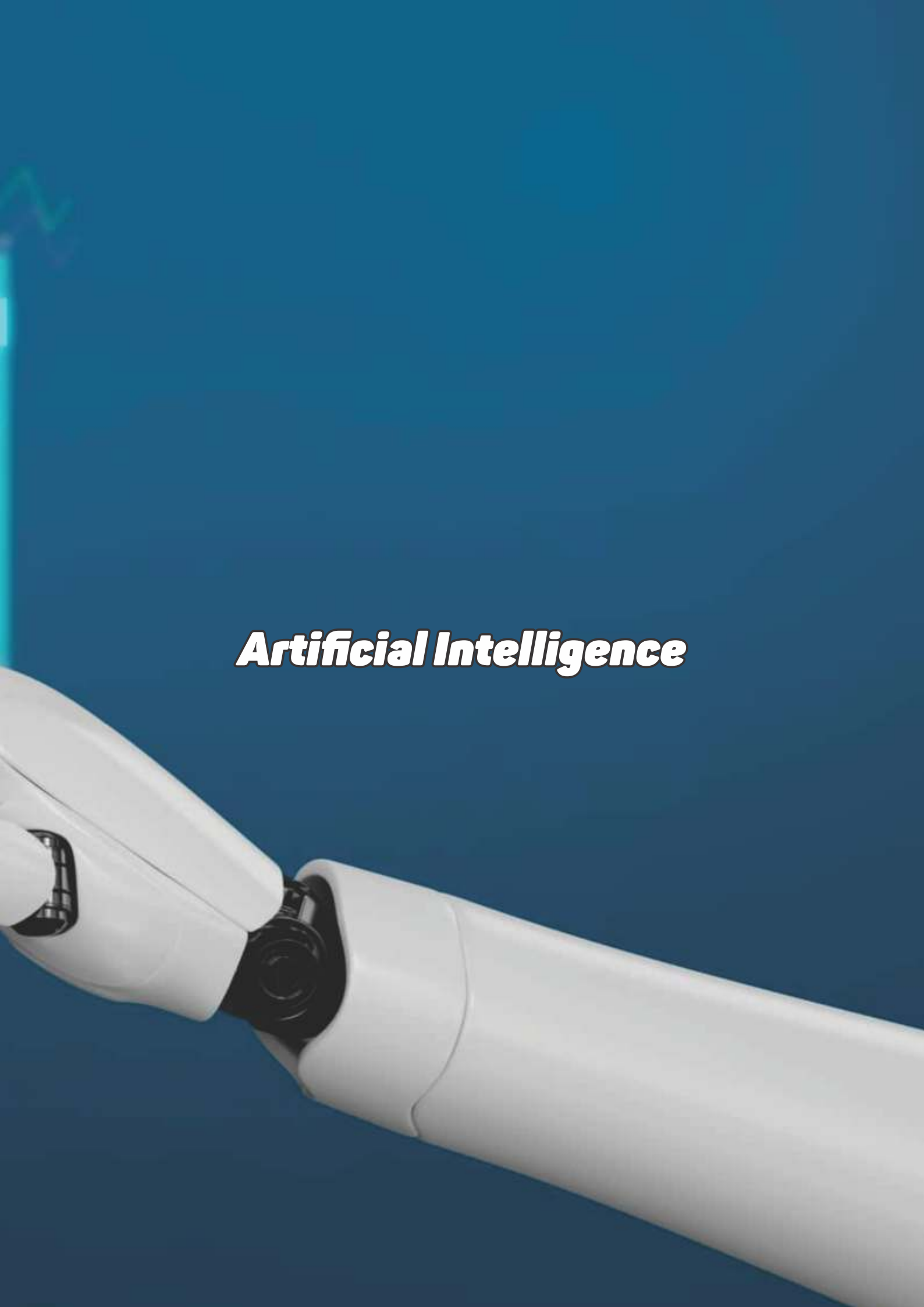
PREFACE

On behalf of the organizing committee and Dr. Vishwanath Karad MIT World Peace University, happy to be part of this event the first of its kind "Indian Scientists Roundtable Conference on Science & Technology", NSRTC-2024, https://nsrtc.org/, to be held at Dr. Vishwanath Karad MIT World Peace University and Hotel Tip-Top International from 19th to 21st July 2024.

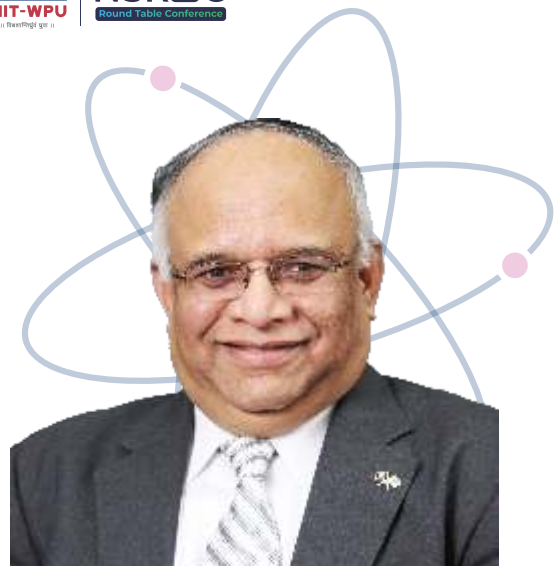
This national conference brings together top Indian academic scientists across the globe leading in their respective fields, also, researchers, and research scholars to exchange and share their experiences and research results on all aspects of Physical Sciences, Life Sciences and Engineering & Technology.

Themes include Artificial Intelligence; Advanced Materials and Processing; Agri-Tech; Biotechnology; Climate Change; Digital Transformations; Health Care & Science, Scientific Temper & Spirituality. My best wishes for successful and fruitful debates at the conference on the mentioned specific themes. I eager to participating and debating on the latest technological advancements towards applications in various sectors industry experts, government, and academic researchers/scientists on these topics.

I assume this will be a great platform for MIT-WPU students and Faculty to find new ways to advance the tools of cutting-edge frontier technologies to create an equitable, sustainable, and human-centric Viksit Bharat@2047. Looking forward to an excellent discussion with experts from different fields sharing their innovative and breath-taking outcomes.


Artificial Intelligence

Big Data, Machine Learning, Artificial Neural Networks, and Artificial Intelligence in Physics Based Models of Energy



Prof. Dr. Jay P. Gore
Purdue University, USA

Dr. Jay P. Gore is known for his world-class scientific research in energy, artificial intelligence, radiation, combustion, & Climate Change and for his transformative educational institution leadership. He has been an influential thought leader in shaping energy, climate and innovation policies in the United States of America (USA).

He has served as the Director of the Energy Center at Purdue University, Jefferson Science Fellow in the U. S. Department of State, and the inaugural Vice Chancellor of the Maharashtra Institute of Technology World Peace University and continues to serve as the Reilly University Chair Professor at Purdue University.

He has made pioneering contributions to energy and exergy efficiency, artificial intelligence (AI), fire safety, turbulence radiation interactions, and gas turbine combustion. His work in turbulence radiation interactions and some breakthrough applications of novel exergy efficiency-based optimization have received worldwide accolades, including the Arden Bement Award, the Best Paper Award from the American Society of Mechanical Engineers (ASME) and the American Institute of Aeronautics and Astronautics (AIAA).

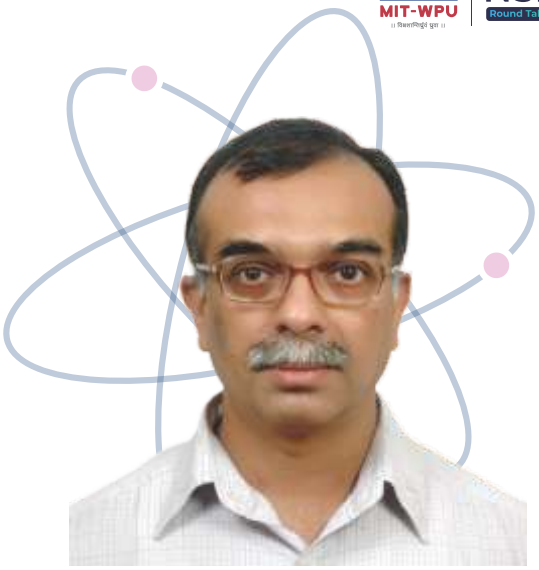
He has been elected as a Fellow of the ASME, the AIAA and the Combustion Institute (International).

The President of the United States of America (USA) honoured him with the Presidential Young Investigator Award in 1991.

ABSTRACT

We have applied the emerging methods in big data, artificial neural networks, machine learning, and artificial intelligence to some wicked problems in the challenging areas of: Climate Change and Power Plant Shutdowns. We were fortunate to receive ten years' worth of detailed data for pressures, temperatures, flow rates, power output, heat input, and operating, contractual, and maintenance costs from a large power plant. These data involve 3650 days or 87600 hours or 525,600.000 minutes or 315,360,000 seconds of data for approximately 250 variables. Clearly, translating into the inverse time units of frequency these are 200 inverse Gigahertz of big data. We accepted these data and engaged in dividing them into multiple realization sets of time series including some designated as validation sets and other designated as building sets for physics-based models. We discovered that most of the data are of great quality while we also discovered that a large enough portion of the data violated our physics-based models and the quality of our adaptive neural network and machine learning algorithms to unacceptable levels. The resulting machine learning models would result in significant improvements in the exergy efficiency of the plant and turn their bankrupting losses to potential profits.

Predictive Models and Simulations of Materials using Quantum Physics and Machine Learning



Prof. Dr. Umesh V. Waghmare

Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru

ABSTRACT

First-principles simulations based on quantum density functional theory have emerged as a powerful new paradigm in materials science that combines the advantages of theoretical and experimental research in design and development of materials for technological applications. They facilitate deep understanding of advanced materials, provide datacomplementary to experiments and even make predictions of new materials and structures. In the last decade, machine learning has made strides in this endeavour showing remarkable promise in revolutionizing methods and applications of such simulations, like in many other fields.

We illustrate these with our recent works on (a) scale-free ferroelectricity in hafnia that can lead to ultimately high-density computer memories, and (b) how charged microdroplets of water can weather natural minerals into their nanoparticles.

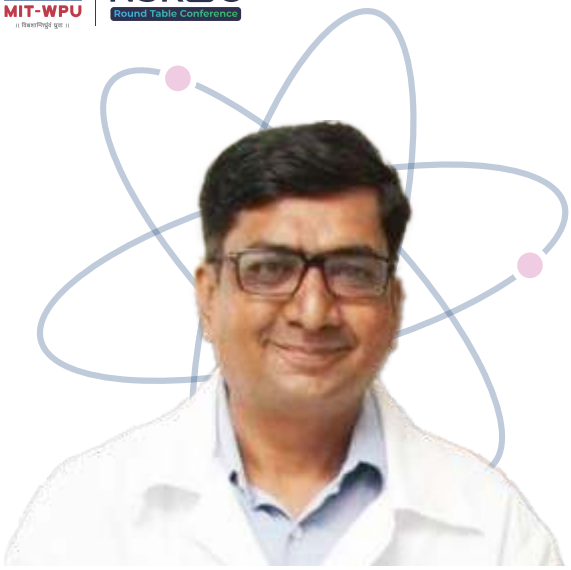
One of the challenges in the use of machine learning in materials science is the lack of large and consistent datasets of material properties. Presenting our work on learning from small data by combining machine learning methods with dimensional analysis and physical laws, we highlight what needs to be done to enhance the efficacy of maching learning towards accelerated development of materials for applications.

Prof. Umesh Waghmare is well-known for his research in theoretical and computational research in Materials Science, and presently also for the contributions to Indian Science as the President of Indian Academy of Sciences, Bangalore. Prof. Waghmare received a B Tech (with institute silver medal) in Engineering Physics from the IIT, Bombay (1990) and a PhD in Applied Physics from Yale University (1996). He worked as a post-doctoral researcher in the physics department at Harvard University. He is also distinguished adjunct professor at Temple University.

Prof. Waghmare is known for his fundamental contributions to the theory of structural phase transitions that are key to multi-functional properties of ferroelectrics, multiferroics and shape memory alloys. His recent work has predicted a new experimental spectroscopic technique that is based on quantum geometry of electrons. Breakthroughs from his research include scale-free ferroelectricity in hafnia and prediction of the GQuES spectroscopy. He was a co-founder of a startup, Breath Applied Sciences PVT LTD, which is engaged in reduction of CO 2 by conversion to methanol. He is an Associate Editor of NanoScale and NanoScale Advances, and a member of the editorial advisory boards of the Journal of American Chemical Society and Materials Today.

He is a recipient of DuPont Young Faculty grant award (2003), MRSI medal (2004), B M Birla award for Physics (2005), DAE outstanding research investigator award (2009), IBM Faculty Award (2009), SS Bhatnagar prize in Physical Sciences (2010) and the Infosys Prize in Engineering and Computer Science (2015). He was recognized as a distinguished alumnus by IIT-Bombay in 2017. He is a Fellow of Indian Academy of Sciences, National Academy of Sciences, Allahabad, the Indian National Science Academy and Indian National Academy of Engineering.

Artificial Intelligence in Chemical Processing: ANN-based Models for Optimizing Food Encapsulation and Ion Exchange Processes



Prof. Dr. Shirish H. Sonawane
NIT Warangal

Prof. Shirish Hari Sonawane, a distinguished academician and researcher, holds the position of Professor in the Department of Chemical Engineering at NIT Warangal. With an impressive track record spanning over two decades, he has made significant contributions to both teaching and research.

His expertise covers a wide range of areas, including the application of nanoparticles reinforced polymer composites, and innovative use of artificial intelligence. Under his guidance, he established the Sonoprocess Engineering Lab at NIT Warangal. Prof. Sonawane has successfully completed over 30 national and international projects, resulting in more than 230 national and international publications and 9 Indian patents.

Prof. Sonawane has received various prestigious awards, including the VASVIK Award and the Hindustan Dorr-Oliver Award. As a fellow of both the Telangana Academy of Sciences and the Maharashtra Academy of Sciences, he actively engages with esteemed societies.

Recently, the innovative wastewater treatment technology, which combines hydrodynamic cavitation with ceramic membranes, has gained significant recognition. The Department of Science and Technology (DST) has acknowledged its effectiveness

ABSTRACT

Artificial intelligence (AI) plays a crucial role in revolutionizing chemical processing industries, driving forward innovation, efficiency, and safety. Its predictive abilities significantly contribute to optimizing processes and formulating chemicals, while recent advancements have led to the development of smarter process control systems, error detection mechanisms, and diagnostic tools. This fosters the adoption of sustainable practices within chemical engineering. For example, artificial neural network (ANN)-based models offer valuable insights into the encapsulation process of bioactive compounds, such as peppermint flavor in gum Arabic (GA). These models are tailored to analyse the effects of various parameters, such as GA concentration, feed flow rate, and spray dryer temperature, optimizing encapsulation efficiency, particle size, and yield. Likewise, ANN models are utilized to predict the optimal conditions for Cu (II) removal from acid mine drainage waste using cation exchange processes. The efficiency of these models in predicting outcomes across diverse chemical processes is remarkable. As a result, optimization studies based on ANN models can save both time and resources by eliminating the need for extensive laboratory trials. Across chemical industries, the diverse capabilities of AI drive innovation, compactness, efficiency, safety, and sustainability, making it indispensable for future advancements.

GenX-AI: A Generative and Explainable AI for Reliable and Robust Human-Centric Applications

Prof. Dr. Siba Kumar Udgata
University of Hyderabad

ABSTRACT

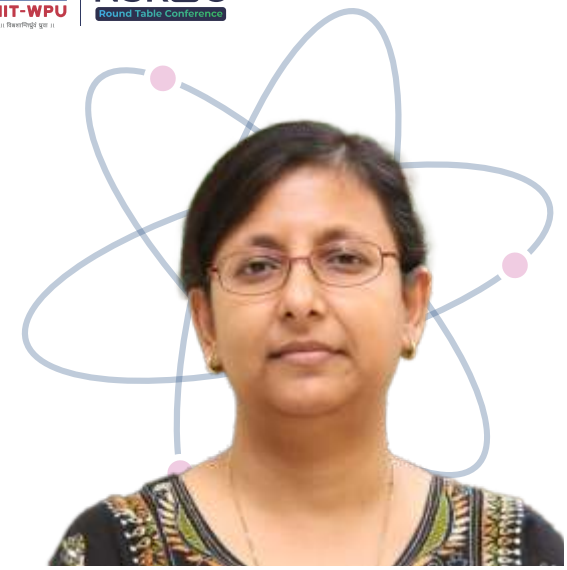
The lack of transparency and interpretability in Artificial Intelligence (AI) models can hinder users' trust and dependency in these systems. Explainable AI (XAI) is an emerging field in machine learning that addresses how decisions are made in an AI system that otherwise considered as a black box. Knowing the problem may not be sufficient and thus generation of recourses in terms of counterfactuals to reverse/counter the unfavourable outcomes based on the classification of the data is an important step towards building sustainable and reliable AI based systems. The generation of counterfactuals for recommending remedial measures instead of focusing on the cause only is also important. In conclusion, how these models can be used for wearable sensor based human activity recognition system, human resources management and women and maternity health improvement are used to improve the interpretability and performance are discussed. Different explainable AI models are proposed in the literature to address these issues. These are mainly the LIME (Local Interpretable Model-Agnostic Explanations) and SHAP (SHapley Additive exPlanations) and how these models can be used to increase the transparency in the AI systems. The DiCE (Diverse Counterfactual Explanations) is also a step towards generating feasible and least cost counterfactuals. We have worked and developed a few GenX-AI based models for group counterfactuals for human resource planning and enhancement of efficiency. We also have done some work on generating GenX-AI models for health-related applications like pre-term delivery and maternity related problems. There are many challenges in this area that includes availability of common data framework, multimodal and inconsistent data, high dimensionality of the data, huge computational requirement, etc.

Prof. Siba Kumar Udgata is a Professor in Computer and Information Sciences at University of Hyderabad, India. He has a Ph.D. in Computer Science in the area of mobile computing and wireless communications He worked as United Nations Fellow and worked at the UNU/IIST, Macau in the year 2001. He is leading the WiSeCom (Wireless Sensing and Communication) Lab at School of Computer and Information Sciences, University of Hyderabad, India.

His research focus is on wireless communication, Wi-Fi Sensing, mobile computing, intelligent sensors, sensor network algorithms, Internet of Things, and applications. He was volume editor for several Springer LNAI, AISC, LNNS International Conference proceedings and also associate editor and editorial board member of IOS Press KES Journal http://www.kesinternational.org/journal/ and Elsevier AKCE International Journal of Graphs and Combinatorics.

Prof. Udgata has published more than 175 research papers in reputed international journals and conference proceedings. He has worked as principal investigator in many Government of India funded research projects mainly for the development of Wireless Sensor Network applications, Wi-Fi sensing for assistive healthcare and WiFi Sensing Enabled Smart-Home applications and Intelligent Algorithms.

He is a recipient of SUR (Shared University Research) award grant from IBM Inc, and an elected Fellow of Telangana Academy of Sciences.



Prof. Dr. Tanusri Saha-Dasgupta

Director

S.N.Bose National Centre for Basic Sciences, Kolkata

Prof. Saha-Dasgupta is a Senior Professor and Director at S. N. Bose National Centre for Basic Sciences. She obtained her PhD degree from Calcutta University in 1995. She was a Post-doctoral Fellow at ONERA, Paris; CNRS, France; Max-Planck Institute, Stuttgart, Germany and IISc, Bangalore.

Prof. Saha-Dasgupta works in the area of computational condensed matter/ materials physics, and a major thrust of her research is the application of first principles electronic structure calculations to understand the physics and chemistry of novel and complex materials.

She is a fellow of American Physical Society, The World Academy of Sciences, Indian National Academy of Sciences, Indian Academy of Sciences, National Academy of Sciences, India, and West Bengal Academy of Sciences. She is recipient of Swarnajayanti Fellowship, MRSI-ICSC Superconductivity & Materials Science Annual Prize, DAE-Raja Ramanna prize, P. Sheel Memorial Award, Dr. A. P. J. Kalam HPC award and J. C. Bose fellowship.

Machine learning helps predict new materials for nano alloys, semiconductors & rare earths

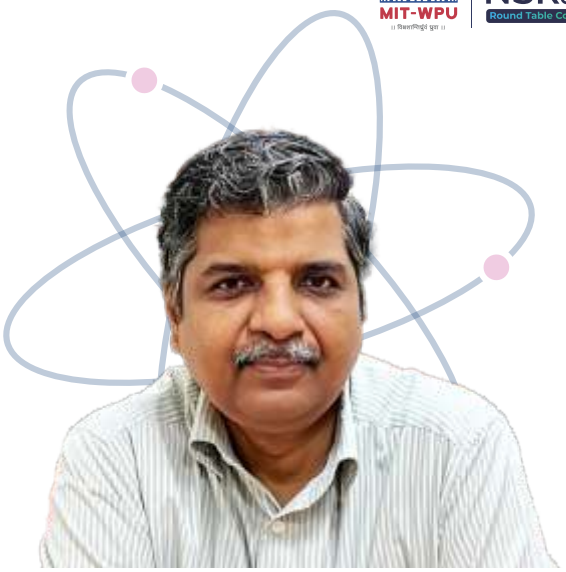
ABSTRACT

The work focuses on recent applications of machine learning (ML) to materials informatics. For example, it is important to know under what conditions core-shell structures are formed in the nanocluster alloys and which metal forms the core, and which stays on the surface as a shell. It is experimentally impossible to determine how they behave in forming nanocluster alloys. But computers can be programmed to predict the behaviour of these pairs and more through 'machine learning'. The machine is taught to recognise patterns by feeding in a number of patterns with well-defined attributes. The attempt to connect ML with nanoscience was successful in tracing the mixing patterns of metal atoms in nanoclusters and formed a basis for the design map, which can help select the pairs of metals for nanocluster alloys. This developed design map will be tested out in the nano laboratories.

Further, the ML model predicted 872 unknown semiconductor hetero-structures of type 2 where the electrons and holes align themselves in A semiconductor and B semiconductor, respectively, giving rise to a desirable hetero-structure for semiconductor gadgets. By construction of a machine-learning model, prediction was made on a list of potential candidates for permanent magnets whose cost will be less than $100 per Kg.

This work carried out through the 'National Supercomputing Mission' has added a whole new drive to humankind's quest for new material.

Towards the next core challenges of AI



Dr. Sasikumar M.

Executive Director
C-DAC, Mumbai

ABSTRACT

While the world is getting very excited with the rapid and significant advancements taking place in AI, there is a segment of the researchers who are seeing the other side of this work. Explainability of decisions has been a challenge being addressed through many adhoc solutions. On of the true sign of intelligence is knowing what one knows, and consequently the ability to know where one can work effectively. Current AI systems, though excellent in the trained subset of the domain, are unable to pass this criteria. This is a major barrier in approaching AGI, in its proper sense. I would like to discuss this aspect, looking at the work in neuro symbolic AI and related trends. Hallucinations and inability to establish truthfulness of utterances is another less-discussed aspects, in common parlance.

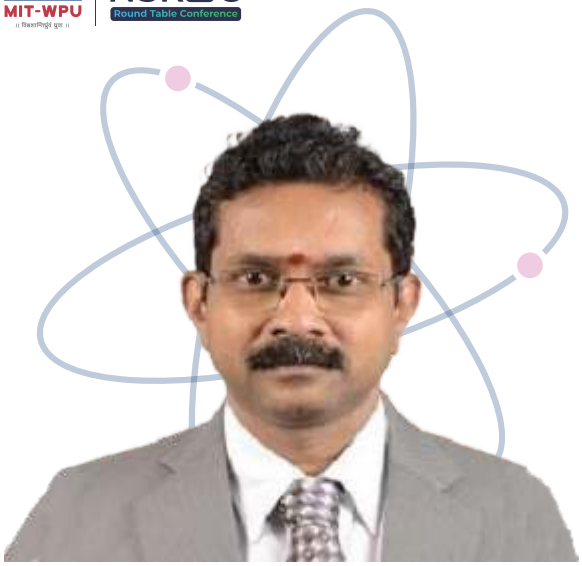
Dr M Sasikumar is currently the Executive Director of CDAC Mumbai.

He graduated from IIT Madras in 1987 and has been with CDAC ever since. He did his Masters from IISc, Bangalore and PhD from BITS, Pilani. He has been primarily with CDAC Mumbai throughout, but for a 3 -year stint at the CDAC corporate office.

His areas of interest have been primarly artificial intelligence and technology for education. 12 students have completed their PhD under his guidance, in topics from handwriting recognition, cloud security, learning disability, e-learning, etc. He has about 100 publications so far. He is also author of 2 books on expert systems and parallel processing, respectively – the latter is published by Prentice Hall, India. He has also taught a number of courses in computing.

Some of the notable works have been a) design and implementation of over 200 virtual labs for schools which help augment the scarce physical labs available b) application of AI techniques for complex vehicle scheduling problems (like airline timetabling, oil tanker scheduling, etc). c) design of an adaptive instruction environment for e-learning, and extending this to handle personalized instruction for students with learning disability. d) Building a framework for language tutoring based on how children learn their first language.

Application of Artificial Intelligence algorithms for the prediction and Optimization of Materials and Manufacturing process parameters



Prof. Dr. K. Palanikumar

Principal

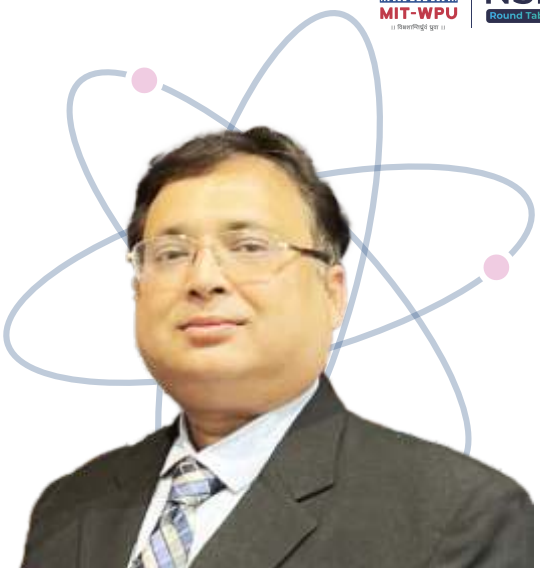
Sri Sai Ram Institute of Technology, Chennai

Prof. Dr. K. Palanikumar is a distinguished academician and researcher, widely recognized for his exceptional contributions to the field of Mechanical Engineering. He secured the University Rank during his M.E. at Annamalai University and holds a Ph.D. in Mechanical Engineering from Anna University. He further advanced his expertise through Post-Doctoral Research with Prof. J. Paulo Davim, Portugal. His area of interest includes composite materials, manufacturing, materials processing, and artificial intelligence applications to materials and manufacturing. His illustrious career is marked by numerous accolades, including being listed among the World's top 2% of Scientists by Stanford University. In 2022, he was honoured with the AICTE-Visvesvaraya National Award for Best Teacher, underscoring his outstanding pedagogical skills and commitment to mentoring the next generation of engineers. His innovation on materials and other areas lead to around 57 patents (published and granted). His research prowess is evidenced by his extensive publication record. He has authored over 350 research articles indexed in Scopus and Web of Science. Driven by his dedication to advancing the field, he has secured substantial research funding exceeding Rs. One Cr from various agencies, highlighting his ability to lead impactful research initiatives.

ABSTRACT

The integration of Artificial Intelligence (AI) in the production and optimization of materials and manufacturing processes marks a revolutionary advancement in the industrial sector. AI technologies, encompassing machine learning, neural networks, and data analytics, have been pivotal in transforming the traditional manufacturing methodologies into more efficient, adaptive, and intelligent systems. AI has significantly enhanced material discovery and development. In the investigation, machine learning algorithms, which analyze vast datasets to predict the properties and behaviors of new materials, such as Carbon fiber reinforced polymer (CFRP), Glass Fiber reinforced reinforced polymer (GFRP), Nano SiC reinforced Al matrix composites, etc. Techniques such as nature-inspired meta-heuristic algorithms, artificial bee colony (ABC), Grouped Bees Algorithm (GBA), Grey Wolf Optimizer (GWO) are employed to explore the vast compositional space, optimizing materials for specific applications, such as high-strength alloys, lightweight composite materials, and advanced polymers. AI-driven modeling and optimization in manufacturing processes such as drilling, milling, turning etc., leads to improved productivity, quality, and sustainability. Predictive maintenance algorithms forecast equipment failures, minimizing downtime, and extending the life of machines. AI models optimize production schedules and supply chain logistics, reducing lead times, and operational costs. In-process monitoring through AI enables real-time quality control, adjusting parameters dynamically to maintain product consistency and reduce waste.

Application of data analyses and assimilation in delineating groundwater scenarios of India



Prof. Dr. Abhijit Mukherjee
IIT Kharagpur

ABSTRACT

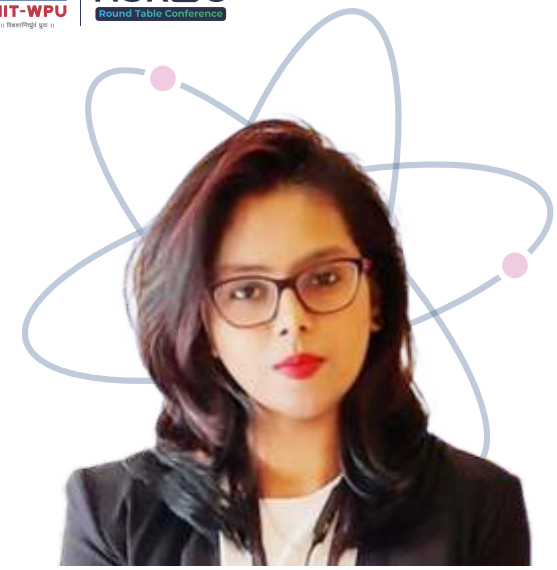
By using a combination of ground-based in-situ groundwater level data, NASA satellite-based estimates of groundwater storage, numerical analyses and simulation of global models on groundwater storage changes, we delineated the long-term, decadal-scale groundwater trends over India. Our study shows that in situ groundwater level trends shows simultaneous occurrence of wells with increasing and decreasing water level between 2005 and 2013. However, parts of the Indus-Ganges-Brahmaputra basin in India mostly show reducing groundwater levels whereas parts of western and southern India show increasing trends. The Groundwater storage (GWS) anomaly shows strong spatial variability in the study region. Observed GWS data indicate renewal of GWS in western (B) and southern (E) zones at a rate of 1.06±0.03, and 0.31±0.02 km3/year. On the other hand, the northern (zone A) and eastern (D) zones have been subjected to rapid GWS depletion at a rate of 4.55±0.11 km3/year and 3.59±0.14 km3/year, respectively. Satellite-based estimates indicate rapid depletion in northern (zone A) and eastern (zone D) zones at a rate of -1.40±0.14 and -1.16±0.35 cm/year (-14.02±1.37 km3/year and -14.49±4.36 km3/year) in the study period, respectively.

Prof. Abhijit Mukherjee is a Professor at the Department of Geology and Geophysics, and the School of Environmental Science and Engineering at the Indian Institute of Technology Kharagpur (IIT Kharagpur), India. Dr. Mukherjee holds a PhD (Hydrogeology) from the University of Kentucky, USA (2006) and completed postdoctoral work at the University of Texas at Austin, USA (2006-2008). Previously, he served as the Physical Hydrogeologist at the Alberta Geological Survey in Canada (2008-2010).

Prof. Mukherjee's main research areas are physical, chemical, and isotope hydrogeology, including numerical modeling, computation, contaminant transport, and water policy applications to society. He is known for his studies on geological and human-sourced water pollution (e.g. arsenic, fluoride, sanitation-borne, and emerging contaminants) in more than a dozen countries, water quantity estimates including the application of advanced computation and Artificial Intelligence techniques.

He has published more than 140 International journal articles, in addition to more than 200 book chapters, conference papers, and proceedings. He serves /has served in an Editorial role in the Journal of Hydrology, Applied Geochemistry, Groundwater for Sustainable Development, Journal of Earth System Sciences, Scientific Reports, Water Resources Research, ES&T Letters, and ACS ES&T Engineering. He is presently serving in the Council of the Geological Society of America. His previous edited books include Groundwater of South Asia (Springer, 2018), Global Groundwater (Elsevier, 2020) and Riverine Systems (Springer-Capital Publishing, 2022)

AI for Viksit Bharat



Ms. Priyanka Kasture
Age of Geeks, Pune

Priyanka Kasture Mamdapure is the founder of Age Of Geeks, formerly known as 'Machine Learning India (MLI),' which has grown into India's largest social-media-driven AI and Machine Learning community with a followership of over 400,000.

Since April 2018, she, through Age Of Geeks has aimed to bridge the awareness and skill gap in India's AI landscape. She firmly believes that emerging technologies, especially AI, present a unique opportunity for India to define its brand of tech leadership on the global stage.

Over the past seven years, Priyanka has established herself as an AI thought leader, evangelist, and marketing expert, helping early-stage AI startups gain a competitive edge.

Her insights and experiences have allowed her to share her knowledge at more than 25 leading institutions across India, including TEDx PVGCOET, NIT Calicut, and Manipal University.

Beyond her professional accomplishments, Priyanka is deeply committed to social causes. She spent two years teaching at a government-funded school for children from low-income families and worked with the NGO 'The Apprentice Project' to enhance the education of these children using an AI-based bot.

ABSTRACT

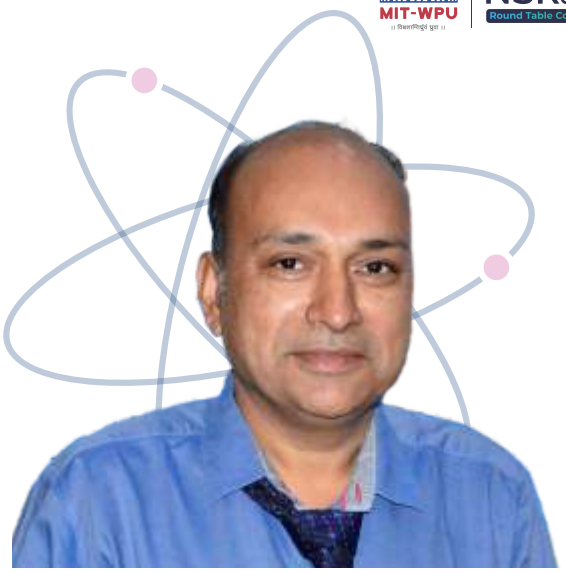
By 2047, Artificial Intelligence will play a pivotal role in transforming India into a "Viksit Bharat", positioning the nation as a global technology leader. AI's integration into various sectors will drive unprecedented economic growth, enhance public services, and address critical India-specific challenges.

In agriculture, AI will optimize crop yields and reduce waste, ensuring food security for a burgeoning population. In healthcare, AI-driven diagnostics and personalized treatments will bridge the gap in access to quality care, particularly in rural areas. Education will be revolutionized with AI-powered personalized learning, making high-quality education accessible to all.

Furthermore, AI will bolster India's infrastructure with smart cities, improving urban living conditions through efficient resource management and reduced pollution. By fostering AI innovation, India will attract global investments and talent, solidifying its position on the global technology map.

Solving for India, given the complexity and multi-dimensional aspects of most of our economic and societal challenges, can easily be extended to the rest of the emerging and developing economies. An integral part of using AI for Vikasit Bharat involves tackling common and complex global challenges that can be solved through technology intervention, and India's scale and opportunity landscape provides the ideal test-bed to ensure sustainable and scalable solutions.

Advancing Mobility: AI-enabled Electric Vehicle Integration in India's Smart Grid



Prof. Dr. Akash Saxena
Central University of Haryana

ABSTRACT

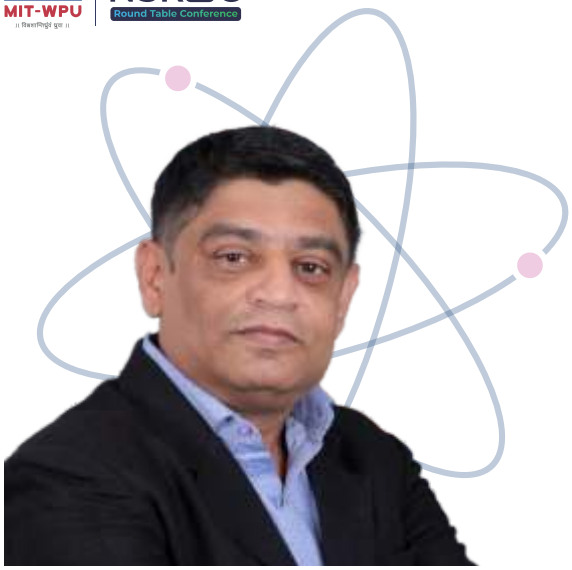
The forthcoming era will witness significant transformations in transportation, spurred by advancements in electric vehicle (EV) technologies. In the work, apart from generic term related to infrastructure and design of EVs, latest research trends will be discussed. EVs have many challenging problems and their integration with the grid will invite some major challenges in front of grid planners. Hence, a comprehensive review of the integration has to be discussed and how AI can be integrated for grid management problem can be a potential research area. Another area of emerging research in EVs is modelling and behaviour analysis with the help of prediction models. Also, efficacy of the battery management modules is also an integral part of the research. In the talk I would like to touch upon following major issues and research direction of the Evs.

1. Policy of the Indian government for promotion of the Evs.
2. Modelling of Battery parameters are infrastructure element of Evs.
3. Range estimation of the vehicle
4. Energy scheduling and congestion management
5. Advanced AI based infrastructure preparedness related to Natural Language Processing (NLP), Cyber Security, Fleet management and many more.

Dr. Akash Saxena is currently working as (Director of Training and Placement) and Professor in School of Engineering & Technology, Central University of Haryana, India. Previously he was associated with Department Artificial Intelligence at Vellore Institute of Technology, University (Bhopal) Campus.

Dr. Saxena is amongst the top 2% scientists of World in the field of Artificial Intelligence, this ranking is given by Stanford University and Elsevier jointly on the basis of quality publications and citation counts. His major research areas are soft computing, Computational and Artificial Intelligence with the specialization in Optimization theory. He has a high H-index 23,i-10 index 42 and total citation 1563+. He has published 100 journal papers (50 Scopus,25 SCI papers, (5 sole author papers (Elsevier).

Dr. Akash Saxena who has been a passionate researcher is currently immersed into extensive research in the areas of Computational Intelligence, Application of Artificial Intelligence in the Power System, and Smart Grid. Also, he holds positions of senior member of IEEE and Fellow member of IETE.



Dr. Pratap Sanap

VP and Head Innovation & Research
Neilsoft

Dr. Sanap worked extensively on Software in Loop & Hardware in Loop, Human in Loop based automation systems. His area of research includes in image, video, and signal processing. He has 23+ years of engineering experience as AI Architect & Data Scientist in building, managing, solutioning products in the field of automation.

He is well known for his experience in handling end-to-end operations at National & International level technology events such as Smart India Hackathon, Singapore India Hackathon, ASEAN Hackathon, UNESCO - India Africa Hackathon & Smart School Hackathon.

Received E-Governance Gold Award under the category of "Research on Citizen Centric Services by Academic/Research Institutions" by Department of Administrative Reforms and Public Grievances in Nov 2022. Honored with Otis President Award for his innovation in the development of predictive maintenance systems in Aug 2008.

Earlier, he served in organizations such as LTIMindtree, Persistent Systems, and Otis Elevators for development of AI based solutions.

Artificial Wisdom-Next Frontier of AI, moving from Machine Intelligence to Machine Wisdom

ABSTRACT

The world is witnessing rapid progress and transformation in technology. We are rapidly getting to a place where, AnyThing, AnyTime, AnyWhere, AnyContext have become a possibility. With all these advancements, the reach of technology and intelligent applications have gone to the grassroots level where every individual within all sections of society and businesses from all industrial sectors have started using technology for overall betterment of their day-to-day work/life. Time is now ripe to work towards automating Essential Value-Added activities.

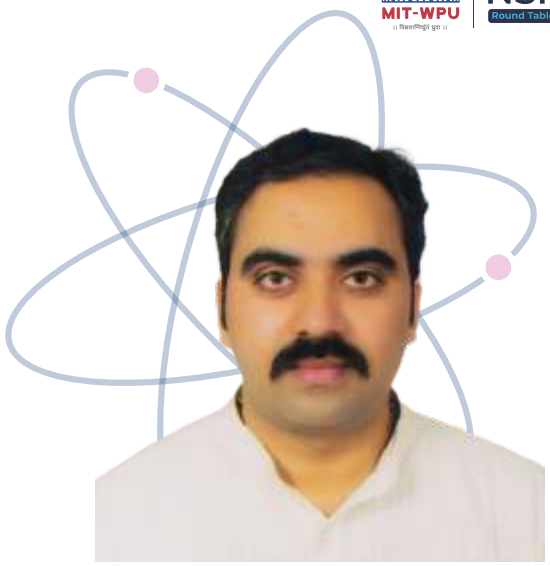
The world of Artificial intelligence (AI) is doing incredible things to cater to people's needs ranging from the common man to Technology experts. Machine Learning (ML), Data science, IoT, Exploratory Data Analysis, Rapid Prototyping, Near Real-time Analysis are the latest buzz words. AI is gradually maturing to cater specific business centric applications.

I see an opportunity to explore the next level of application development with integration and interpretation of Individual Factors, Experiential Factors and Facilitative Factors, alternatively called as the basic components of human wisdom. With AI maturing fast, the next big thing could be Artificial Wisdom (AW). The developer community might be expected to consider Emotional Intelligence, Social Awareness, Responsible Decision Making, Sharing Experiences, Knowledge, Cognition, Social Interactions, Collaborative Development and Consideration of Context for next-generation implementations. Essential Non-Value-Added and repetitive activities are already being replaced by ML & AI implementations.

A. Present Work – Intelligent Automation with Software in loop, Hardware in loop and Human in loop
B. Breakthrough(s), if any
C. Challenges in future and probable solutions / strategies in this area-Converting unstructured data to structured data with domain context and with automation of data harmonization.

Writing Frameworks for data qualification and governance

AI for Social Media Data Analytics



Prof. Dr. Vivek Kumar Singh
University of Delhi

ABSTRACT

The social media platforms are of different nature and capabilities, merely allowing users to post text, images, and videos online. The feelings, opinions, thoughts, and emotions of people are quite visible on these platforms. Social media platforms have also become the preferred source for communicating thoughts, opinions and viewpoints on various issues ranging from politics and religion to elections and social problems. Social media platforms have become so influential that they are not only affecting individual thoughts and behaviours but also guiding collective behaviours of groups and societies. There are now innumerable instances of hate speech, abusive content, cyberbullying, misogyny, fake news and disinformation etc. on social media platforms. Such content can severely impact our emotions, mental health, and well-being. The spread of hate speech, misinformation, fundamentalist propaganda, religious hate campaigns etc. on social media platforms can be furthermore dangerous as it could disturb the social order and harmony.

The hateful and targeted campaigns can affect social structures and institutions, values, and norms. Therefore, it is extremely important that such content is identified and appropriately dealt with. However, due the huge volume and speed of creation of such content, it can only be done by using sophisticated computational methods that can automatically detect and identify harmful content. Taking into account the fact that social media is accessible in a large number of languages across the world, the task becomes more challenging. Availability of enough and suitable data and computational resources is a fundamental requirement towards this endeavour. This talk will look into the broader domain of AI for Social good, focusing specifically on use of AI-based methods for social media data analytics.

Dr Vivek Kumar Singh is Professor in the Department of Computer Science, University of Delhi, Delhi, India. Prior to this, he was Professor & Head of Department of Computer Science at Banaras Hindu University, Varanasi, India. He has obtained his Bachelors, Masters and Doctorate degrees in Computer Science from University of Allahabad, all in first class. He has obtained 1st rank in University of Allahabad during Masters studies. He is a recipient of the JRF Award of the University Grants Commission. He is active in research and has published about 160 research papers, obtained 10 extramural research projects (total funding more than Rs 6.00 Crore) and supervised 15 doctoral and more than 75 Masters thesis. He is editor of Journal of Scientometric Research (indexed in Scopus & ESCI) and is on review boards of more than 20 top-tier SCIE indexed international journals in Computer Science and Information Systems. He is a Senior Member of IEEE and ACM and Life member of CSI, IETE and ISSI. He has also been elected as Board Member of ISSI for the term 2023-2027.

Snail Homing and Mating Search Algorithm: A Novel Bio-Inspired Metaheuristic

Prof. Dr. Anand J. Kulkarni

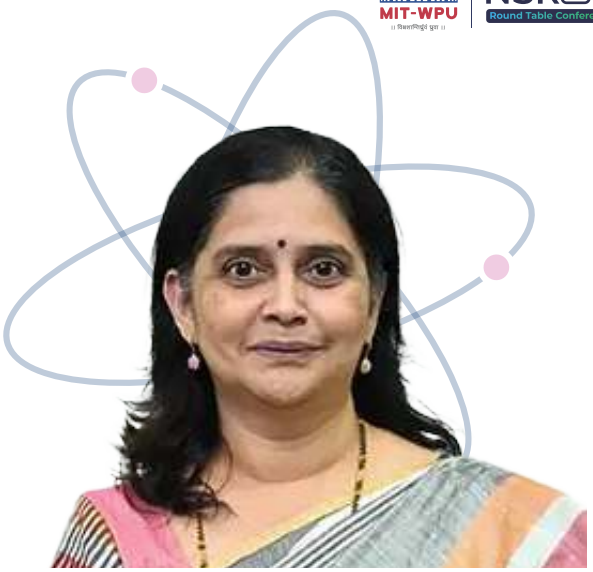
Research Professor & Associate Director
Institute of Artificial Intelligence, MIT-WPU

Anand J Kulkarni holds a PhD in Artificial Intelligence (AI) based Distributed Optimization from Nanyang Technological University, Singapore, MS in AI from University of Regina, Canada. He worked as Postdoctoral Research Fellow at Odette School of Business, University of Windsor, Canada. Since 2021, he is working as Research Professor and Associate Director of the Institute of Artificial Intelligence at the MITWPU, Pune, India. His research interests include AI based Nature Inspired optimization algorithms, and self-organizing systems. Anand pioneered optimization methodologies such as Cohort Intelligence, Ideology Algorithm, Expectation Algorithm, Socio Evolution & Learning Optimization Algorithm, and Snail Homing and Mating Search Algorithm. Anand has published over 80 research papers in peer-reviewed reputed journals, chapters and conferences along with 7 authored and 15 edited books. He has guided 6 doctoral, 10 masters and over 60 UG students. Anand is the lead series editor for Springer and Taylor & Francis as well as associate editor of Elsevier journals such as 'Engineering Applications of Artificial Intelligence' and 'Systems and Soft Computing' as well as IOS Press KES journal. He is the recipient of the best paper award in IEEE ICNSC, Chicago, USA and 'Swatantryveer Savarakar Award' 2023 by 'Pune Marathi Granthalay', Pune for his Marathi book entitled 'Artificial Intelligencechya Watewar'.

ABSTRACT

Artificial Intelligence (AI) is no more a new term to the industry, academic world and society in general. There are several applications of AI not only in the field of engineering and science. The algorithms also referred to as the solution methodologies are at the heart of AI. As the notion of 'No-Free-Lunch' still prevails as a fact, there is need to develop new algorithms. This is inspiring researchers to develop novel nature inspired algorithms referred to as metaheuristics. The proposed discussion intends to churn upon a novel Snail Homing and Mating Search (SHMS) algorithm inspired from the living habitat of the snails. Snails usually live in moist and humid regions and continuously travel to find food and a mate, leaving behind a trail of mucus that serves as a guide for their return journey. Snails tend to navigate by following the available trails on the ground and responding to cues from nearby shelter homes. These activities have been mathematically modeled and an AI based metaheuristic algorithm is developed. It is tested on a standard benchmark test suite and applied in the design of heat exchangers.

Enhancing Underwater Fauna Monitoring: A Deep Learning based Real time Fish Detection and Tracking



Prof. Dr. Anuradha C. Phadke

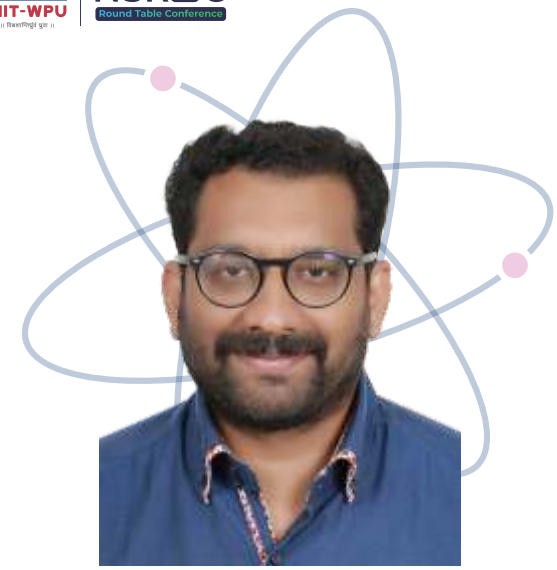
Department of Electrical and Electronics Engineering, MIT-WPU

ABSTRACT

For understanding and preserving underwater biodiversity, regulation of marine ecosystems is vital. Due to the latest encroachments in the field of artificial neural networks and image recognition have revolutionized detection and monitoring of objects from videos. YOLO (You Only Look Once) is acknowledged as one of the most popular and highly accurate deep learning-based algorithm, designed specifically for object detection. This work answers to the need for effective underwater fauna monitoring by implementing various deep learning techniques of cutting-edge object detection models especially, YOLOv4 and YOLOv8 for real-time fish detection and tracking within dynamic underwater environments. Performance evaluation for these models is done using performance measures including accuracy, real-time processing speeds, and the models' adaptability to the challenging conditions of underwater environments. For this study, both YOLOv4 and YOLOv8 architectures were trained on a cloud platform. This cloud-based approach circumvents the challenges and logistical complexities of deploying manpower and complex hardware in underwater scenarios, making it a more effective solution for underwater fauna monitoring and yielding superior results. The results obtained substantiate the superiority of the YOLOv8 model over the YOLOv4 model for underwater video surveillance applications, even under different dynamic and challenging conditions. This work underlines the significant role that highly accurate object detection methods like YOLO can play in the quest to safeguard the future of our planet's aquatic life.

Dr. Anuradha Chetan Phadke received BE and ME degree in Electronics, from Walchand College of Engineering, Sangli, India in 1993 and 1995 respectively and Ph.D. degree for research work titled "Development of Algorithms for Diagnosis of Breast Cancer using Digital Mammogram Analysis", in 2016 from Savitribai Phule Pune University (SPPU). Her expertise is in the domain of Computer Vision. Dr. Phadke has a total of 28 years of teaching experience along with 12 years of research experience in the field of Digital Image Processing, Pattern Recognition, Embedded System Design and Machine learning. Her research yielded three patents (granted), two books, and several scientific articles in reputed journals and conferences. She was recipient of Ideal Teacher Award (in 2011) from MAEER, Pune, and Prof. Y. K. Bhushan Most Influential Professor citation from World education Congress 2023.

Unravelling Mysteries in Heterogeneous Catalysis: Integrating DFT and Machine Learning Methods



Prof. Dr. Praveen C. S.

Cochin University of Science and Technology, Kochi

Dr. Praveen C. S. is currently a faculty at the International School of Photonics of the Cochin University of Science and Technology. Dr. Praveen has obtained his PhD from the University of Nova Gorica, Slovenia for modelling semiconductor materials for Photocatalytic water splitting applications.

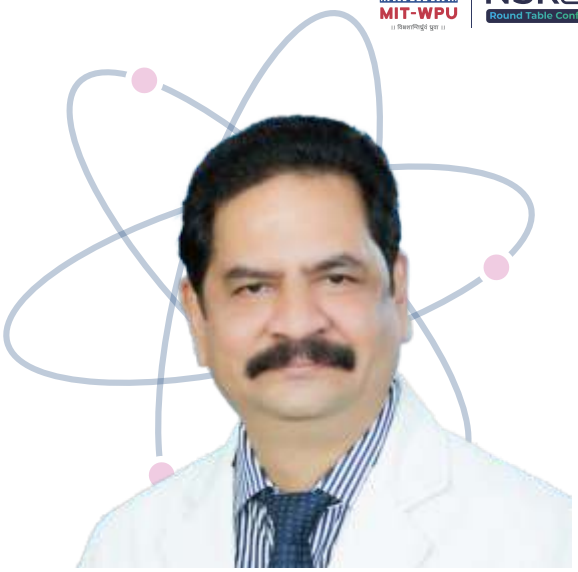
He was a postdoctoral fellow at the condensed mattery theory division of CNR-IOM hosted at SISSA, Trieste Italy. During this period, he has worked extensively on the electronic properties of supported graphene and h-BN. Later he moved to ETH Zurich and worked mainly on the theoretical aspects of heterogenous catalysis at the nanoscale simulations group and the chemistry and applied biosciences group. In 2017, Dr. Praveen has moved to India and received the DST-INSPIRE faculty fellowship.

Presently Dr. Praveen works mainly on Heterogenous catalysis especially in developing materials for activating CO2 and CH4 by combining Density Functional Theory and Machine Learning methods. Dr. Praveen has extensive experience in working with the development teams of popular DFT codes such as Quantum ESPRESSO, CRYSTAL and CP2K.

ABSTRACT

The quest for sustainable and efficient catalytic processes is critical for addressing global challenges such as climate change and energy crisis. In this context, heterogeneous catalysis involving metals and metal alloys plays a pivotal role towards sustainable energy production. As an application, Hydrogenation of Co_2 and the total combustion of methane are two important reactions with significant environmental and industrial implications. This talk explores the synergistic integration of Density Functional Theory (DFT) and Machine Learning (ML) to unravel the complexities of these catalytic processes and enhance their performance by scanning a large number of catalytic surfaces. Our research leverages DFT to provide detailed atomic-level insights into the catalytic mechanisms and surface interactions of metals and metal alloys. By systematically varying the composition and structure of these materials, we gain a comprehensive understanding of the factors influencing their catalytic activity and selectivity. However, the computational intensity and complexity of DFT calculations often limit their application to a narrow set of conditions and materials. To overcome these limitations, we incorporate ML-based methods to extend the predictive power of DFT calculations across a broader range of catalytic systems and reaction conditions. By training ML models on extensive DFT datasets, we develop robust ML model for predicting the adsorption energies of molecules on catalytic surfaces. Our approach not only accelerates the discovery of high-performance catalysts but also uncovers new trends and design principles in heterogeneous catalysis.

Future Role of AI in Teaching and Research in Indian Universities



Prof. Dr. Deepak Kumar Behera
Vice Chancellor
Kalinga Institute of Social Sciences, Bhubaneswar

ABSTRACT

The future role of Artificial Intelligence (AI) in teaching and research in Indian universities promises significant advancements aligned with NEP-2020 goals. AI can revolutionize classroom teaching by enabling personalized learning experiences, where teachers use adaptive learning platforms to tailor content to individual student needs. For students and research scholars, AI tools provide access to the latest trends, enabling the development of critical thinking through data analytics and machine learning applications. Faculty members can leverage AI to enhance classroom activities, streamline the grading process, and assist in writing research papers by automating literature reviews and data analysis. Creating a research ecosystem within universities can be facilitated by AI-driven collaboration tools, enhancing interdisciplinary research, and fostering innovation. AI also plays a crucial role in supporting slow learners by providing customized learning paths and continuous feedback, helping them upgrade their skills at their own pace. Even students and teachers from social science and commerce backgrounds can utilize AI for data analysis, trend prediction, and improving academic productivity through AI-powered tools, ensuring they stay competitive in a technologically evolving landscape. My final remark: integrating AI in Indian universities can create a dynamic, inclusive, and research-intensive educational environment, aligning with the vision of NEP-2020. The future role of AI in Indian universities includes breakthroughs in personalized learning, research efficiency, and administrative automation. Challenges encompass digital divide, ethical concerns, and skill gaps. Solutions involve strategic investment, robust infrastructure, ethical guidelines, and capacity-building programs to harness AI's potential effectively while addressing these issues.

Deepak Kumar Behera hails from Sambalpur district in Odisha and is an internationally acclaimed anthropologist. Presently, he is serving as the Vice Chancellor of Kalinga Institute of Social Sciences (KISS) Deemed to be University. Prior to joining KISS-DU, he served as the Vice-Chancellor of Sambalpur University, Berhampur University and Rajendra University, Bolangir. Under the leadership of Professor Behera, Berhampur University secured "A" grade by NAAC (the first state-funded university in Odisha to achieve this distinction). Professor Behera has the distinction of being the only academician from Odisha to become the Vice Chancellor of four different universities.

Professor Behera has many national and international distinctions to his credit. He was a Fulbright Visiting Professor at California State University, Long Beach. As a recipient of DAAD fellowship, he had been a Visiting Guest Professor in the Department of Anthropology at Karl Ebrard University, Germany. The other prestigious fellowships received by Prof. Behera also received visiting professorship and fellowship from many other countries like, Europe, America, and South Africa.

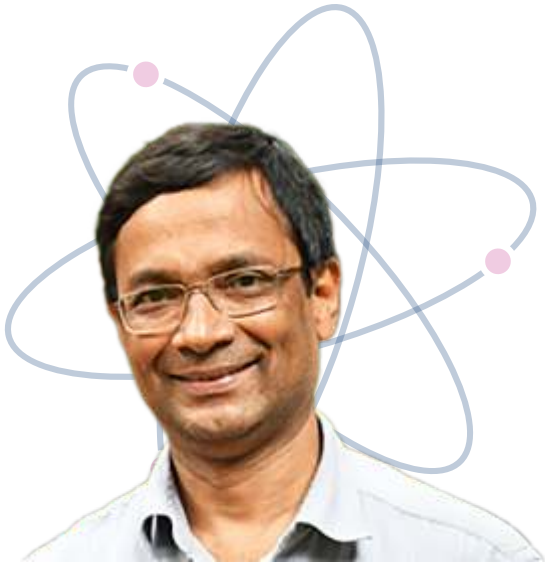
Prof. Behera has also been a recipient of the prestigious Sarat Chandra Roy Memorial Gold Medal by the Asiatic Society, Kolkata (the oldest educational institution in Asia) for his outstanding contribution in the field of cultural anthropology in India.

He has to his credit more than 120 research publications in reputed journals and edited volumes. He is the author/editor of 22 volumes. So far, 26 candidates received their doctoral degree under the supervision of Prof. Behera. He also served as a member of the Executive Board of World Anthropology Association (International Union of Anthropological and Ethnological Sciences, IUAES) for two consecutive terms, i.e. for the period 1998-2009.


4.0
AI


Advanced Materials
and Processing

Hybrid halide perovskites - A miraculous materials family



Prof. Dr. Dipankar Das Sarma
Indian Institute of Science, Bengaluru

D. D. Sarma obtained a 5-year Integrated MSc (1977) in Physics from IIT Kanpur and a Ph.D. (1982) from IISc. He worked at Kernforschungsanlage Jülich as a Visiting Scientist during 1984-1986. He was a faculty member at IISc during 1986-2021. Presently, he is an Honorary Professor and CSIR Bhatnagar Fellow at IISc.

His research interest spans the science of strongly correlated electron systems, semiconductor nanocrystals, and energy materials.

He has made pioneering contributions to the understanding of electronic, magnetic, and optical properties of a wide range of material families. He has published about 500 scientific papers and holds several patents.

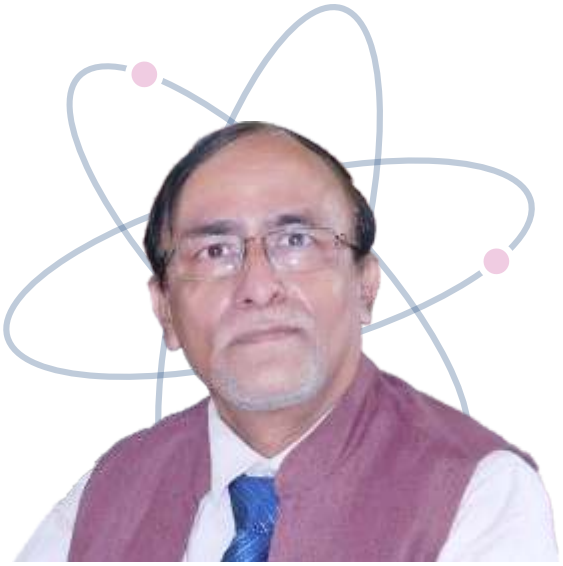
He is an elected Fellow of all three Indian science academies, the Engineering Academy in India, the World Academy of Sciences (TWAS), and the American Physical Society. He has received many national and international awards and recognitions, including multiple Honoris Causa Doctorate degrees and the Distinguished Alumnus Award of IITK. He has held several academic positions, such as the inaugural J N Tata Chair Professor at IISc, Gaspard Monge Visiting Professor at Ecole Polytechnique, University Professor at University of Vienna, Guest Professor at Uppsala University, Visiting Professor at University of Tokyo, Distinguished Scientist of CSIR, MLS Chair Professor at IACS, Adjunct Professor at TIFR, Honorary Professor at JNCASR, SNBNCBS, and CSIR-NIIST, and Distinguished Visiting Professor and Eminent Visiting Fellow at IACS.

ABSTRACT

The last decade has seen the most spectacular rise of a class of materials known as halide perovskites and related compounds. Their photovoltaic, light emission, and detection properties have reached superlative performance levels within this exceptionally short period and have taken the world by surprise.

Along with the intense effort to further improve efficiency, stability, and other technological aspects, there is a considerable effort in understanding the origin of such exceptional attributes. I shall discuss some historical aspects of this field of study and some of the recent results identifying the underlying scientific issues and then follow it up with some discussion based on our efforts to understand the physical properties of these hybrid materials.

Emergent Materials for Nanophotonic and Energy Harvesting Devices



Prof. Dr. Samit Kumar Ray
IIT Kharagpur

ABSTRACT

We shall discuss the progress of emerging two-dimensional (2D) transition metal dichalcogenides (TMDs), inorganic perovskites and their heterostructures for photonic and energy harvesting devices. A review of our work on low cost colloidal synthesis of high quality single-crystalline perovskite nanocrystals that are kinetically stable at room temperature will be presented. Utilizing the superior luminescence properties and high color purity of inorganic perovskite nanocrystals, we reported the fabrication of color-saturated $CsPbBr_{3-x}Ix$ (x=0-3)/ZnO heterojunctions based white light emitting diodes on a flexible platform. Hybrid heterostructures comprising of zero-dimensional perovskite nanocrystals having excellent photosensitive characteristics offer the possibility to achieve next generation optoelectronic devices with superior functionalities. This has been demonstrated through giant photo-amplification in highly stable ∂-$CsPbI_3$ NCs on layered WS_2 mixed-dimensional heterostructures photo-FET with asymmetric contacts. Some of our efforts on enhancing the stability of perovskites with improved optical properties will be discussed.

Prof. Samit K. Ray has made an outstanding contribution in the field of semiconductor nanomaterials, useful for the next generation electronic, optoelectronic and energy harvesting devices.

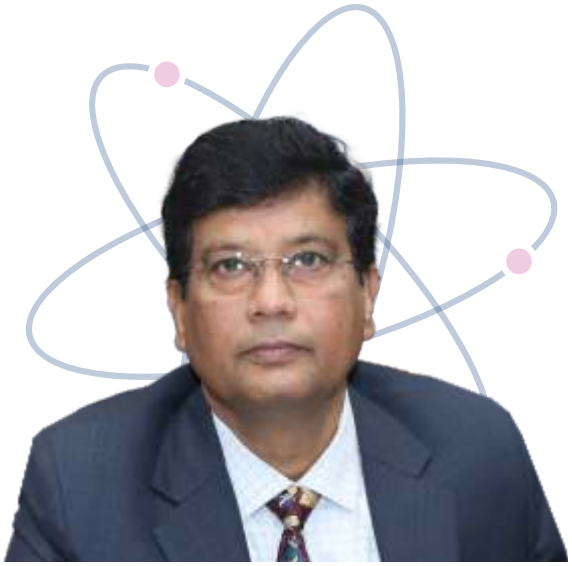
He has previously served as the Director S. N. Bose National Centre for Basic Sciences, Kolkata, Dean (Post-graduate & Research Studies), Head, Department of Physics and Chairman, School of Nanoscience and Technology, IIT Kharagpur.

Present Research Work: Through atomic scale imaging of crystalline ß-CsPbI3 nanorods and ligand-stabilized nanocrystals, he not only underscored the performance of all-inorganic perovskite photovoltaics but also provided solutions to achieve air-stable devices for commercial applications. Using interface engineered semiconductor nanostructures, he demonstrated the enhanced efficiency of flexible piezoelectric and triboelectric nanogenerators for harvesting bio-mechanical energy in driving low power IOT and wearable electronic devices

Breakthrough research from you/your group

He has served as a visiting faculty/scientist at the Tokyo Institute of Technology, Japan, University of Delaware, USA, University of Texas at Austin, USA, Queens University of Belfast, UK and Chang Gung University, Taiwan. He is an elected fellow of the Indian National Science Academy, National Academy of Sciences India, Indian National Academy of Engineering, West Bengal Academy of Science & Technology and is the recipient of INSA Young Scientist Award, UGC Homi Bhabha Award, MRSI Superconductivity & Materials Science Senior Award etc.

The Emergence of Nanoscience for a Sustainable Future



Prof. Dr. Amitava Patra

Director
Institute of Nano Science and Technology, Mohali

He was born in 1965 and received his Ph. D. (1993) from Jadavpur University, India. He was a Central Glass & Ceramic Research Institute scientist from 1996 to 2005. Then he moved to the Indian Association for the Cultivation of Science as an Associate Professor (2006-2009), and now a senior Professor since 2010 to till date. Amitava Patra is amongst the world's top 2% scientists in 2020-2021, with a global rank of 149 in Physical Chemistry (Ranking is based on C-score). In the 2023 Edition of our Top Scientists in Materials Science Ranking from Research.com, he ranked 4156 globally and 36 in India.

He is interested in learning the fundamental mechanisms for photo-initiated processes such as exciton dynamics, ultrafast carrier dynamics, electron transfer, and energy transfer of nanomaterials for solar energy conversion. He is the author or co-author of more than 272 scientific papers, 5 book chapters, and 2 Indian patents. His research papers have been cited by more than 13500 peers (h-index= 63).

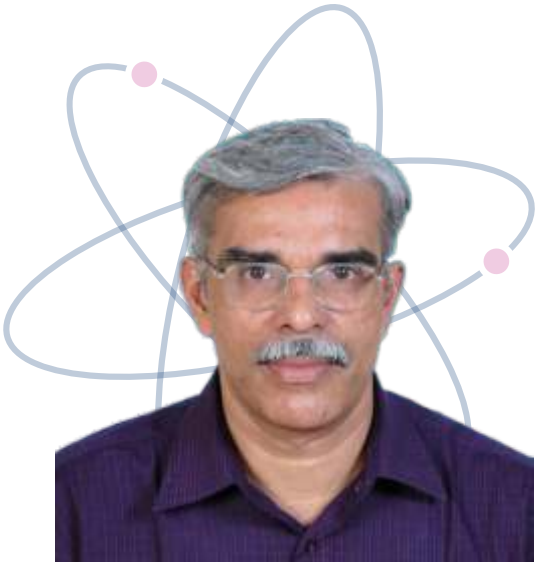
Prof. Amitava Patra has been elected as a Fellow of the Optical Society of America (OSA) and the Royal Society of Chemistry (FRSC). He is a Fellow of the Indian Academy of Sciences (FASc), India, and the National Academy of Sciences (FNASc) and Indian Chemical Society, India. He was an Advisory board member of Nanoscale, Journal of Physical Chemistry, ChemPhysChem, ChemNanoMat, and others.

He is the recipient of the Acharya J. C. Ghosh Memorial Award, National Prizes for Research in Chemical Spectroscopy and Molecular Structure, MRSI-ICSC Materials Science Annual Prize, C.N.R. Rao National Prize for Chemical Research, DAE-SRC Outstanding Investigator Award, A.V. Rama Rao Foundation Prize in Chemistry, AsiaNANO 2010 Award, CRSI Bronze Medal, Ramanujan Fellowship, MRSI Medal.

ABSTRACT

Developing strategies for efficiently converting solar energy to renewable energy is a challenging and active area of research nowadays. Photosynthesis is the most well-known process for converting natural solar energy to chemical energy. In the past few years, inorganic nanocrystals have aroused increasing attention in the design of nanoscale-based light-harvesting systems. The major challenge in nanoscience is designing nanomaterials with tailored properties and understanding their functionality at fundamental levels. A comprehensive understanding of the photophysical processes in low dimensional quantum confined systems is important to improve the performance of light-harvesting systems.

Designing v-gap engineering Nanohybrids for Energy Storage Applications



Prof. Dr. Vijayamohanan K. Pillai
IISER Tirupati

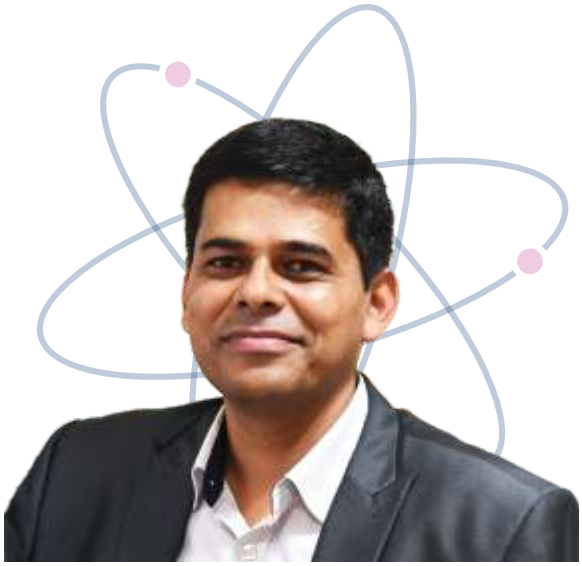
ABSTRACT

When we consider few layers of Two Dimensional materials, they reveal a finite Van der Waals gap (v-gap) providing a clear separation between the in-plane and through plane electronic interactions. Although the carrier transport and associated unique features are studied in accurately prepared and precisely characterized monolayers, many technological applications such as nanoelectronics, electrocatalysis, biosensing, solar energy conversion, and energy storage use multilayers which are conveniently prepared using inexpensive and scalable chemical methods. For example, among various two-dimensional (2D) materials, graphene possesses similar interlayer spacing of multiwalled carbon nanotubes (0.32–0.35 nm) which could be modulated by several strategies such as the intercalation of cations and anions, the nature of the solvent, and surface functionalization. The resultant graphene nanoribbons (40 nm dia) formed by the ionic liquid-assisted transformation of multiwalled carbon nanotubes of an average diameter (21 nm) along with graphene quantum dots having an emission wavelength of 445 nm are more useful for some of the specific applications. This electrochemical approach not only reveals the introduction of multiple heteroatoms at room temperature but also modulates the van der Waals gap between the layers of multiwalled carbon nanotubes, which could have significant implications for the mechanical and electrical properties. The tunability of this spacing depends on the nature of the ionic liquid, the size of the incoming ions, the applied potential, and the time. In this lecture several examples of v-gap engineering will be demonstrated for specific applications like Na/Li ion batteries and fuel cells.

Prof. Vijayamohanan K Pillai is a leading Electrochemist from India, who worked in many areas of Materials Electrochemistry for about two decades at the National Chemical Laboratory, Pune. In addition to being Director of CSIR-CECRI (2012 –2018), he held the additional charge as Director, CSIR-NCL, Pune for one year (2015-2016). He has become a J C Bose Fellow of SERB in 2020 after joining IISER-Tirupati in2019.

He has authored over 280 publications and 30 patents related to many innovations in both Electrochemistry and Materials Chemistry, while advising about 25 Ph.D. students in Electrochemistry. His group has developed highly sensitive nanostructured electrocatalysts for Polymer Electrolyte Fuel Cells (PEMFC) and many two-dimensional electrocatalysts including graphene and phosphorene as quantum dots. His research interests include Materials Electrochemistry, functionalization of carbon nanotubes/graphene nanoribbons and hybrid materials using many 2D systems for energy storage applications. His books on "Functional Materials: A Chemist's Perspective" published by university Press and "Multifunctional Electrocatalysts" (Royal Society of Chemistry , 2024) are a good sources for teaching many topics in Materials Chemistry. He has received many honors and awards like The MRSI Medal, CRSI Bronze and Silver Medal. He is a Member of the Editorial Board of Bulletin of Materials Science from 2005 onwards, Electrocatalysis from 2012 and Scientific Reports (Nature Publishing Group) from 2015 and is a Fellow of the Indian Academy of Sciences since 2008 and the Indian National Science Academy (2018).

He is at present functioning as Dean, R&D and chair of Chemistry at IISER – Tirupati and may be contacted at vijay@iisertirupati.ac.in



Prof. Dr. Satish Patil
Indian Institute of Science, Bangalore

Satish Patil is a Professor and Chair at the Indian Institute of Science, Bangalore. Prof. Patil has made extensive fundamental and applied contributions to research on organic semiconductors. In particular, his research works on air-stable n-channel conjugated polymers, singlet fission in organic materials, and observation of band-like transport in conjugated polymers is truly path-breaking. Professor Patil has guided several PhD students and has more than 17 years of teaching experience in India's premier R&D and academic institution. He is a recipient of the Indian National Science Academy (INSA) medal for Young Scientist (2009), Young Affiliate of the World Academy of Sciences (TWAS), DST-SwarnaJayanti Fellow, Bronze Medal of Chemical Research Society and Materials Research Society of India and Prof. Kaushal Kishore Memorial Award of the Society of Polymer Science, India. Prof. Patil is elected fellow of the Indian Academy of Sciences (FASc).

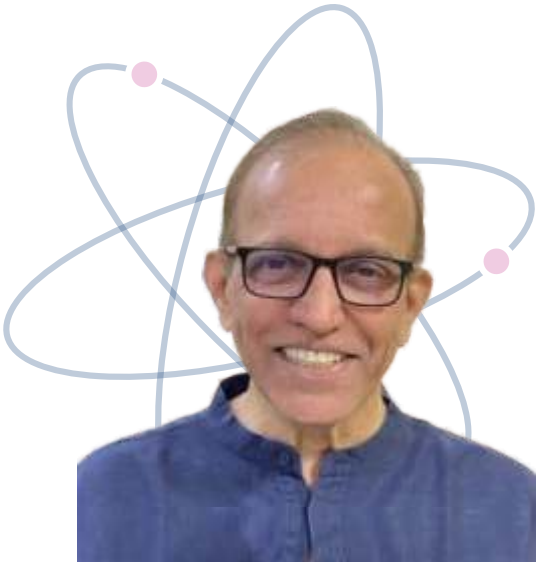
Emerging Renewable Energy Technologies to Enable Net-Zero

ABSTRACT

The dependence on fossil fuels to meet our energy demands has come with major environmental costs due to catastrophic climate change. The energy transition to net-zero CO_2 emissions sustainably requires radical technological transformations. Adapting renewable energy sources like solar and wind poses formidable challenges due to inadequate cost-effective energy storage technologies. In this regard, novel and disruptive renewable technologies are needed to achieve net-zero emissions.

I will discuss using organic materials for redox flow batteries in this talk. Organic materials have already made considerable inroads into emerging optoelectronic devices such as organic light-emitting diodes, solar cells and transistors. In my talk, I will discuss the current status of organic semiconductors for energy generation and storage devices.

Energy, Sustainability and Self-Reliance



Prof. Dr. Satishchandra B. Ogale

Director, TCG-CREST, Kolkata
IISER Pune

ABSTRACT

The world is currently going through a major transformation in the Energy sector, being driven intensively towards enhanced use of clean and renewable energy due to the rapidly worsening environmental situation attributed to unscrupulous and continued usage of polluting fuels for our developmental needs over several decades. This much-needed and unavoidable transformation towards seeking sustainable solutions is quite complex and encompasses several sectors such as Science, Technology, Education, Resources, Manpower, Industry, Economics, Policy, and International Relations. In my talk, I will outline this scenario by emphasizing the absolute need for us to be self-reliant along the lines of Atmanirbhar Bharat and Make-in-India. I will cite a few examples of own R & D efforts towards indigenous development of Na-ion/Li-ion batteries in collaboration with Indian Industries. I will also present a few examples of new materials development for efficient and low cost Green Hydrogen and CO_2 to Clean Fuels production.

Prof. Satish Ogale has over 40 years of research experience in the field of Advanced Materials Science encompassing different fields such as high Tc superconductivity, CMR Manganites, Diluted Magnetic Semiconductors, Multiferroics and more recently Clean and Renewable Energy Harvesting and Storage. He has over 500 research publications in international pee-reviewed journals, 10 US Patents granted based on research done in India, three books co-edited for Springer, Wiley and Elsevier. His h-index is 89 with over 38000 citations. He has worked for many years at University of Pune (15 years as Professor and Physics Chair), University of Maryland at College Park (9 years as Senior Research Scientist), National Chemical Laboratory, NCL Pune, India (as Chief Scientist) and IISER Pune, India (as Professor of Physics) before joining TCG-CREST Kolkata. Challenges in future and probable solutions/strategy: Affordability and wide spread deployment of new solutions in the clean energy sector, Materials (raw) availability, Purification, and scale of in energy device manufacturing, Government-Industry-Academia joint initiatives and efforts, Enhancing the base of technical manpower through translational research and restructuring education.

Prof. Ogale is on the Editorial Boards of several high impact research journals in the field of Energy and Environment including Energy and Environmental Science, Sustainability & Fuels, ACS Applied Materials and Interfaces, J. Physics Energy, and Progress in Energy. He has won several national awards / recognitions including the INSA Young Scientist Medal, B. M. Birla Prize, Sir C. V. Raman prize, MRSI medal, MRSI Silver Jubilee Medal, Ramanujan Fellowship, Raja Ramanna Fellowship, and more recently the International Newton Prize as a lead member of the UK-India APEX Solar Energy program. He has also been a recipient of the prestigious Prof. CNR Rao Lecture Prize given to only one materials Scientist in India each year. He is also the elected fellow of the Indian Academy of Science and the National Academy of Science.

2D Materials: Potential Materials for energy storage devices

Prof. Dr. Shyamal Kumar Saha
National Cheng Kung University
Taiwan

Prof. S K Saha did his BS and MS in Physics from the University of Calcutta and graduated from the Indian Association for the Cultivation of Science, Kolkata.

Currently he is working as a professor in the "Academy of Innovative Semiconductor and Sustainable Manufacturing", National Cheng Kung University, Taiwan. Before joining to National Cheng Kung University, he has served Indian Association for the Cultivation of Science, Kolkata as Senior Professor and Chair of the School of Materials Sciences. He was also appointed as full professor under cross appointment between Osaka University and Indian Association for the Cultivation of Science.

He has visited Purdue University and National Chen Kung University as visiting Professor. He has also visited several Universities like Tokyo Institute of Technology, University of Tokyo, Tohoku University and National Institute of Materials Sciences (Tsukuba) under "DST-JSPS Special Lecture tour Program". He has been awarded "JSPS Invitational Fellowship to work in Osaka University.

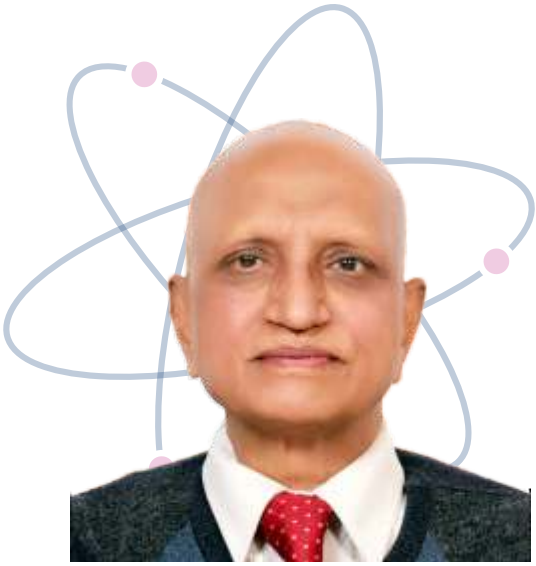
Prof. Saha has become the Fellow of the Institute of Physics, UK and the West Bengal Academy of Science and Technology. He is also the recipient of "Materials Research Society of India" Medal.

He has Published more than 150 papers in reputed International Journals and around 25 Ph D students have been graduated under his supervision. His major research contribution is in the area of Nanoscience & Technology. During the last 25 years, he has worked on Nanomaterials like quantum dots, metallic and semiconducting nanowires and nanotubes, conducting polymers etc. and studied electronic, magnetic and optical properties for optoelectronic and sensing applications. Currently, he is working intensively on 2D materials e.g. Graphene, MoS2, MXene, Graphitic Carbon Nitrides, Siloxane etc. for storage device applications.

ABSTRACT

The discovery of graphene has sparked tremendous interest in two-dimensional (2D) materials in both fundamental and practical research, owing to their many unique physical and chemical properties. In particular, the atomic-thin morphology, large surface area and layered structure make them ideal candidates for various applications like semiconductor devices, energy storage devices, sensing, optoelectronic and many others. Considering the tremendous growth of 2D materials for future device technology, in the present talk, I would like to share some of my research activities on 2D materials like graphene, transition metal dichalcogenides (TMDs), MXene, graphitic carbon nitrides etc. for fabrication of energy storage devices. Large surface area, high conductivity make 2D materials as potential materials in the energy storage devices to meet the tremendous global energy crisis.

Evolution of Micromachining and nano-finishing processes: An overview.



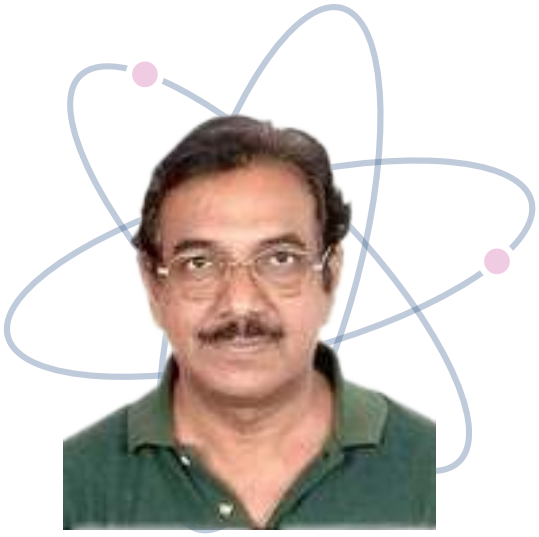
Prof. Dr. Vijay K. Jain
IIT Kanpur

ABSTRACT

There are many micro-machining and nano-finishing processes which can be divided in two categories: Traditional and Advanced micromachining and nano-finishing processes. Traditional includes micro-turning, -milling, drilling while traditional nano-finishing including grinding, honing, polishing etc. Advanced micromachining includes electrochemical-, electric discharge-, laser beam-, ultrasonic-micromachining. Advanced nano-finishing includes abrasive flow finishing, magnetorheological finishing, magnetic float polishing etc. We have proposed a "tool design in electrochemical machining" and "bit type of tools in ECM" concepts which has solved many problems of practical use in industries. In nano-finishing, we have developed "Magnetorheological Abrasive Flow Finishing (MRAFF)" and Chemo-mechanical magnetorheological abrasive flow finishing (CMMRAFF) process. These processes have made it possible to finish complex shaped components and can give as good as 0.5 nm (Sub-nanometer) surface finish. Tool design and scientific analysis of these processes are real challenges.

Dr. Vijay K. Jain passed his B. E. from M.A.C.T. Bhopal (under Vikram University, Ujjain) in 1970; M. E. and Ph.D. from University of Roorkee (U.O.R.) in the year 1973 and 1980, respectively. He has 47 years of teaching and research experience. He has served as a Visiting Professor at the University of California at Berkeley (USA) and University of Nebraska at Lincoln (USA). He retired as a Professor (HAG) from IIT Kanpur. He has also served as a faculty at other Indian Institutions. Dr. Jain has won 3 gold medals, 2 silver medals and best paper awards as recognition to his research work. Dr. Jain has written 9 books (including edited books) and 16+ chapters for different books published by international and national publishers. He has been awarded Life Time Achievement Award by the AIMTDR (NAC). Dr. V. K. Jain is presently as Editor-in-chief for 3 international journals (IJPTech, JAMS, JMF), and Associate Editor of 2 International Journals. He has also worked as a Guest-Editor for 22+ special issues of different International Journals. He has been opted as a member of the editorial board of 12+ International Journals. Dr. Jain has guided 20 Ph.D., 100+ (M. Tech. + M.E.) and 30+ B.Tech. / B.E. students while working at different universities during his carrier. He has 400+ publications to his credit. He has 13 Indian patents and 1 USA patent to his credit.

2D/III-Nitrides hybrids based Heterostructures for efficient photo-detection



Prof. Dr. S. B. Krupanidhi
Indian Institute of Science, Bengaluru

Dr. S.B. Krupanidhi is currently an Emeritus Professor, Materials Research Centre, Indian Institute of Science, Bangalore. Prof. Krupanidhi obtained his MSc Tech (Applied Physics) (1975) from Andhra University and PhD (Physics) (1981) degree from Delhi University. He worked as a post-doctoral fellow in department of Physics, Queen's University, Kingston Canada (1981-84), Principal Scientist, Motorola, Albuquerque, USA (1984-88), Professor of Engineering Science, The Pennsylvania State University, USA (1988-95). Later he was Professor of Materials, Materials Research Centre, Indian Institute of Science (1995-2016).

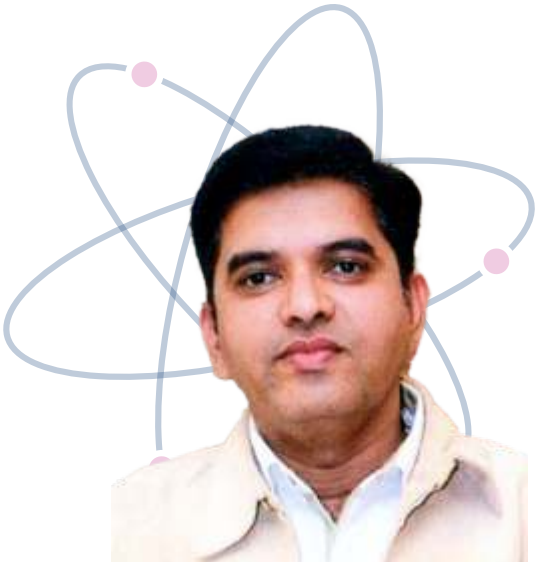
He has built world class labs at MRC, IISc to establish research of international repute, in the areas of thin films of complex ferroic oxides, III-V and III-Nitride compound semiconductors and chalcopyrites for various devices such as high density memories, I.R. detectors, high bright LEDs and photovoltaics respectively. Involved in the development of various electronic devices for homeland security and remote sensing.

Professor Krupanidhi was conferred 2 Engineering Invention Awards at Motorola, USA, (1986), MRSI Medal, India (1997), VASVIK Medal (2004), MRS Superconductivity-Materials Science Award (2004), Tatachem Chair Professorship, Indian Institute of Science (2006), Rustum Choksi medal for research excellence (2006), J.C. Bose Fellow (2009-2020) and CNR Rao prize lecture for Advanced Materials (2010) and MRSI Distinguished Materials Scientist of The Year Award (2019). He was elected Member of the Asia Pacific Academy of Materials (2003), Fellow of the Indian Academy of Sciences, Bangalore (2003), Fellow of the Indian National Science Academy (2012), and Fellow of Indian National academy of Engineering (2012). He is currently President, Materials Research Society of India.

ABSTRACT

The photodetectors are of great importance due to their various applications from everyday consumer electronics to more elegant applications such as environmental monitoring, space research and optical communication. The self-powered photodetectors such as p-n junction, heterojunction, Schottky junctions and organic/inorganic hybrid junctions can immediately separate the electron-hole pairs due to the built-in electric field, which shows faster photo response and higher responsivity at zero bias and have drawn much attention of scientists and technologists. The hybrid heterostructures of 2D/III-Nitride are found to be most suitable candidates for such applications. The present talk deals with the epitaxial heterostructures made out of combinations of III-Nitrides with perovskite oxides and 2D layers of transition metal dichalcogenides. Photo-detection has been chosen as a common theme for gaining a comparative understanding of the structures made by MBE process.

Advanced Flexible Solid-State Supercapacitor



Prof. Dr. B. R. Sankapal
VNIT, Nagpur

ABSTRACT

Present technologies are well focused towards energy sectors in terms of energy conversion and energy storage. In this regard, advancement of technology needs flexible approach where it is possible to mechanically bend the designed devices for portable, and wearable application.

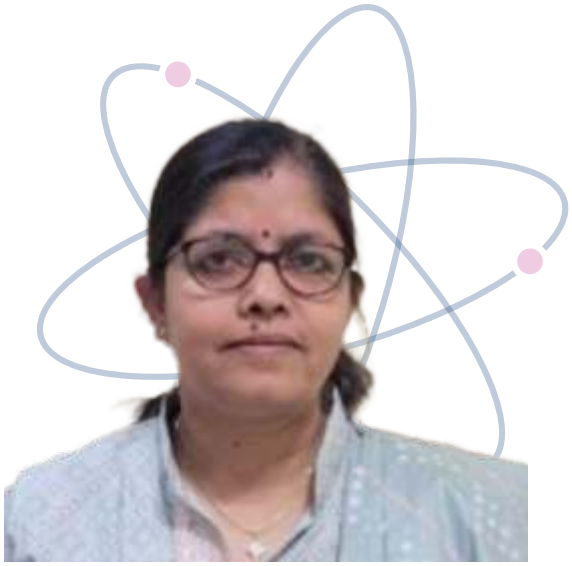
Direct fabrication of complex nanostructure with controlled morphology and surface architecture is renowned due to its numerous applications. Environmentally benign and low temperature processes are plus in this concern which can be integrated to small scale to large scale for roll-to-roll technologies. Energy storage process rely on two distinct mechanisms, electric double layer capacitance (EDLC) and pseudo capacitance but EDLC possess high stability but suffers through low capacitance; on contrary, pseudo has high capacitance but suffers through low stability. Mostly, EDLC uses carbon-based materials whereas pseudo uses metal oxides, chalcogenides and polymers.

In hybrid through 'material mutualism', it can be possible to integrate both EDLC and pseudo materials which can take advantages of both leading to high capacitance along with high stability.

Hence, start of art will be demonstrated for 'Material mutualism' towards supercapacitor application with aid of simple and low-cost chemical routes from synthesis of nanomaterials to device grade development flexible solid-state supercapacitor which will have wide future applications including flexible electronic devices. Device grade demo to run LED panel and small DC fan will be explored its practical applicability for advanced flexible energy storage applications.

Prof. Dr. Babasaheb R. Sankapal is a recipient of Young Scientist-Outstanding work presentation award by Material Research Society, Japan, in 2005. Prof. R. Sankapal is listed under World's Top 2% Scientist for year 2021, 2022, 2023" as per Stanford's University Data. After his Ph.D., he was postdoctoral fellow at Hahn-Meitner-Institute, Germany, Gifu University (JSPS Fellowship), Japan, and University of Wisconsin, USA. He has published more than 180 scientific research papers in reputed journal with higher impact factors. He has secured 10 major research projects worth of Rs. 2.82 Crores from different Indian government funding agencies. So far, Dr. Sankapal guided 17 Ph.D. students amongst six got opportunity to work abroad in countries like: Germany, Spain, Israel, Denmark, Japan and South Korea. Under his leadership, the department of physics (VNIT Nagpur) received DST-FIST grant of Rs. 2.19 Crore. He is a fellow/member of Maharashtra Academy of Sciences, Institute of Physics (IOP)-UK, Indian Science Congress Association, Materials Research Society of India, and Indian Association of Physics Teachers.

Structure dependent Physical Properties in Nanostructured Oxide Materials and its Applications



Prof. Dr. Chandana Rath
IIT BHU, Varanasi

Dr. Chandana Rath is known for scientific research for investigation of structure assisted physical properties in Nanostructured materials. She has gained enough expertise in the area of Nanomagnetics, Thin film devices, Multiferroics, Ion Irradiation, and Ceramic Glass composite. She is a Professor in School of Materials Science and Technology, IIT(BHU). Before joining, she received the PhD degree from Utkal University and did her post doctoral research in University of Girona, Spain for 2 years. She has served as head of the department, chairman of many committees in IIT(BHU) and board of studies member outside. She is one of the council members of MRSI. She has been awarded various awards including Women Achiever in Science, Technology, Engineering and Mathematics (STEM) 2021, MRSI MEDAL from Materials Society of India,Young Research Award in International Union of Materials Research Society India. Her group has received many best poster awards in various conferences. Many Sponsored Projects has been sanctioned to her including National Foundries of Fine Analysis (NFFA) Europe, SERB, UGC, DST, and UGC-DAE CSR, Indore, Mumbai. Also, she has used the sophisticated facilities outside India such as Synchrotron source of Elettra, Italy, Petra, Germany, MBE technique at JCNS, Germany, Diffused neutron scattering and polarized neutron reflectometry at FRMII, Munich, Germany after peer review of her proposal. 12 PhD students and more than 50 MTech students have received their degree under her. 5 patents and more than 100 papers have been published from her group.

ABSTRACT

Nanostructured materials have fascinated all researchers due to their unusual physical properties. One such instance, we have demonstrated in rare-earth orthochromites ($RCrO_3$) which has been rejuvenated in recent years due to magnetism induced ferroelectricity, magnetization reversal, are essential for magnetoelectric devices. $RCrO_3$ crystallizes in orthorhombic distorted perovskite structure and exhibits canted antiferromagnetic due to the antisymmetric Dzyaloshinsky–Moriya (D–M) interaction exhibiting a weak ferromagnetic behaviour at low temperature. Although, these rare earth orthochromites show paramagnetic behaviour at room temperature, the D–M exchange coupling between the Cr^{3+} ions is predominantly antiferromagnetic and makes them magnetically ordered at T_N (~200 to 282 K). We demonstrate that the nanocrystalline, $CeCr_{1-x}Fe_xO_3$ (x=0 and 0.005) compounds crystallized in orthorhombic, Pnma structure shows an increase in distortion in orthorhombic structure due to bending of $Cr\text{-}O_6$ octahedra due to lattice expansion after incorporation of Fe. Besides, temperature-dependent magnetization exhibits some peculiar features such as compensation temperature, T_{comp}, and spin reorientation temperature, T_{SR} and a stable switching behaviour of magnetization by varying the external field in the same direction. A decrease in band gap from 2.9 eV to 2.6 eV makes this material suitable for bipolar magnetic switching and photocatalytic applications.

Quantum enhanced imaging efficiency : A new perspective

Prof. Dr. Pritam Deb
Tezpur University, Assam

ABSTRACT

Motivated by prospective applications of contrast agents in next-generation molecular imaging technologies, this talk will provide a broad overview of current trends in molecular imaging and explore new perspectives. This wide ranging talk will touch on numerous applied problems related to the science of molecular imaging identifying the impact areas and materials challenges in contrast efficiency, diagnosis and imaging. Alongwith the development of new imaging modalities that need contrast agents or tracers for improved visualization, it is realized that nanoparticles can form an important class of materials with unique features suitable for biomedical imaging. In recent years, the notion of 'Quantum Materials' has emerged as a powerful unifying concept across diverse fields of science and engineering. The field has significantly expanded to encompass two-dimensional materials and their van der Waals heterostructures, Moire materials. It is my hope that this collective vision will contribute to sparking new fascinating questions and activities at the intersection of materials science, condensed matter physics, chemical engineering, and biomedicine.

Dr Pritam Deb is a Professor in Physics and DPIIT Chair Professor at Tezpur University. He is also Adjunct Professor of Manipal University (MAHE). He did his PhD at the Jadavpur University on probing magnetization dynamics in iron oxide nanoparticles in 2003, following which he worked in TU Delft University as a post doctoral researcher. Starting his research group, Advanced Functional Materials Laboratory and rose to the position of Chair Professor at present. He was a visiting researcher at Rice University, USA (2016-17), Max Planck Fellow at Max-Planck-Institut für Eisenforschung, Germany (2009-2012), Visiting faculty at Nanyang Technological University, Singapore, Universiti Malaya, Malaysia and as a Advisory Group Member of the Herbert Gleiter International Institute, Shenyang, China. He has made fundamental contribution in proposing a new model to predict the behaviour of spin relaxation with strength of interaction in ensemble of nanoparticles. His seminal contributions in two dimensional van der Waals quantum systems, encompassing both experiment and theory, have significantly expanded the understanding of the key properties of Quantum materials. He has resolved the long standing question on the limitation of quantum mechanical outer-sphere diffusion model of magnetic resonance relaxivity by neglecting the contribution of magnetization and introducing an anisotropy constant contribution. He has published over 160 peer reviewed papers, filed and granted around 12 patents, published 2 books, given over 100 invited or key note conference presentations and transferred 2 patented technologies. He received Prof K C Kar Memorial Lecture Award, President of India Visitor's Award in Technology Development, VASVIK Research Award in Material Science and Technology, DBT S Ramachandran National Bioscience Award.

Glass Technology and Viksit Bharat: A Technological Journey from the 18th to 21st Century

Prof. Dr. Gopi Sharma
Kanya Maha Vidyalaya
Jalandhar

Dr. Gopi Sharma's career is truly remarkable, blending impactful research with leadership roles in academia. Her expertise in linear and non-linear optical studies of glasses and glass ceramics has not only advanced scientific understanding but also is a trademark for many.

Currently serving as Dean of International Affairs, Director of DDU KAUSHAL Kendra, and Coordinator of IQAC at Kanya Maha Vidyalaya Jalandhar, Dr. Sharma holds key positions that shape educational initiatives and quality assurance. Her multidimensional contributions extend beyond her institutional roles.

Dr. Sharma's pioneering research contributions encompass a wide spectrum, ranging from non linear and linear optical properties, structural and thermal studies of oxide glasses and glass ceramics. Her repeated election as a Visiting Fellow at ENEA Advanced Technological Physics/ION, Italy, underscores the international recognition of her work. Similarly, her tenure as a Visiting Professor at Coe College, USA, speaks volumes about her expertise crossing borders.

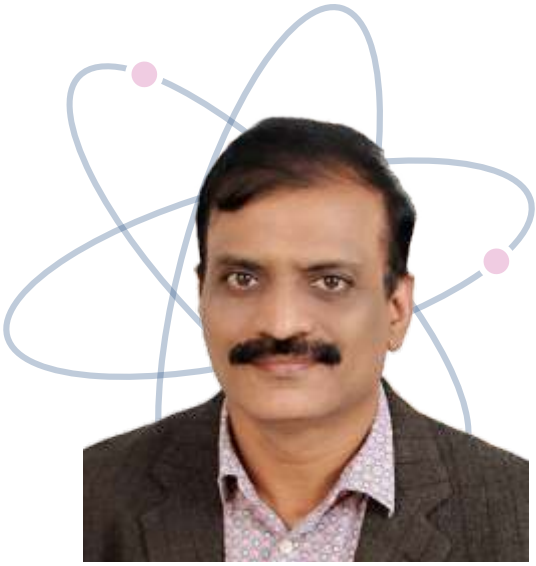
Moreover, her ability to secure substantial funding—exemplified by the 1.2 crores grant from various projects funded by the Government of India—underscores the confidence in her research endeavors. With over 50 research papers to her credit and a track record of delivering invited talks at national and international forums, Dr. Sharma's influence in the scientific community is profound.

Beyond her research accomplishments, Dr. Sharma's mentorship is evident in her supervision of 5 Ph.D. candidates and more than 30 M.Sc. students, nurturing the next generation of scientific talent. Her holistic contributions underscore her dedication to advancing both knowledge and education in the field of optical studies and beyond.

ABSTRACT

The field of glass science and technology boasts an impressive history of more than two centuries of research. The most researched materials include oxide glasses, metallic glasses, amorphous carbon, and amorphous silicon, which continue to receive significant focus today. The origins of glassmaking can be traced back to the third millennium B.C., when craftsmen (from Mesopotamia) discovered techniques for glazing jewelery and small objects with colored glass. The renaissance saw the development of glass for scientific purposes, including lenses for telescopes and microscopes, which were crucial for advancements in astronomy and biology. The 20th century's breakthroughs in x-ray diffraction, microscopy, and optical properties revolutionized glass applications, from heat-resistant kitchenware to lossless optical fibers and large TV screens. Luminescent glasses and glass ceramics, celebrated for their exceptional thermal and chemical stability, present an intriguing alternative to LCD and LED phosphors. In the realm of nonlinear optics, highly nonlinear glasses emerge as formidable candidates for crafting all-optical switching devices. The ongoing advancements in photochromic/photosensitive glasses are reshaping diverse fields, from high-density data storage to holographic optical elements, and beyond. The future innovation in glass science and technology includes development of smart glasses that can change its properties (e.g., transparency) in response to electrical signals or environmental changes. Innovations in 3D printing technologies are enabling the creation of complex glass structures that were previously impossible to produce using traditional methods. This study aims to systematically review the aspects and components of glass art and trace its development from the past to the present for Viksit Bharat.

Metal-Organic Frameworks (MOFs) for Clean Energy Applications: Water Splitting, Proton Conductivity and CO2-fixation



Prof. Dr. Kumar Biradha
IIT Kharagpur

ABSTRACT

Metal-organic frameworks (MOFs) represent a special class of hybrid inorganic-organic porous supramolecular materials consisting of metals or their clusters (SBUs) and organic struts through strong coordination bonds to generate open pore frameworks with permanent porosity, high thermal stability and enormous scope of tunable functional properties. MOFs symbolize the beauty with brilliant chemical structures having framework flexibility. Thus, the modular nature and facile tunability of MOFs make them ideal candidates for heterogeneous catalysis with uniform active sites through judicial choice of building blocks. MOFs can overcome the limitations of homogenous catalysts such as discreet metal complexes and single atom catalysts (SACs). The heterogeneous nature of MOFs allows easy separation as well as their structural tunability, ultrahigh surface area and pore volume facilitate the maximum exposure of catalytic active centres. Our group have been extensively devoted for exploring the functional properties of MOFs towards catalyzing hydrogen evolution & oxygen evolution reactions, catalyzing the conversion of CO_2 to value added products and developing proton conducting membranes. The development of a cost-effective, efficient, and durable materials for water splitting, proton conductivity and CO_2 addition reactions through design of MOFs containing non-noble transition- metals and appropriate organic struts will be discussed.

Kumar Biradha received his Ph.D. in Chemistry from the University of Hyderabad, Hyderabad, India in 1997. Subsequently he did his postdoctoral research in Saint Mary's university, Halifax, Canada and Nagoya University, Nagoya, Japan. Currently he is working as a Professor at the Indian Institute of Technology, Kharagpur, India.

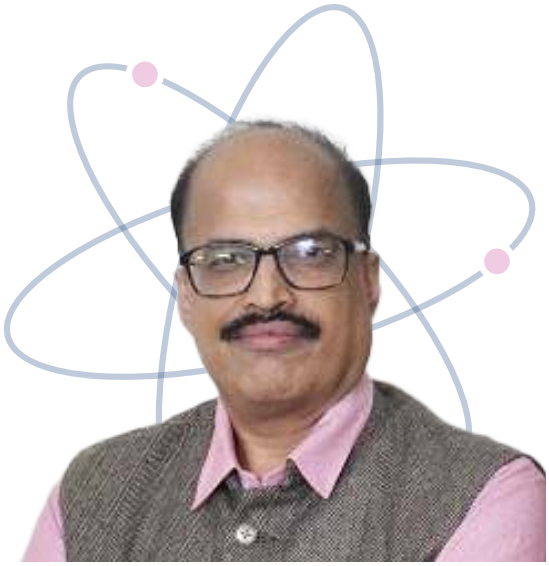
He is the author of over 230 research publications which covers his research interests in supramolecular chemistry, crystal engineering, solid state reactions, MOFs, gels and materials chemistry.

His works demonstrate the potential applications of crystalline MOFs and MOGs in the fields of electrocatalysis, molecular sensing, solid state [2+2] photo-dimerizations and polymerizations, gas adsorption, inclusion materials, semiconductivity, luminescence, and isomeric hydrocarbon separation.

Light initiated single-crystal-to-single-crystal transformations to crystalline polymers, photo-chromic semiconducting materials and photomagnets are some of the prominent of his research works.

He served as editorial board member of New Journal of Chemistry, R. Sc. (2008-2011) and served as co-editor for Acta Cryst. Sec-E (2011). He worked as Associate Editor of Crystal Growth & Design, ACS publications for 10 years (2012-2021) and member of research council of CSIR-NEIST, Jorhat, India (2017-2020). He had received Scopus young scientist award by Scopus in 2006 and fellow of Royal Society of Chemistry in 2010.

Large Scale Nanomaterial Synthesis and Bridging the Gap Between Laboratory and Market: The Role of a Chemist in this Relay Race



Prof. Dr. B. L. V. Prasad

Director
Centre for Nano and Soft Matter Sciences, Bengaluru

Bhagavatula L. V. Prasad also holds a position of Chief Scientist in the Physical/Materials Chemistry Division of National Chemical Laboratory (CSIR-NCL), Pune, India. He received Masters and PhD degrees in Chemistry from Central University, Hyderabad. After two post-doctoral stints; one at Tokyo Institute of Technology (2 years JSPS fellowship and 1 year Research Associate ship) and second at Kansas State University (KSU; 2.5 years - NASA sponsored project); he joined NCL in 2003. In 2021 he has assumed the office of Director, Centre for Nano and Soft Matter Sciences, Bengaluru. His group is actively working in the general area of material synthesis and in particular nanoparticles and nanoscale materials. He has published 140 papers in international peer reviewed journals and has 8 international patents to his credit. He was invited as visiting professor by different universities in many countries, including Japan, USA, UK, France and Germany. 18 students have completed PhD under his supervision and another 6 are pursuing their PhD currently.

Our group mainly works in the general area of materials chemistry including the most promising areas of nanomaterials and soft materials. At present we are working on synthesis of multicomponent and high entropy alloy systems for various applications, particularly our focus is towards hydrogen economy.

Prof. Prasad is a Fellow of National Academy of Sciences, Royal Society of Chemistry; Indian Academy of Sciences. Prof. Prasad received Young Career Award-DST Nanomission, Bronze Medal from Chemical Research Society of India, and CSIR-RAMAN Fellowship for his scientific contributions.

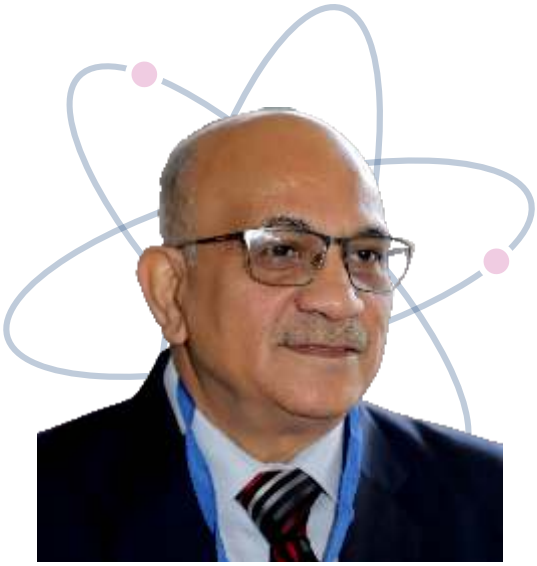
ABSTRACT

As the applicative domain of nanomaterials is increasing there is a great demand for their large-scale production. Conventional chemical batch processes of nanomaterial synthesis have several limitations as they involve several steps and/or reagents. To scale them up we need to reduce the number of steps/reagents/solvents involved. Addressing this, we have embarked on a journey to develop new methods to synthesize different classes of nanomaterials. These are,

- One-step synthesis of metal nanoparticles using flow chemistry and microwave methods.
- "All-in-one" precursors for the preparation of metal and semiconducting nanocrystals.
- Sol-gel synthesis of nanocrystalline oxides using impinging microjets.

In this talk, we will first briefly introduce the different approaches for the chemical synthesis of nanomaterials and then take up each of the above-mentioned cases one by one and delineate the challenges involved in achieving large-scale synthesis. Our efforts in successfully circumventing these problems in collaboration with chemical engineers that resulted in reproducible and reliable large-scale synthetic processes will be described. To realize the true potential of bottom up chemical syntheses and to transform them as industrial scale processes we need many such systematic studies in a collaborative fashion between chemists, chemical engineers and industries.

Nanoscience : A truly interdisciplinary science



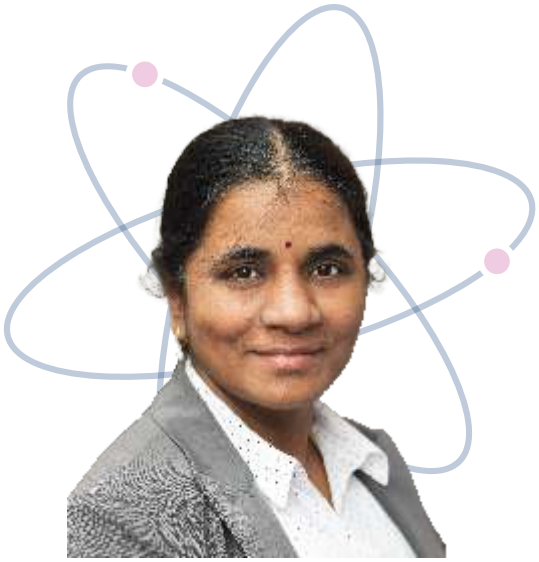
Prof. Dr. Ashok Kumar Ganguli
Director, IISER Berhampur

ABSTRACT

Nanoscience is an interdisciplinary area which overlaps across many disciplines starting from core sciences (Physics, Chemistry and biology) to materials science, engineering and medicine. Nanoscience can be observed around us in living and non-living objects. In my presentation I will dwell on the multidisciplinary aspects of nanoscience, design of specific nanostructures with applications from water purification to medicine . In addition I will share with you some research results, especially on the aspects of applications in water purification, water splitting and hydrogen generation, antireflective coatings for solar panels, low cost biosensors for clinical and environmental applications, 2D materials and films, nanotherapeutics, low cost microfluidics and agricultural nanotechnology.

Professor Ganguli is currently the Director and Professor of Chemical Sciences at IISER Berhampur. He is on Lien from IIT Delhi where he is a Professor of Chemistry. He was Deputy Director, IIT Delhi(2019-22) and was also the founding Director of Institute of Nano Science and Technology(Mohali, India) from 2013-2018. His main research interest is in the area of design of new materials, especially nanomaterials for waste remediation, energy conversion and also superconducting materials. He has published over 350 papers and has filed five patents(two granted). He is currently member Editorial board of several journals. He is a recipient of the MRSI Medal, CRSI Silver Medal, National Award of Nano Science and Nanotechnology (DST), and Distinguished Materials Scientist of the Year Award(2021) and several others. He is a fellow of all the three science academies of India.

Dr Ganguli was keenly involved in the formation of Delhi S&T Cluster (DRIIV) part of the initiative of PSA, Govt of India and was also part of the knowledge cluster at chandigarh(CRIKC). Dr Ganguli has very keen interest to promote outreach activities for underprivileged sections of society and has been to remotest schools and colleges (~ 400 in the last 10 years).



Prof. Dr. Sumathi R. R.

Leibniz-Institut für Kristallzüchtung, Berlin
Ludwig-Maximilians Universität, Munich

Dr. habil. R. Radhakrishnan Sumathi is a well-known international expert in crystal growth (Materials Science) for her forefront research in semiconductors and for her extensive experience in wide-band-gap materials. She has developed a technology for large area, native AlN crystalline substrates for applications like high-power devices, autonomous driving/e-mobility and for environment friendly deep-UV light sources for air & water purification to disinfect bacteria and viruses like SARS/Covid-19.

She is the Vice-Head of Volume Crystals Department at Leibniz-Institute for Crystal Growth (IKZ), Berlin and a faculty at Ludwig-Maximilians University (LMU), Munich, Germany.

Dr. Sumathi and her team are primarily known from their pioneering work on providing crystals of highest structural perfection and purity for redefinition of new "kg-mass", a fundamental physical unit and for breakthrough work on one of the world's purest semiconductor crystals made by human.

She is a life member of professional societies: DGKK, IACG.

Dr. Sumathi has received "habilitation" title from LMU, consistently ranked as "Top-50" the world best universities.

She has received many awards namely Indian Physical Society-Young Scientist, European Physical Society-Young Scientist, German Association for Crystal Growth-Prominent Young Researcher, LMU Excellent Mentoring award and Young Achiever Award by Indian Science & Technology Association.

Advanced materials technology and process developments in Semiconductors : current trends and its impact from societal-use applications to driving discovery physics

ABSTRACT

Semiconductors are inevitable nowadays and reshaping various sectors, driving innovation and societal transformation. Advanced semiconductor materials further fuel new developments and their demands are ever growing for enhancing quality of life and connectivity for individuals worldwide. Of lately, most of the countries now realize the relevance of these semiconductor materials in this digital age and started to instate these semiconductor R&D and supply chain eco-system in their own yard.

Besides providing a comprehensive overview on the technology enablement of high-performance electronic, optoelectronic and quantum devices in terms of miniaturization, increased energy efficiency to reduce carbon footprints, and enhanced functionality, this talk specifically aim to underscore the crucial role of the advanced semiconductor materials in driving discovery physics. We will also explore how advanced semiconductor materials technology is unlocking new realms of scientific inquiry and providing new platforms for probing fundamental physical phenomena by bridging the gap between material science and physics. Furthermore, the presentation will delve into a societal use through case study and real-world example because of the advancements in processing of these materials. Continued technology and process development in advanced semiconductor materials will undoubtedly unlock new possibilities for fostering a more connected, efficient, and sustainable world.

Roadmap of Advanced Materials in the Emerging Field of Microwave Technology & Energy Storage

Prof. Dr. S. K. S. Parashar
KIIT, Bhubaneswar

ABSTRACT

Nanomaterials, with their distinct properties at the nanoscale, can be engineered to display desired microwave properties. Microwave investigations on nanomaterial-based ceramics along with incorporated flexible substrates resulted in the creation of multifunctional devices capable of executing numerous applications at once. The present study covers the broad area on the roadmap of advanced materials research which can improve many electronic devices by tunable characteristics of the targeted ceramics as well as flexible (2D & 3D) materials in their substrates, allowing a single wireless device to operate both as a transmitter and receiver of signals, as well as a radar or sensor element. Similarly, absorbers might be designed to not only reduce electromagnetic radiation but also capture energy or serve as sensors. Microwave research have enabled breakthroughs in nanomaterials-based ceramics, which may open the way for new and creative applications in aerospace, automotive, telecommunications, and defence. Lightweight and high-performance antennas might be fitted into airplanes or satellites, while efficient absorbers could be employed to mitigate electromagnetic interference or stealth technology. Not only advanced communication, but also the multifunctional materials have their scope in energy storage as well as energy harvesting for high scale industrial applications. Predicting the future of research is inherently imprecise, but based on present developments, here's one conceivable scenario for the influence of microwave studies on nanomaterial-based ceramics in the next high frequency operational year of 2047 aiming towards Viksit Bharat and indigenous technology for Atmanirbhar Bharat.

Prof. S.K.S. Parashar has Post Graduated from Co-Operative College Jamshedpur. After Post Gradution, Dr. Parashar joined NIT Jamshedpur for M.Tech Program in Surface Science Engineering. Prof. Parashar completed Ph.D. Program from IIT Kharagpur in the area of Nanotechnology. After Ph.D. he went to DTU Germany for higher research. He worked at NIT Hamirpur for a year. Dr. Parashar has a experience of more than 20 years in teachings and research. Prof. Parashar has an elaborative area of research in the field of Nano Materials synthesis & Characterization towards the application of Energy Storage, Sensors, Super capacitors, Battery, Piezoelectric & Ferroelectric, Microwave Applications, Antenna & Absorber Designing, Nano Fluids, Non-Thermal Plasma, Bio-Medical scopes of Cancer Study, Dentistry, Dermatology, Rheumatology & COVID-19. He is a member of five/six scientific committee. He has published more than 200 research article in international journal of repute. He has completed more than ten sponsor's project and three are now ongoing. Now he is working in the School of Applied Sciences, KIIT Deemed to be University as a full time Professor. Currently he is the convener of ISCA Bhubaneswar Chapter.

High Temperature Mechanical Properties of Oxide Dispersion Strengthened (ODS) Inconel 718 Superalloy Processed by Powder Forging

Prof. Dr. Vikram V Dabhade
IIT Roorkee

Dr. Vikram Dabhade obtained his Ph.D from the Dept. of Metallurgy and Materials Science, Indian Institute of Technology Bombay in 2005. He later worked as a post doctoral research associate at the Korea Institute of Ceramic Engineering and Technology (KICET), South Korea and at the Institute for Metal Forming, Dept. of Materials Science and Engineering, Lehigh University, Bethlehem, PA, USA. After working for a year as a Research Manager at Sandvik (Asia) Ltd., in Pune, India he joined the Dept. of Metallurgical and Materials Engineering, Indian Institute of Technology Roorkee in 2009 where he is at present working as an Associate Professor. Dr. Dabhade's broad field of research expertise is in Powder Metallurgy in which he has worked in various areas such as oxide dispersion strengthened (ODS) steels and superalloys, machinability of powder metallurgy steels, tungsten heavy alloys, Fe-Cu-C based structural powder metallurgy alloys, aluminium composites, electrical contact materials, sintering kinetics of nanocrystalline powders, etc. He has received funding (Rs. 513.17 Lakhs as PI / Co-PI) for several research projects and industrial consultancy from agencies such as BRNS, RDCIS-SAIL, NTPC-BRNS, ISRO, SERB, SMILE-IITR, etc. Dr. Dabhade is an active member of several professional bodies like the powder metallurgy association of India (PMAI), Indian Institute of Metals (IIM), Indian society for non-destructive testing (ISNT), Associate member of the institute of engineers (AMIE). He has supervised seven doctoral students (four ongoing) and twenty two master's students so far. Dr. Dabhade has over sixty peer reviewed journal research papers and over twenty national / International conference papers to his credit. He has developed and undertaken several teaching courses at undergraduate and post graduate levels such as powder metallurgy, non-destructive testing, inspection and quality control, electrical & electronic materials, ceramic and metal powder processing and materials science, etc.

ABSTRACT

At elevated temperatures above 700 °C the strength of nickel based superalloys deteriorates due to coarsening and dissolution of gamma prime (g′), gamma double prime (g″) in the gamma matrix (g). On the other hand oxide dispersion strengthened superalloys can be used at higher temperatures (>700 °C) due to the stability of these oxides unlike that of the gamma prime (g′) and gamma double prime (g″) precipitates. Oxides such as yttria (which are stable at higher temperatures) create obstacles to dislocation motion and creep deformation leading to increased strength at high temperatures.

The aim of this work is to develop yttria reinforced Inconel 718 superalloys by powder forging and determine their microstructural stability and high temperature mechanical properties. Prealloyed powders of Inconel 718 were mixed with varying fractions of yttria by cryo-milling. The mixed powders were sintered in a capsule at 1200 °C under an Ar + H_2 atmosphere and subsequently forged in a channel die to obtain a near full dense forged slab. A standard AMS 5562 heat treatment was applied to the slab. The forged slab was characterized and mechanically tested in both the longitudinal as well as transverse direction to determine the level of anisotropy. Further, tensile tests at room temperature as well as high temperatures were carried out to determine the role of the yttria dispersoid content on the mechanical properties. Due to cryo-milling and subsequent consolidation nano-cluster complexes Y-Ti-O and Y-Al-O were found to precipitate in the matrix. The dispersoids corresponding to Y-Ti-O and Y-Al-O were found to considerably improve the tensile strength at elevated temperatures. The heat treated samples exhibited a combined strengthening effects of dispersoids as well as g″ and g′ precipitates. Optimization of dispersoid content and g″ and g′ precipitates is required to obtain a suitable combination of high temperature strength and ductility.

Bulk Metallic Glasses

Prof. Dr. Shantanu Madge
IIT Jammu

ABSTRACT

Metallic glasses have come a long way from a laboratory curiosity to serious engineering materials. The talk will trace the development of bulk metallic glasses, and their mechanical behaviour. Strategies to improve their toughness will be highlighted. The current applications of BMGs will be explained, along with the latest issues in 3D printing of metallic glasses.

After graduating in Metallurgy from CoEP (Pune), Dr Madge, having secured 2nd rank nationally in GATE, went to IISc Bangalore for his M.E. There he stood first, which facilitated his way for a Ph.D. in Trinity College, University of Cambridge in the UK. After his Ph.D., Dr Madge did his post-doctoral work at eminent institutions like Forschungszentrum Karlsruhe (Germany) and Tohoku University (Japan). He also has wide work experience in applied research, gained through his stints at prestigious places such as the CSIR-National Metallurgical Laboratory (Jamshedpur), Eaton Corporation (Pune). Dr Madge was the founding HoD of the Materials Engineering Department at IIT Jammu, where he is currently employed. His primary areas of work have been alloy development and processing-structure-property relationships.

Dr Madge, during his career, has published many research papers in reputed international journals, including Acta and Scripta Materialia and has 3 patents to his credit.

Quantum Multibody Interactions Across the Charge Density Wave Transition in Metal Chalcogenides

Prof. Dr. Ajay Soni
IIT Mandi

Dr. Ajay Soni is a faculty member at the School of Physical Sciences, IIT Mandi. Dr. Soni has expertise on physics of charge transport, thermoelectricity, light matter interactions and structural property correlations in nanomaterials and nano-functional devices for energy harvesting technologies. Dr. Soni has made excellent contribution to the fundamental understanding of light matter interactions at nanoscale as well as in bulk materials.

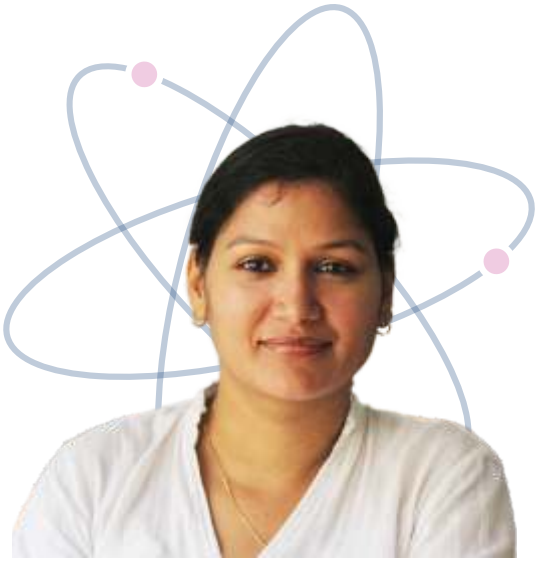
Prof Soni did his PhD from UGC-DAE Consortium for Scientific Research Indore (2009), India and post-doctoral research at Nanyang Technological University Singapore and National University of Singapore (2009-2013). He also worked as visiting Professor at Rensselaer Polytechnic Institute Troy, NY, USA, in 2018.

Prof Soni has been elected as a senior member of IEEE (2022) and Fellow of Royal Society of Chemistry, UK (2024). He is recipient of BASE award from Indo-US Science and Technology Forum (2018) and Research excellence award from IIT Mandi (2021). He is an executive board member of society for interdisciplinary research in materials and biology (2017). He is an associate editor of journal 'Materials Lab' and has been a member of young leader's editorial board of "Energy and Environmental Materials" (2021-2023).

ABSTRACT

Atomically thin materials have displayed a paradigm shift for understanding of physical and electronic properties because of quantum size effects, broken symmetry and dielectric screening. In this regards, the light matter interactions have provided significant information about such quantum phenomena in these materials. One of the interesting correlated phenomena is Charge density wave (CDW) in 2 dimensional solids, where the periodic modulation of the electronic density is accompanied by the lattice distortion, electronic instability with high anharmonicity. Interestingly, the reconstruction of the lattice leads to new band structure and folding of Brillouin zone along with the emergence of collective modes and enhanced multi body interactions. In this talk, I will discuss the interesting aspects of Raman modes and multiphonon interactions observed in layered chalcogenides such as $NbSe_2$, VSe_2 and TaS_2. While the bulk 2H-TaS_2 endures a CDW transition at ~76K, the major emphasis is on the existence of CDW instability in ultrathin layers well above 200 K, due to breaking of center of inversion and translational symmetries. The talk will also elaborate on our recent work on unique optical properties and light-matter interactions in the chalcogenide materials for thermoelectric research.

3D Printing of Nanomaterials for Photonics Application



Prof. Dr. Shobha Shukla
IIT Bombay

ABSTRACT

The fabrication of 3D micro/nanostructures has recently gathered significant attention due to the increasing demand for miniaturization of devices for various applications. Conventional techniques such as photolithography, electron beam lithography and X-ray lithography are commonly used for creating these miniaturised structures, but have limited resolution, poor reproducibility and unable to provide free-standing 3D structures. Two-photon lithography (TPL), a femtosecond-laser assisted additive manufacturing technique, is a state-of-the-art technique can be used as an alternative method for fabricating high-resolution, precise, and accurate 2D and 3D micro/nanostructures. This enables the fabrication of intricate 3D micro/nanopatterns tailored for diverse functionalities.

We have explored the fabrication of 3D micro/nanostructures using TPL, augmented with various nanomaterials, for the specific applications such as sensing, anticounterfeiting, photovoltaics and, plasmonics. The utilization of TPL allows precise control over structural features at the micro and nanoscale, crucial for enhancing optical properties and performance in photonics applications. Recently, we have developed a miniaturised nanopatterned sensor using TPL which can be used for accurate detection of heavy metal contamination in wastewater. By harnessing the unique properties of nanomaterials and the precision of 3D printing techniques, we aim to contribute to the development of advanced photonics devices capable of addressing challenges in biotechnology and environmental monitoring.

Professor Shobha Shukla is Professor in the Department of Metallurgical Engineering and Materials Sciences at the Indian Institute of Technology, Bombay, India. She obtained her doctoral degree at the State University of New York/SUNY Buffalo, USA. Subsequently she worked as a postdoctoral fellow at the School of Engineering and Applied Sciences, Harvard University, Cambridge, Massachusetts, USA. Her research interests are in the field of nanophotonics devices, water related technologies, metamaterials, and plasmonic devices. Prof. Shukla has published her research in several reputed journals and presented her research on international platforms. She also has several patents granted for Two-photon lithography-based fabrication of sub -wavelength structures for photonic applications. She is also on the editorial board of Scientific Reports by Nature Publishing group & Journal of Physics-Photonics by IoP publishing. Prof. Shukla is currently heading the water innovation center (WICTRE) at IIT Bombay and has recently been awarded as the "Most Impactful Water Management Leaders" by the World Water Leadership Congress.

Quantum Materials for Future Transformative Applications

Prof. Dr. R. Jayavel

Dean, Alagappa College of Technology
Anna University, Chennai

Prof. Jayavel was the former Director, Centre for Nanoscience and Technology, Director-Research and Director, Centre for International Affairs, Anna University.

Prof. Jayavel was a Visiting Professor at Shizuoka University, Japan, University of Gottingen, Germany, University of Queensland, Australia and University of South Australia. So far 45 researchers have obtained their Ph.D. Degree under the guidance of Dr. Jayavel. He has edited a book on "Advanced Materials for Optoelectronics". He has got two Patents on Quantum dot sensitized solar cells and Eco-friendly nanopackaging material.

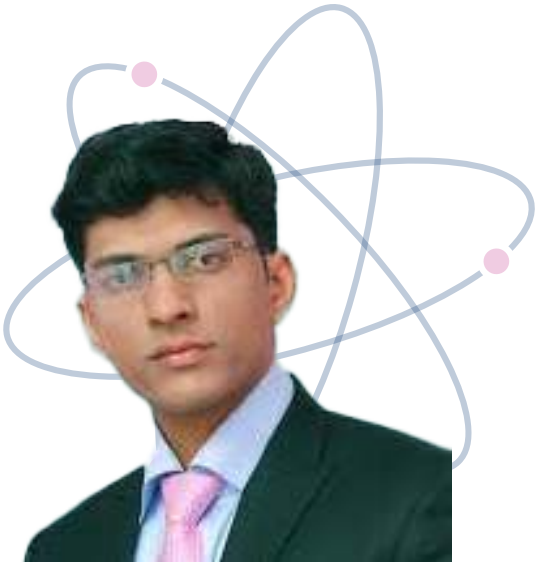
Prof. Jayavel is a recipient of several awards and recognitions, namely, Fellow of Tamil Nadu Academy of Sciences, Fellow of Society for Advancement of Electrochemical Science and Technology, Science and Technology Agency Fellowship-Japan, DAAD Sandwich Fellowship-Germany, Active Researcher Award, Anna University, Tamil Nadu Scientist Award, Life Time Achievement Award-Indian Spectrophysics Association, MRSI Medal-. Materials Research Society of India, LEAP Fellowship-Ministry of Education, Govt. of India, Senior Scientist Award-Academy of Sciences Chennai, Mid Career Award-University Grants Commission and Research Excellence Award-Anna University. He was a Member of UNESCO Chair in Materials and Technologies for Energy Conversion, Saving and Storage.

ABSTRACT

The unique properties of quantum materials enable their application across a wide range of industrial domains, including next generation electronics, spintronics, sensors, energy storage, laser technology, optoelectronic and photonic devices and quantum computing. Quantum 2D materials, such as graphene, transition metal dichalcogenides (TMDs), and black phosphorus, have garnered significant interest in recent years due to their unique electronic, optical, and mechanical properties. These materials exhibit quantum confinement effect, high carrier mobility, and tunable bandgaps.

We have been extensively working on 2D functional quantum materials for energy storage and sensor application. We have demonstrated the fabrication of supercapacitors with extreme power density and energy density with extended cyclic stability. We have also fabricated composite and hybrid electrode materials for sustainable energy storage solutions. Some of the major challenges and future directions in quantum materials are the scalability, stability, interface engineering, retention of desired properties during device integration. are also addressed. Understanding and harnessing the properties of quantum 2D materials will be crucial for developing next-generation technologies with enhanced performance and new functionalities. To fully realize the transformative potential of these materials, intensive research focus, industry collaboration, and large scale investment are crucial.

Prussian Blue Analogues (PBAs) for sodium ion battery applications



Prof. Dr. Rahul R. Salunkhe
IIT Jammu

ABSTRACT

Sodium-ion batteries (SIBs) have emerged as a promising alternative to lithium-ion batteries due to sodium's abundance and low cost. Prussian Blue Analogues (PBAs) have garnered significant research interest as cathode materials for SIBs due to their advantageous properties, non-toxic nature, and cost-effectiveness, which are highly desirable for energy storage applications. PBAs possess an open framework with large three-dimensional (3-D) diffusive pathways that facilitate easy and highly reversible intercalation and deintercalation of alkali ions. PBAs can accommodate up to 2 Na+ ions within their structure, resulting in a theoretical capacity of 170 mAh g^{-1}.

In addition to their structural benefits, PBAs are economically advantageous for three main reasons: firstly, their synthesis does not require high-temperature conditions; secondly, they utilize cost-effective raw materials, enabling large-scale production; and lastly, the storage of PBA compounds does not necessitate specific environmental conditions. These beneficial properties have led various national and international companies, such as CATL, Natron, and Noavasis, to produce commercial SIBs based on PBAs.

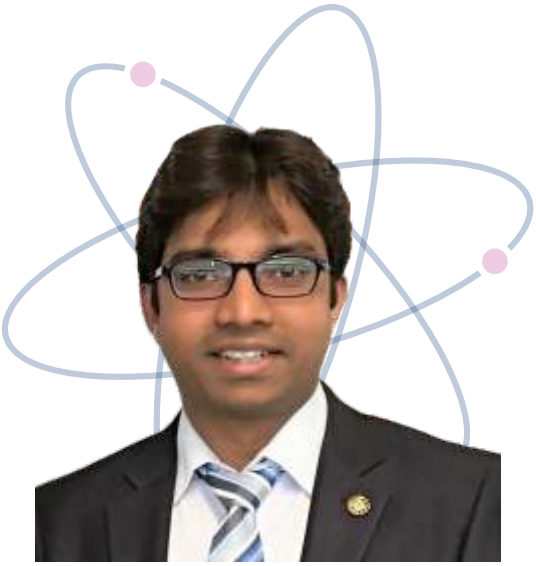
Our research is focused on developing various PBAs at the lab scale and addressing fundamental issues. During the formation of the PBA framework, an octahedral vacancy corresponding to $[Fe(CN)_6]^{4-}$ is generated, which is filled by six H_2O molecules known as coordinated water. This coordinated water may interact with the organic electrolyte, leading to side reactions and potential safety hazards. By minimizing these water molecules, we have achieved stable electrochemical performance. The synthesized cathode material exhibits stability up to 300 cycles with an 89% retention rate at 100 mA g^{-1}. The cell achieves a near theoretical capacity of 160 mAh g^{-1} at 10 mA. g^{-1}, which is highly competitive with commercial grade materials.

Prior to joining IIT Jammu, Prof. Salunkhe was a researcher at Hanyang University (South Korea, 2009–2012), National Tsing Hua University (Taiwan, 2012–2013), and National Institute for Materials Science (Japan, 2013-2017).

His current research interest includes nanoporous materials, sodium ion batteries, and solid state batteries for energy storge applications.

Received UGC research fellowship (Govt of India) for meritorious students in sciences (2008), INSPIRE faculty award (2014) from Department of Science and Technology (Govt of India), Ramanujan fellowship (2017) from SERB (Govt of India).

Advanced Functional Materials: Synthesis and Applications in Textiles, Water Treatment, and Energy Storage



Prof. Dr. Sarang Gumfekar
IIT Ropar

Dr. Sarang Gumfekar is a researcher of material science, mainly polymers and nanomaterials, and its applications in the energy and environment domain. He develops scalable material synthesis strategies to transform the technologies from lab to industry.

Dr. Gumfekar is a faculty of Chemical Engineering at IIT Ropar and Associate Dean of Continuing Education and Outreach Activities. Before joining IIT Ropar, he was a lecturer at the University of Alberta, Canada. He obtained masters in chemical engineering from the University of Waterloo and PhD in chemical engineering from the University of Alberta, Canada. He held a postdoctoral fellowship at the National Research Council Canada-Nanotechnology Research Centre.

His research group focuses on developing materials with unique properties and their field-level applications. Key research areas in his group are - metal-organic framework (MOF) embedded nanofiltration membranes, hydrodynamic cavitation-based water treatment, microreactor-based scalable synthesis of nanomaterials, microencapsulated phase change materials (PCM) for thermoregulating fabrics, surface engineering of electrocatalysts for PEM fuel cells and green hydrogen production.

Dr. Gumfekar's group has developed expertise in using microreactor technology to produce various nanomaterials such as silver, platinum, bimetallic nanomaterials, and MOF on a large scale. Simultaneous engineering of nanomaterial interfaces has allowed him to produce materials with precise properties.

Dr. Gumfekar is also a Marie Curie Fellowship awardee. He serves as an Associate Editor of the Canadian Journal of Chemical Engineering. He is also an Associate Fellow of Maharashtra Academy of Sciences.

ABSTRACT

Materials with unique properties and strategies to make them reproducible at a large scale have constantly challenged researchers. Moreover, field-scale application of materials is necessary to exploit the uniqueness of those materials for society. One of our works focuses on developing microencapsulated phase change materials (PCM) and coating them onto fabrics to control thermoregulation. The clothing finds application in extreme weather, such as in Siachen or Jaisalmer. In another work, we have tailored the pore structure of nanofiltration membranes to selectively remove the contaminants from water. We have shown the effectiveness of our approach in removing the pesticides found in agricultural wastewater. We have developed an integrated advanced oxidation process based on hydrodynamic cavitation to treat textile wastewater at a commercial scale. We have developed unique spinel and perovskite electrocatalysts that have shown remarkable activity toward the production of green hydrogen through water splitting. We adopt a unique approach of microreactor technology to produce various nanomaterials at a large scale with excellent reproducibility. Interface engineering of nanomaterials has allowed us to produce materials with precise properties. In the future, material scientists will be challenged for reproducibility of material properties, economically feasible techniques to manufacture them, and demonstration of real-world applications so society can benefit from the research.

Pioneering Safer Quasi-Solid-State and Ultralow Temperature (<-100 °C) Li-ion Batteries

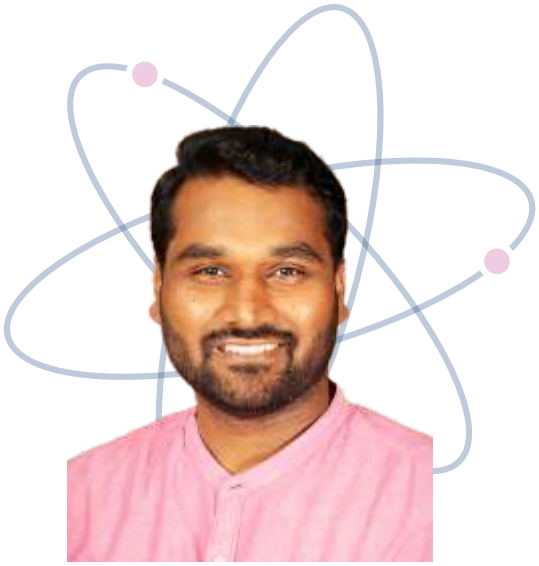
Prof. Dr. Vilas G. Pol
Purdue University, USA

ABSTRACT

In 2019, Nobel Prize in Chemistry was awarded to Lithium-ion battery (LIBs) innovation. Purdue University's ViPER (Vilas Pol's Energy Research) group specialized in innovating anodes, cathodes, binders, ion conductive ceramics, salts, fire suppressing molecules as well as understanding their fundamental interplay to make semi-solid-state LIBs fundamentally safer. In one of the case studies, the cell comprised of $LiFePO_4$/tailored electrolyte/graphite was in-situ monitored between 25 to 300°C employing multimodule calorimetry for its thermal runaway behavior. Less than 40 J/g exothermic heat was measured repeatedly, on the contrary the analogous cell with conventional liquid electrolyte released significantly higher (>1000 J/g) exothermic heat. We will discuss ViPER's recent efforts on making LIBs thermally and mechanically safer. A glimpse on the recent invention on the early detection/sensing of gases/VOCs informing battery management system to circumvent calamitous LIBs thermal runaway and fire will be provided. Moreover, we will demonstrate ultra-low temperature (≤ -100 degree Celsius) performance of LIBs with solvation shell tailoring of innovative electrolyte.

Vilas G. Pol is a Professor of Chemical Engineering at Purdue University, IN, USA. He authored/co-authored >270 research publications (h index 58), an inventor on 20 issued US patents and 10+ applications. He delivered hundreds of invited, keynote and plenary talks including 'TEDx'. Purdue University honored him with Outstanding Engineering Teachers, Most Impactful Inventors, Seed for Success, Bravo, and Purdue Faculty Scholar awards. He is honored with 35+ prestigious awards from professional AIChE, ACS, MRS, ACerS, TMS and Carbon societies. He also received 2015 R and D 100 award as well as two Guinness World RecordsTM. He is a fellow of Royal Society of Chemistry (FRSC).

Next-Generation Semiconductor Materials for Solar Cells: Understanding Basics and Exploring New Horizons



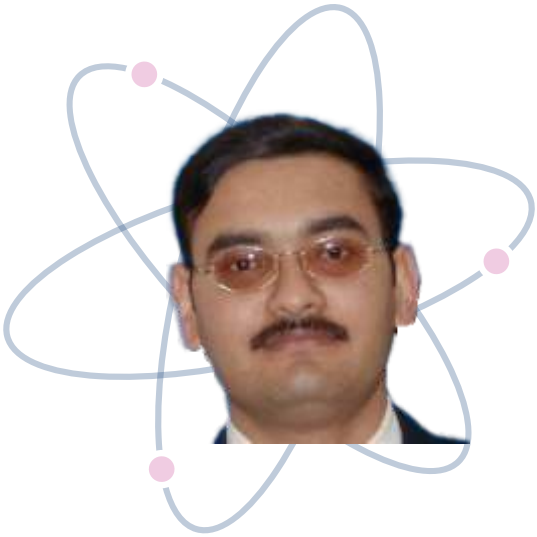
Prof. Dr. Sachin R. Rondiya
Indian Institute of Science, Bengaluru

I am currently Assistant Professor in the Department of Materials Engineering, Indian Institute of Science (IISc), Bangalore, India. During my last ten years research journey, I worked with more than 10 different nationality researchers and faculties. I experienced, one of the major benefits of working in a multicultural society is that the cultural exchange of ideas, values, and habits, which helped me a lot in increase my quality of life and depth understating of my research area. Clean and renewable energy is perhaps one of the most important research areas at the current moment for our green and sustainable future. My work is interdisciplinary in nature involving physics, chemistry, materials science, metallurgical engineering, and more. This diverse expertise helps us to deal with a wide range of issues across the fields of nanotechnology and advanced functional materials for energy harvesting, storage, and conservation. I am strong believer that fundamental science very important for next generation technology development. My vision is extending current knowledge in solar cell field using detail and depth fundamental investigation of semiconductors. My primary research interests and experience are in the understanding and improving, emerging material-based device performance. Our research is focused on the optical and electronic properties of novel nanoscale semiconductor systems for a wide variety of energy applications.

ABSTRACT

The generation and storage of renewable energy are vital in order to meet the world's growing energy demands and the development of emerging novel materials has become a significant feature in driving the needed technological evolution. Recently, the earth-abundant semiconductor materials (binary, ternary and quaternary) have drawn major interests as viable candidate to boost the energy conversion efficiency of solar cells. Effective commercialization of solar cells hinges on the low-cost scaled up synthesis approaches along with cost-effective device fabrication techniques. Earth-abundant semiconductor materials have shown a great potential for these synthesis methods and the thin-film technology with portable deposition techniques has proven to be the most cost-effective route for solar cell fabrication. These materials have attracted substantial attention due to their low-cost potential, direct band gap commensurate with optical absorption in the visible range and high absorption coefficient ($>10^4 cm^{-1}$). Thorough atomic-level insights about the fundamental properties of the interfaces and mechanisms underlying the interfacial phenomena are immensely desirable, which aids in the fabrication of high-quality and structurally ordered junctions for efficient photovoltaic applications. The understanding about the band alignment and the related properties at the interfaces is of paramount importance as it directly affects the device performance. Several of our recent studies focused on band alignment engineering for a clear understanding of the concurrent carrier transport mechanism at heterointerface. The facile synthesis, cost-effective deposition, and fundamental insights about the band-alignment provide a promising approach for fabrication of next-generation solar cells with earth-abundant light-absorbing materials.

Next Generation Manufacturing: 3D & 4D Printing



Prof. Dr. Balasubramanian K.

Defence Institute of Advanced Technology
Pune

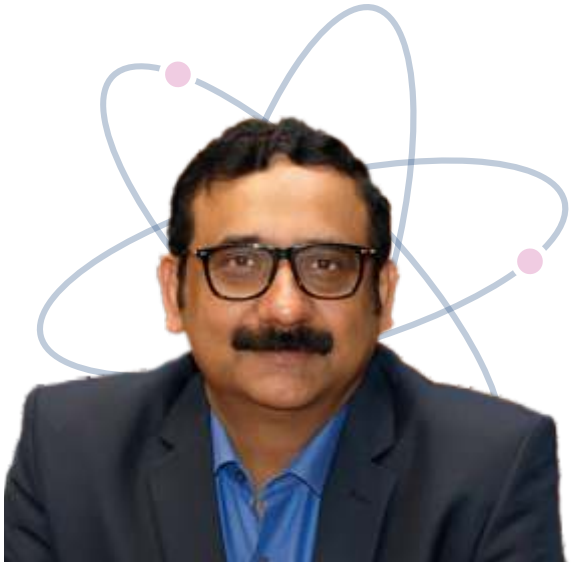
ABSTRACT

The additive manufacturing technique/3D printing have enthralled everyone with their 3D built-up and time-material efficiency in an additive approach for the construction of products in a consecutive layering sequence producing relatively complex structures when confronted with conventional manufacturing techniques. Over the last 12 years our group has been extensively working on the development of highly intricate functional polymeric structures with the aid of additive manufacturing technology. The biomimicking of interdigitating architecture of natural materials like honeycomb or mollusc shells in polymeric structures were found to render superior mechanical properties. A unified approach was carried out elucidating the effect of architectural design and its parameter on the mechanical property of dimensionally controlled 3D prototyping of poly(acrylonitrile-co-butadiene-co-styrene) tri block copolymer by manipulating tablet orientation and tailoring the site-specific positions. The residual stress generation however complicates the smooth functioning of the printed parts and the dimensional accuracy in the 3D printing which gave rise to the development of 4D printing. The printed material conjoined with smart materials manifest another dimension of time rendering it the name of 4D printing where the material undergoes a physical transformation in the vicinity to the environment i.e. stimulus.

Prof. Balasubramanian received his Bachelor and Master degrees in Chemical Technology from UDCT, Mumbai. Later, he went to Loughborough University, UK, for his PhD in Polymer Science and Technology. He has authored more than 425 research papers. He has supervised 24 students for their PhDs and 37 students for their Masters theses. He has 10 patents (granted), 4 trade marks (granted), and 2 design patents (granted) to his credit. So far, he received Rs. 72 Crore from different governmental funding agencies for research projects.

He is in the list (released by Stanford University) of Top 2% scientists in polymer engineering, plastic recycling, additive manufacturing, high performance polymers (from 2019–2022). He is a recipient of international awards from IoMMM (UK), Pera Innovation Park (UK), UK Matri (UK), IoN (UK), Honda Innovation award (Japan), and ASM (USA). Prof. Bala is a Fellow of Royal Society of Chemistry (UK) and Chartered Engineer (UK).

Quantum Materials and Heterostructures



Prof. Dr. P. S. Anil Kumar
Indian Institute of Science, Bengaluru

P. S. Anil Kumar obtained a Ph.D (Physics) degree in 1998 from the University of Pune. He was a Dutch Technology Foundation Post-Doctoral Fellow at the University of Twente in The Netherlands until 2000. Then he moved to the Max-Planck Institute of Microstructural Physics, Germany, with Max-Planck Post-doctoral Fellowship. Subsequently, he received the Alexander von Humboldt Research Fellowship. He joined the Department of Physics of the Indian Institute of Science in 2004. He is currently a Professor of Physics and Dean of Admin & Finance at IISc. His research interests are in experimental Condensed Matter Physics/Applied Physics/Material Science, covering topics like spintronics, magnetic nano-structures, magneto-transport in metallic multilayers and oxides, magnetic properties of ultra-thin ferromagnets, spin-polarized electron scattering, quantum materials & technology, etc. He has authored more than 240 research publications. He is the recipient of the Department of Atomic Energy (DAE) Young Scientist Research Award (2005), the Max-Planck India Fellowship (2004-2008), the DAE Young Achiever Award (2008), Appointed as Head of the Max-Planck Partner Group on Surface Magnetism, at IISc (2010-2015), Material Research Society (India) Medal (2011), NASI-Scopus Young Scientist Award 2010 (2011), Microsoft Research India outstanding young faculty award (2011), DAE Raja Ramanna Lecture award (Physics)(2012), Prof. Y.T. Thathachari Prestigious Research Award for Science (2013), Material Research Society (India) silver jubilee medal (2014), Young Career Award in Nanotechnology by Nanomission, Dept. of Science and Technology, Govt. of India (2015), Prof. CNR Rao Bangalore India Nano Science award (2019). He is the general secretary of the Materials Research Society of India and the Vice-President (I) of the International Union of Material Research Societies (IUMRS) for the year 2024.

ABSTRACT

Quantum materials exhibit exotic electronic properties manifested due to reduced dimensionality, quantum confinement, topology of wave functions, etc. Materials such as graphene, topological insulators, Weyl semimetals, spin-liquids, etc., belong to this category and have been widely investigated by condensed matter physicists and materials scientists in the past few decades. These materials are perceived to be the building blocks for the next generation of electronic devices owing to their superior properties. In this lecture, I will illustrate the advantages of quantum materials, viz. topological insulators, Weyl semimetals, topological superconductors, and the heterostructures of these materials, along with some of their perceived applications. Topological insulators are materials characterized by insulating bulk and gapless metallic states on the sample surface. Electrical transport in three-dimensional topological insulators occurs through spin-momentum-locked topological surface states that enclose an insulating bulk. In Weyl semimetals, two non-degenerate bulk bands cross linearly at the band-touching points (Weyl nodes) and are 3D analogs of graphene. Topological superconductors are of great importance due to their potential to host Majorana zero-energy modes, which can lead to the generation of topologically protected qubits essential for fault-tolerant quantum computing. Research in these areas has opened enormous possibilities in fundamental physics and technology.

Highly stable and crystalline semiconductor quantum dot glassy materials for energy generation and storage

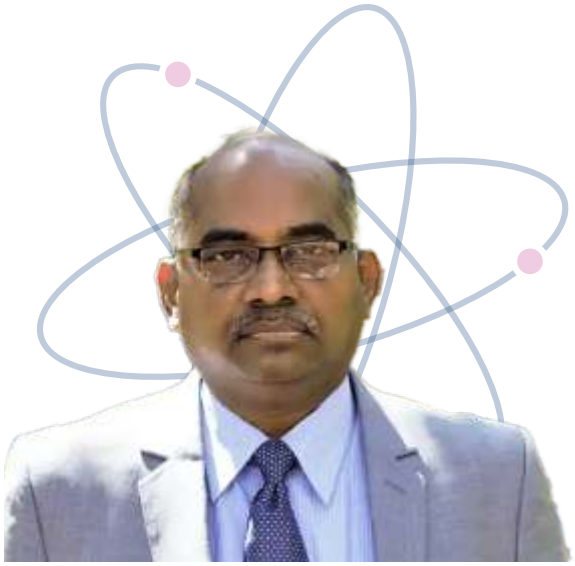
Prof. Dr. Bharat B. Kale, *FRSC*
Director CoE (Materials Science), MIT-WPU
Former DG, C-MET, Pune

ABSTRACT

Major advances have been made recently in exploring new kinds of QDs-embedded glasses, improving luminescent metrics and understanding mechanism involved, and exploring their potential applications particularly for optical devices. As summarized above, these QDs-embedded glasses demonstrated efficient and stable luminescence in the visible to the mid-IR range, and showed many competitive applications such as phosphors and fiber amplifiers. However, this is the first time, we have used such a unique glass for energy applications. The semiconductor quantum dots are not stable at ambient conditions and hence very difficult to study their size quantization and functionality, precisely. In view of this, the semiconductor quantum dots of different size (2-7nm) are grown in the glass matrix and studied their optical properties. These Q-dot semiconductor glasses are highly stable and can be used for optical applications. The CdS, CdSSe, Bismuth quantum dots grown in glass matrix have shown fantastic optical properties and used for solar light harvesting to produce hydrogen. The challenges are how to control quantum dot size and uniformity with 1-2 nm. Such glasses will have future in photonics.

Dr Kale is a emeritus professor in MITWPU and also Emeritus scientist in C-MET, Pune. He is actively involved in nanostructured materials for various applications. He has demonstrated many technologies including battery and hydrogen. He has vast experience of 35 years and completed projects of more than Rs. 100 Crore as a chief investigator. He was a Director General of C-MET and heading all centres of C-MET. He has completed many projects, guided 22 Ph.D. students, published more than 290 papers and filed 28 patents. His H-index is 56 and citation now close to 11000. He is in the list of 2 % world scientist and ranked in Material science. He is FRSC, UK, received many awards like APAM (international), Vasvik (Industry). He is the fellow of academy and also life member of ICS and MRSI. There are many awards on his credit.

Sensing toxic, volatile aldehydes (HCHO) using nano materials (GO / rGO / Graphene)



Prof. Dr. techn. Murthy S.S.S. Chavali Yadav

Dean, Research & Development
MIT-WPU

He received his B.Sc., in Chemistry (1990, ANU, India); M.Sc. (Tech.) in Chemistry (1994, JNTUH, India), and his Ph.D.Tech., in Analytical Chemistry (2000, TUWIEN, Austria) and served as Post-doctoral Fellow in the USA, Japan (as JSPS and VBL Fellow), and Taiwan (NSC Fellow).

Professor Chavali has over 30 years of research experience and 27 years of teaching experience. He is a recipient of several research felicitations/awards/ fellowships, and commendations both nationally and internationally and has been invited to several countries to speak on his group's research activities. He is also a Visiting Professor/Researcher/ Scientist/Fellow at 15 universities/Institutes abroad. He was a recipient of over 150+International Travel Grants visiting abroad.

Listed among World's Top 2% Scientists by Stanford University and Elsevier. Prof. Chavali was a recipient of National Level BEST PG Teacher Award (2020) - Prof. Dr. Bhupendra Sahai Saxena Award by ACT. To name a few, he is a recipient of a number of awards and fellowships like OEAD-NSD, NSF, NSC and JSPS, VBL. Research products developed (~20); Key technologies developed (~53); Research facilities created (~32).

Dr. techn. Murthy Chavali has published widely over 1350 at various international and national which include 430 articles/communiqués in reputed peer-reviewed journals; presented at over 270 seminars/symposia/ conferences/workshops; over 195 technical reports and 136 books/book chapters. He also guided 28 PhDs, 6 PDFs and around 150 UG and PG Students. He made team contribution towards 8 patents as well with help from international collaborators. He also made a team contribution toward 12 patents. He also focuses on student entrepreneurship allowing students to learn more than their study in their chosen field by creating an interdisciplinary environment to work and develop.

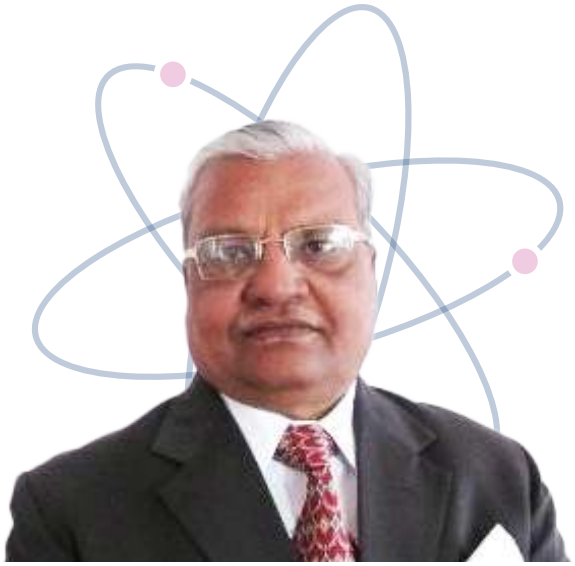
ABSTRACT

Formaldehyde (HCHO) colourless chemical with a strong pickle-like odour, classified as a human carcinogen, even short-term exposure can be fatal. Exists as a gas at room temperature, part of volatile organic compounds (VOCs). Nanomaterials have been widely used in analytical chemistry as a chemical sensor and biosensor materials. Graphene, a kind of nanomaterial, has attracted attention increasingly since it was isolated in 2004 showing promising applications in scientific and technological fields owing to its novel properties such as electrical, thermal, and mechanical properties. Graphene and its derivatives including graphene oxide (GO) have attracted ever-increasing devotion in recent years as a novel class of 2D carbon-based nanomaterials with the promise of a range of applications. GO has the large surface area, excellent conductivity, good chemical stability and easy fabrication; in combination makes GO the paramount materials in the fields of sensors.

A graphene oxide (GO) based formaldehyde sensor to detect at room temperature was developed. Graphene oxide was synthesised by a modified Hummers method. FT-IR spectra of the graphene oxide revealed these –OH and –COOH functional groups were formed on the graphene surface. XRD patterns also showed the formation of graphene oxide material. The p-type semiconductor sensing material of GO was performed and at room working temperature. It was tested as 10 to 50 ppm HCHO concentrations for GO, and the sensor response was raised from 2.11 to 6.98. Using Material Studio 4.3 software, the adsorption phenomena were explained to the HCHO sensing property.


Agri-Tech

Viksit Bharat in Agriculture in 2047



Prof. Dr. Madangopal C. Varshneya
Kamdhenu University, Gandhinagar,
Anand Agricultural University, Anand

Prof. Dr. M C. Varshneya has 52 years of experience in Education, Research, Extension Education and University Administration. He is a renowned scientist in Agricultural Meteorology, sp. in' Crop Modeling'.

He has guided 75 thesis of M.Sc. (Agriculture), 2 thesis of M.Tech.(Agricultural Engineering), 6 projects of B.Tech. (Agricultural Engineering) and evaluated 3 thesis of Ph.D. He had written 14 books, 87 thesis, 46 chapters in various books, 16 articles and 43 reports He had prsented 45 articles in varous sicintific conferences. He served as the first Vice- Chancellor of Anand Agriculture University (2004-2010), Anand and of Kamdhenu University (2014-2017), Gandhinagar, Gujarat

He was honored with national award for 'Soil Health Card'. Also, he was awarded as the best Director of Centre of Advanced Studies by Indian Council of Agricultural Research, New Delhi. Similarly, he has also honored as 'Fellow of Association of Agro-Meteorologist-FAAM' in 2017". He served as Chairman of 'Association of Agriculture Meteorology (2009-2011) (AAM)", He was honored with Ph.D. degree by Nanaji Deshmukh Veterinary Science University, in 2019. He also served as Chairman (2015-16) of 'Indian Agricultural Universities Association (IAUA), '.

He was nominated by the Governor of Maharashtra as member on 'Maharashtra Agriculture Universities Recruitment Board" Maharashtra Council of Agricultural Education and Research, Pune. He served as Chairman and member of various Government and University committees He visited U.S.A. Italy, Israel, Thailand, South Africa and Nepal

ABSTRACT

India is having a Geographical Area of 328.7 m ha, 7th in global ranking. However, it has agricultural land of 180.8 m ha. Out of which 153.8 m ha is cultivated. Around 40% land is irrigated. Agricultural production is 309 mt, fruits and vegetable production is 322.7 mt, and milk production 230.58 mt. Out of the total population of 142million 65% population is engaged in agriculture. Out of this almost 82 % farmers are landless, marginal and small farmers. Agricultural productivity is less, therefore, many farmers are poor.

In Vikasit bharat it is aimed to develop integrated farming system (animal based, horticulture and tree based and fisheries based) modules. Bharatiya (organic, natural) agricultural technologies are to be developed so as to increase the productivity and production to the highest level. For this purpose climate resilient crops and cropping practices, primary and advanced food processing technologies will be innovated. Similarly, Warehousing and transport and cold chain facilities will be further developed. This will help in stabilizing the market prices and banking system will give support maximally.

The efforts will be to get good income and sustainable life to all the farmers especially to landless and marginal farmers. New technologies viz. Crop Modeling, Satellite imaging, Drone , AI, Data Analysis and digital electronic systems will be made use of.

Ensuring Income and Nutritional Security through Farming of Under-utilized Subtropical Fruits of India

Dr. Sanjay Kumar Singh

ICAR-Central Institute for Subtropical Horticulture Lucknow

ABSTRACT

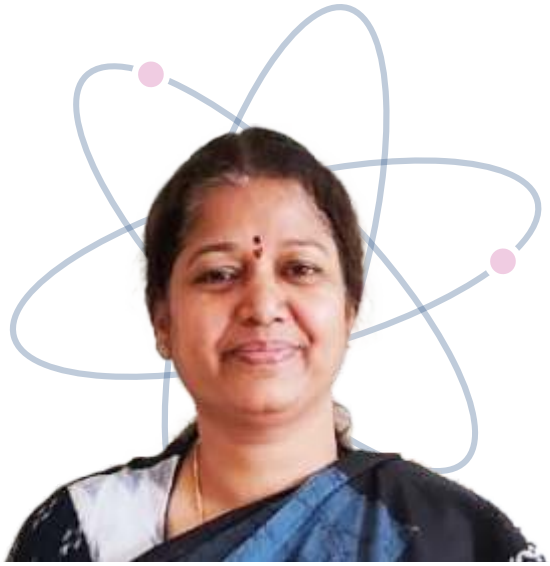
Under-utilized subtropical fruits has high production potential in degraded lands and having high nutritional value have immense potential for commercialization in rural India in the years to come. Work done on under-utilized subtropical fruits in the country has opened up new vistas of horticultural growth for enhancing small farmers' profitability and also the nutritional security. The crops like aonla (Emblica officinalis Gaertn), karonda (Carissa carandas L), bael (Aegle marmelos Correa), jamun (Syzygium cumini Skeels), and tamarind (Tamarindus indica L.) and jackfruit (Artocarpus heterophyllus L.) have a lot of diversity and offer immense potential of identifying superior genotypes for commercialization. Many aonla cultivars like Kanchan, Krishna, NA-7, NA-10, Lakshmi-52, Goma Aishwarya have gained popularity while bael cvs. CISH B-1, CISH B-2, Pant Aparna, Pant Sujata, Pant Shivani, Pant Urvashi, NB-5, NB-7, NB-9, NB-16, NB-17, Goma Yashi, Thar Divya and Thar Neelkanth have spread in many new areas and contributed to enhanced profitability. Jamun cvs. Paras, Konkan Bahdoli, Thar Kranti, Goma Priyanka, CISH J-37 and CISH J-42 (seedless); karonda cvs. Pant Manohar, Pant Sudarshan, Pant Suvarna, Maroon coloured, White Pink Blush and Thar Kamal and Konkan Prolific; jackfruit cvs. Singapore/Ceylon Jack, Hybrid Jack, Burliar-1, PLR-1 (Palur-1), PPI-1 (Pechiparai-1) are some of the promising cultivars developed for commercialization. The crops like mulberry, barhal, wood apple, khirni, chironji and carambola have exhibited tremendous variability in fruit traits for selection and commercialization of new cultivars.

These crops are playing a vital role in nutrition and livelihood for rural and tribal masses for employment and income generation. They are ideal for cultivation because of their low input requirement, less production cost, higher nutritive value and high yield, particularly important for medicinal properties and famous for the retentive value in ayurvedic medicine. The Indian peninsular region is one of the richest reservoirs of genetic variability and diversity of these fruits, which exists in plant types, morphological and physiological variations, resistance to disease and pests, adaptability and distribution. It lays emphasis on exploiting the potential usefulness of such valuable resources, in combating the challenges of food and nutritional security to the ever-increasing population.

Presently, working on Bael, Aonla, Karonda and Seedling mango of subtropical regions. Earlier worked on tree physiology (of mango, guava and litchi), post harvest aspects of arid zones fruits and vegetables and studied endogenous hormonal changes during flowering / vegetative phase. He has also worked on improvement on mango, pummelo etc. and adored with handling of DBT Sponsored-National Database on Mango Project (for Bihar and Jharkhand), UNEP-GEF/TFT sponsored Project on Mango and Pummelo, and Farmer's FIRST Programme (Improved livelihood through good Practices in an agricultural production system). He was instrumental in handling Coca Cola India Private Limited (CCIPL), Gurugram, India sponsored 'Litchi Unnati" project in collaboration of Dehaat. Developed more than 40 success stories under doubling farmer's income and identified > 150 custodian farmers on mango from Bihar and Jharkhand.

At ICAR-CISH, Lucknow, He is looking after the work "Evaluation of diversity and decline of indigenous seedling mango of Bihar and study for its conservation strategy" besides taking care of 'Improvement in Aonla, Karonda and Bael for higher yield and neutraceutical value'. He is handling Unnati Mango (Addressing Climate-Nutrient-Water Nexus Challenges for Mango Value Chains in UP) sponsored by WRG-2020, World Bank, UP Chapter, Lucknow and on Evaluation, conservation and utilization of diverse underutilized fruit crops of Chhattisgarh sponsored by CGMFPFED, Raipur.

Received JSIL Fellowship Award 2019 from Confederation of Horticulture Association of India (CHAI), New Delhi and Overall Young Agricultural Scientist Award 2021 conferred by University Institute of Agricultural Sciences, Chandigarh University, Mohali, India.



Dr. C.H. Janaki
C-DAC, Bengaluru

Dr. Janaki is currently serving as Scientist "F" at C-DAC Bangalore. She has more than 23 years working experience at C-DAC and her expertise is in Bioinformatics, Machine learning & data analytics in life sciences and healthcare domains, HPC & Grid Computing. She completed her PhD in Computational Biology, from Indian Institute of Science, Bangalore in the year 2020. Currently she is heading projects related to Machine learning & AI in life sciences, Mental health, Indian Heritage & Language computing at C-DAC Bangalore. She published many papers in peer-reviewed journals and conferences.

Heading group projects in the areas of Bioinfomatics, Data analytics, Machine Learning and AI, Precision Agriculture, Health analytics and Mental Health Related projects Mental health (MANAS), Fraud Analytics, Heritage and language computing.

Contributed in the following research topics:

- A scalable and digital platform for Mental Health (MANAS)
- A machine learning based platform for Drug target identification for Anti-epileptic drugs (TREADS)
- Agentic Applications for mental healthcare services
- Data science framework for ATM Fraud Analytics

Following are few research breakthroughs from my research group:

Release of a national mental health platform, Mental Health and Normalcy Augmentation System (MANAS) app (Android and ioS), to Jharkhand and Maharshtra University of Health Sciences (MUHS). Study on Unity and Diversity among viral kinases through genomics approaches

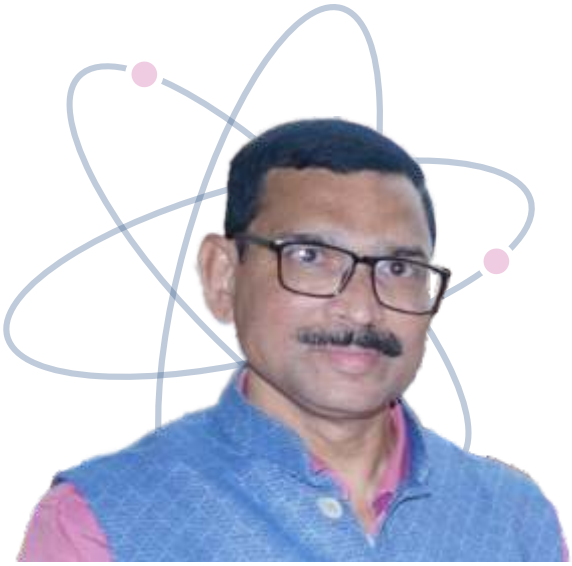
Multi-modal data analysis for Precision Farming

ABSTRACT

Our current resource-intensive methods for micro-farming in urban areas and small-scale farming in rural areas not only need more scrutiny, but also viable alternatives that are economically and environmentally sustainable. Developing large-scale models simulating agro-climatic, agro-ecological conditions along with genomic analysis can help in providing real-time advisories to farmers on the possible yield for a particular crop. At C-DAC Bangalore, we are working on developing a multi-modal approach for the precision agriculture.

Considering the huge diversity in crops, climatic conditions, and resource availability, building crop models in the Indian scenario would be both data and computationally intensive task. High Performance Computing (HPC) and artificial Intelligence (AI) have emerged as key enablers for precision agricultural research. HPC has the potential to revolutionize agricultural practices by enabling the analysis of large and complex big data, running of sophisticated AI models, and the simulation of complex agricultural systems. C-DAC's HPC resources under National Supercomputing Mission (NSM) to be utilized for solving and scaling large-scale agriculture problems.

Emerging Strategies for Abiotic Stress Management for Sustainable Agriculture



Dr. K. Sammi Reddy

ICAR-National Institute of Abiotic Stress Management, Baramati

ABSTRACT

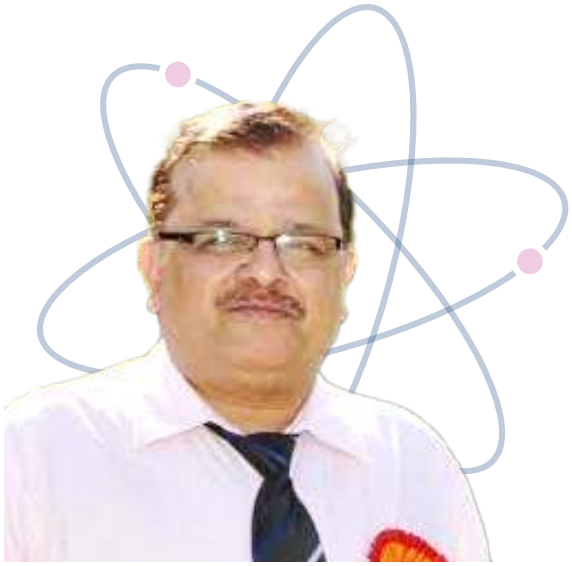
Abiotic stresses refer to the adverse effects of non-living factors on living organisms within a specific environment. Abiotic stresses like extreme temperature (heat, cold, chilling), water (drought, flooding/waterlogging), radiation (UV, ionizing radiation), chemicals (pollutants/ heavy metals/pesticides, gaseous toxins), edaphic stresses (low organic carbon, nutrient deficiencies/excesses, salinity, alkalinity, acidity, physical and biological stresses), mechanical (wind, soil movement, submergence) etc cause reduction in crop productivity by negatively affecting the plant growth, metabolism, and overall productivity. According to world estimates, on an average, about 50% yield losses in agricultural crops are caused by abiotic stresses. These comprise mostly of high temperature (40%), salinity (20%), drought (17%), low temperature (15%) and other forms of stresses (8%). Several abiotic stress adaptation, mitigation and management strategies such as climate resilient varieties, tolerant root stocks for grafting, microbe based interventions, nano-materials, biostimulants & bioregulators, conservation agriculture practices, integrated farming system, precision and deficit irrigation, protected agriculture, sustainable soil management have been developed to address these challenges etc. These technologies have been proved to not only increase the crop productivity by alleviating different stresses but also enhance the resource efficiency on experimental and farmers' fields.

Currently, the major challenge, Indian agriculture facing is the increasing frequency, duration and intensity of occurrence of abiotic stresses due to climate change. Moreover, multiple stresses occurring together, but so far emphasis was made on addressing the single stress by following one or few technologies. Therefore, there is a need to address multiple stresses together by enhancing adaptation to multiple stresses through genome editing, and by implementing the short, medium and long-term mitigation and adaptation strategies in an integrated way through system approach. Need to explore the use of upcoming smart technologies (simulation, AI, IOT, UAVs, space applications) to develop advisories for building resilience in multiple stressed environments.

Dr K. Sammi Reddy is known for his valuable contributions to the basic and applied research on efficient plant nutrient management, climate change and soil health, carbon sequestration, evaluation of novel fertilizer materials, abiotic stress management etc. He has been striving hard to shape the education and research programmes at the ICAR-NIASM, Baramati.

He has served as the Director (Acting), ICAR - Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad; Head, Division of Resource Management, CRIDA, Hyderabad; Scientific Assistant, National Remote Sensing Agency, Hyderabad; Principal Scientist, ICAR-Indian Institute of Soil Science, Bhopal. He led multi-institutional consortium projects funded by the Australian Centre for International Agriculture Research (ACIAR), Australia and developed Mother – Baby Trial Extension Approach for farmers' participatory development of integrated nutrient management technologies. He also involved in the development of 121 Climate Resilient Clusters comprising of 446 climate resilient villages under NICRA. He has published about 394 publications which include 131 research articles in reputed international and national journals, 24 books, 25 book chapters etc.

He is a Fellow of National Academy of Agricultural Sciences, Indian Society of the Soil Science, Hari Om Ashram Trust Award of ICAR; 12th International Congress of Soil Science Commemoration Award of ISSS; Golden Jubilee Commemoration Young Scientist Award of ISSS; PPIC-FAI Award; IMPHOS-FAI Award; TSI-FAI Award; FAI Golden Jubilee Award for Excellence; Dhiru Morarji Memorial Award of FAI .



Prof. Dr. Dinesh Amalnerkar
Savitribai Phule Pune University
Pune

Highly sensitive label-free bio-interfacial colorimetric sensor based on silk fibroin-gold nanocomposite for easy detection of organophosphate pesticide

ABSTRACT

Herein, the preparation of gold nanoparticles-silk fibroin (SF-AuNPs) dispersion and its colorimetric detection of the organophosphate pesticide, namely chlorpyrifos, at ppb level are reported. The silk fibroin solution was extracted from B. mori silk after performing degumming, dissolving and dialysis steps. This fibroin solution was used for synthesis of gold nanoparticles in-situ without using any external reducing and capping agent. X-ray Diffractometry (XRD), Field Emission Transmission Electron Microscopy (FETEM) along with Surface Plasmon Resonance based optical evaluation confirmed generation of gold nanoparticles within SF matrix. The resultant SF-AuNPs dispersion exhibited rapid and excellent colorimetric pesticide sensing response even at 10 ppb concentration. Effect of additional parameters viz. pH, ionic concentration and interference from other pesticide samples was also studied. Notably, SF-AuNPs dispersion exhibited selective colorimetric pesticide sensing response which can be calibrated. Furthermore, this method was extended to various simulated real life samples such as tap water, soil and agricultural products including plant residues to successfully detect the presence of chlorpyrifos pesticide. The proposed colorimetric sensor system is facile yet effective and can be employed by novice rural population and expert researchers alike. It can be exploited as preliminary tool for label-free colorimetric organophosphate pesticide sensing in water and agricultural products.

Dr. Dinesh Amalnerkar is Professor Emeritus at SP Pune University. Previously, he served as the Director General of Centre for Materials for Electronics Technology @ Pune, Hyderabad & Thrissur. He has long-standing trans-disciplinary research experience in multi-institutional and multi-country settings. While placed at CMET, he held long-term visiting assignments at Gifu University, Japan & Korea Research Institute of Chemical Technology and short-term assignments in Singapore, Switzerland, Slovenia, Bulgaria, Japan and Saudi Arabia. Subsequent to his superannuation, he worked as Korean Government's Brain-Pool Invited Scientist at Sungkyunkwan University (2015-16) and Hanyang University (2017-18). His versatile research contributions in Electronic & Nanostructured Materials and Nano-Bioscience include 240 peer-reviewed research papers, 24 Indian Patents, 3 US Patents, 1 Book Chapter and 3 Technology Transfers.

He is Fellow of Maharashtra Academy of Sciences and Indian Chemical Society. He is recipient of prestigious Medal Award of MRSI in the year 2008. He has received revered Fellowships of Indian Society of Analytical Scientists, International Institute of Advanced Materials (Sweden) and Engineered Science Society (USA) for his pioneering contributions in Materials Science & Engineering. His name has been featured in the Stanford University Global list of Top 2 Percentile Scientists in the category of Career Long Research.

Strategies for Climate Resilient Agriculture

Prof. Dr. Vilas K. Kharche

Director of Research
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola

ABSTRACT

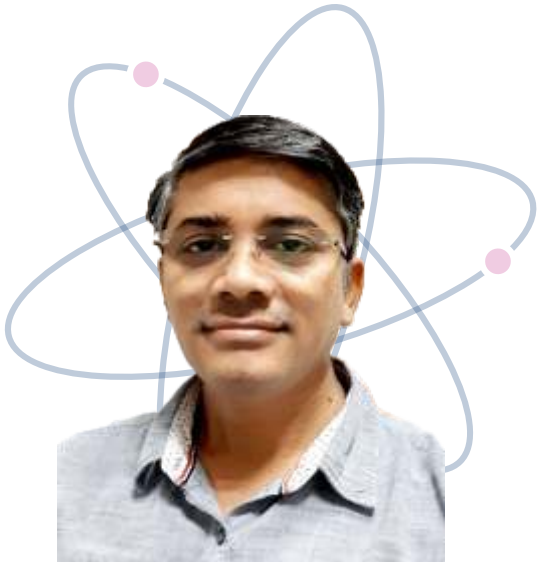
Indian agriculture has made significant progress in the past in respect of food grain production and green revolution in the country was successful for achieving self sufficiency in food grains. However, todays agriculture is facing acute problems of declining availability of natural resources. The climate change and its impact in the form of abiotic and biotic stresses are likely to further aggravate the situation. This calls for strategies to be laid out for overcoming these problems.

Development of technologies, recent techniques and tools that support resource use efficiency are essential. Climate resilient agricultural practices are crop and location specific and can be tailored to fit into the agro ecological and socio economic conditions and priorities of farmers. Concerted efforts are required for adaptation to reduce the vulnerability of agriculture to the adverse impacts of climate change and making it more resilient. In the present concerns of climate change, the Climate Resilience deserves a serious consideration and holds much promise to help address food security challenges through efficient management of agro ecosystems for improved and sustained productivity. New advanced developments in the form of various types of sensors, mechanisms, control systems and information communication tools through advanced computing systems are aiding the faster adoption of precision agriculture practices. Spatial information technologies include global positioning systems (GPS), geographical information systems (GIS), variable-rate technologies (VRT), and remote sensing (RS). Nano-materials in agriculture will reduce the wastage in use of chemicals, minimize nutrient losses in fertilization and will be used to increase yield through pest and nutrient management. At present, the agricultural sector is facing various global challenges; climate change, urbanization, sustainable use of resources, and environmental issues such as run-off and accumulation of pesticides and fertilizers. These situations are further exacerbated by stagnation in crop yields, low nutrient use efficiency, declining soil organic matter, multi-nutrient deficiencies, climate change and shortage of labour besides exodus of people from farming. Resource conservation technologies supported by precision farming like laser land levelling, direct seeding of rice, etc. saves water and energy costs. These technologies will help farmers to minimize the adverse impact of climate change induced weather aberrations.

He is Ph.D. in Soil Science and Agricultural Chemistry and served over 29 years in different capacities in Mahatma Phule Krishi Vidyapeeth, Rahuri, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola and ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur. He has contributed extensively in Pedology, Soil Survey and Land Use planning, Remote Sensing and GIS, Land Degradation, Soil Fertility and Plant Nutrition and Soil Quality Evaluation research in semiarid ecosystems. He has published over 102 peer reviewed research papers, 133 technical and conference papers, over 166 popular articles, 18 book chapters, seven books and 27 research bulletins.

He has released several recommendations and generated technologies beneficial to the farming community. His significant research contributions have been useful for change in cropping pattern in Vidarbha, enhancing crop productivity and increasing farmer's income. He has done sustained contributions in developing technology for reclamation of sodic soils useful to the farmers in problem soil areas of Maharashtra. Several crop varieties, farm implements and machineries and production technologies have been generated under his leadership which are useful for the farming community in Maharashtra.

Dr. Kharche served the Indian Society of Soil Science for long time at all levels. He has guided 10 Ph.D. and 24 M.Sc. students. He is the recipient of ISSS Best Doctoral Research Award, Vasantarao Naik Krishi Gaurao Puraskar, Mridagandha Puraskar, IPI-FAI-Award, RCF Award, K.G. Joshi Award, Swiss Forum International Agricultural Research Team Award, ICAR-CSSRI Excellence Award for his outstanding research contributions. He is the Vice President of Indian Society of Soil Survey and Land Use Planning, Nagpur. He is a Fellow of Maharashtra Academy of Sciences.



Dr. Ravindra Patil
Agharkar Research Institute
Pune

Received his masters and doctoral degrees from Savitribai Phule Pune University, Pune. He contributed to the development of four wheat varieties for commercial cultivation. He carried out research on identification of water-stress tolerant accession in soybean and investigation of molecular mechanism for the water-stress tolerance by RNAseq.

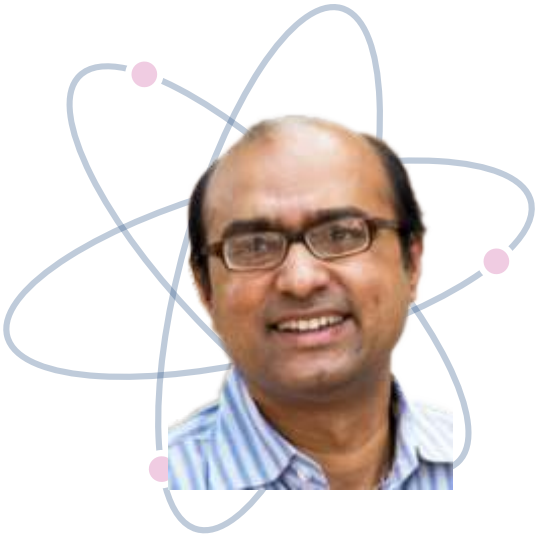
He has written 18 research papers and 4 book chapters. Under his supervision 5 students are doing their doctoral research.

Alternative dwarfing genes to develop semidwarf wheat genotype with improved establishment traits suitable for semi-arid environments and conservation agriculture

ABSTRACT

Wheat is an important staple food for about 40% of the world population, accounting for at least one-fifth of human calorie intake. The human population has doubled over the past 40 years, reaching 8 billion people in 2023, and is predicted to reach 9.7- 10 billion by 2050. Considering the increasing population, additional 224–359 Mt wheat will be needed by 2050 to meet the increased demand. These wheat production targets must be achieved despite of the challenges posed by biotic and abiotic stresses. Early vigour in wheat has been identified as a crucial trait that can significantly impact grain yield through enhanced water-use efficiency, particularly in dry environments. The present wheat cultivars carrying Rht-1 dwarfing allele are suboptimal for semi-arid environments due to short coleoptile and poor seedling establishment. Semi-dwarf wheat with alternative GA-sensitive dwarfing genes are tolerant to moisture stress conditions owing to their longer coleoptile, better emergence and seedling vigour, thus, provide a useful alternative to GA-insensitive dwarfing wheats under water stress conditions. Therefore, it is important to investigate molecular bases for GA-sensitive dwarfing genes. We have identified the precise map position of two GA-insensitive dwarfing genes Rht14 and Rht18. These genes were further transferred to elite Indian wheat cultivars using marker assisted breeding approach to improve early vigour. Advanced breeding lines carrying Rht14 and Rht18 showed significantly improved early vigour, seedling emergence and yield under limited irrigation conditions. Thus, the study delivers useful wheat genetic resources compatible to early and deeper sowing to use residual moisture from the rainy season; that allows farmers to save one irrigation and thus increases water use efficiency. Backcross breeding lines with longer coleoptile and improved establishment traits were less affected by left-over crop residues / stubbles as compared cultivars carrying Rht-1, thereby helping conservation agriculture.

Strategic Management of Crop Disease: A Discourse



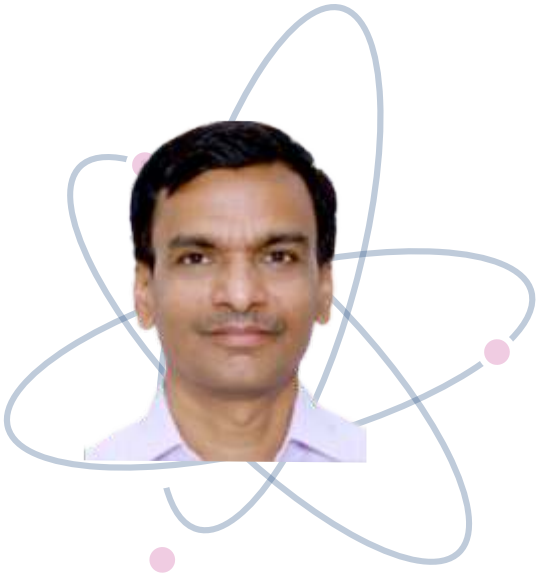
Dr. Sujoy Saha
ICAR- National Research Centre for Grapes
Pune

ABSTRACT

Climate change influences the prevalence and severity of crop diseases by altering disease dynamics and intensifying crop vulnerabilities threatening global food security. Fluctuations in environmental conditions facilitate plant infection in multiple ways such as altering pathogen evolution, changing host–pathogen interactions, vector physiology and facilitating the emergence of new strains of pathogens, which in turn can break down host-plant resistance. Predicting the impacts of climate change on plant disease is complex and challenging, as multiple aspects of plants, pathogens and the environment are involved. These climate-induced challenges complicate disease management and demand innovative strategies. Recent advances like CRISPR-Cas9 genome editing, gene silencing, remote sensing, geographic information systems (GIS), forecasting and real-time monitoring, early disease detection, nanoformulations and integrated disease management (IDM) offer promising alternatives for disease management in agriculture. These approaches aid farmers with practical information for targeted interventions, optimizing resource use and minimizing disease spread. Adopting IDM practices emphasizes fungicide reduction and provides real-world solutions for a healthier environment. The combination of IDM with innovative techniques forms a reliable framework for future disease management, mitigating climate-induced pressures and promoting sustainable agriculture. This approach enhances resilience and supports long-term food security.

After completion of Ph. D. in Plant Bacteriology from the Indian Agricultural Research Institute, New Delhi, served as a Scientist with the Department of Agriculture, Govt. of West Bengal, the main area of research being disease management of cereal crops and vegetables from 2000-2008. Served as Senior Scientist, Plant Pathology at the Indian Institute of Vegetable Research (under ICAR), Varanasi where the primary area of research was new generation fungicides, PGPRs and disease dynamics in relation to climate change from 2008 to 2015. Identified by APEDA to develop package of practices for exportable vegetables. Presently serving as a Principal Scientist at the National Research Centre for Grapes, Pune, where he is entrusted to look into key matters of export, food safety and bio security. Coordinates several research projects with APEDA, FSSAI, DRDO and NCL as well as with the pesticides industry. Published around 120 research papers in journals of national and international repute, 15 review articles, one compendium, 10 books chapters, 5 manuals, 62 research abstracts, 20 leaflets/Folders and more than 84 popular articles. Life member of APIV, IMS, IPS, ISVS, and ISCA. He has guided 3 PhD students.

Green Hydrogen: Opportunities in Sugar & Distillery Industry



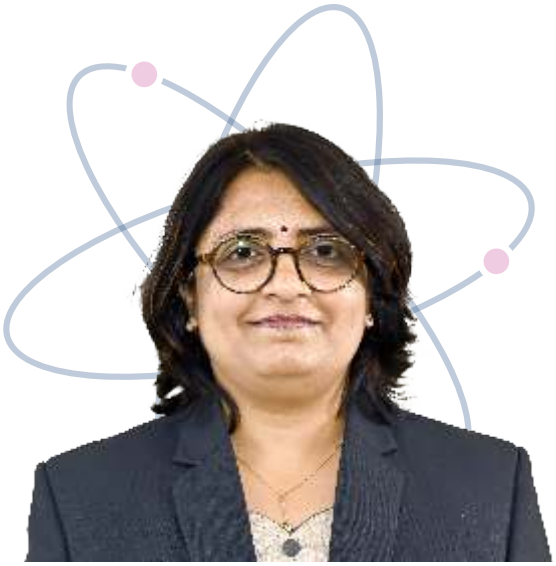
Dr. Kakasaheb Konde
Vasant Dada Sugar Institute
Pune

Dr. Kakasaheb Konde is currently working as Head & Technical Adviser of Alcohol Technology & Biofuels at Vasantdada Sugar Institute. Before joining VSI, he was working at DuPont India Pvt. Ltd. & Honeywell Technology Solutions. He received his Ph.D degree in Chemical Engineering from IISc Bangalore. He has more than 15 years of industrial experience. His expertise is in Biofuel and Biochemical fields with focus on Sugar and distillery industry. His areas of interest are process design and optimization of 1G & 2G ethanol, bio butanol, CBG, Potash Recovery and other value added product from Sugar Industry byproduct. He has published several research papers in different National & International Journals & have 5 patents. He has received various award such as Best employee award, VSI, Annual business award for excellent team work, DuPont India, Award for Safety, Health, and Environment, DuPont India, Honeywell technology solution-wide Technical Excellence Team Innovation Award, etc.

ABSTRACT

In addition to ethanol, the renewable energy sources like hydrogen will play important role in country's energy requirement in future. Hydrogen is one of the clean fuel options for reducing motor vehicle emissions. India consumes about six million tonnes of hydrogen every year for the production of ammonia and methanol in industrial sectors, including fertilisers and refineries. This could increase to 28 million tonnes by 2050, principally due to the rising demand from the industry. As India's hydrogen demand will increase five-fold by 2050, India has set target of 80% green hydrogen production with respect to its total demand to reduce carbon emission. Sugar industry has excess of power/electricity generated after captive consumption. Excess electricity is sold to grid. Day by day tariff for electricity is going down. Sugar industry is looking for economically viable alternative like hydrogen production using water electrolysis with electricity. Bagasse (carbon neutral energy source) can be also used for hydrogen production using gasification. In addition, bagasse, press mud cake and spent wash can be used for biogas (60-65 % methane) production using anaerobic digestion. Steam Methane Reforming can be used for production of hydrogen from methane/biogas. The techno-economics for hydrogen production using electrolysis technology was evaluated. For 5 TPD plant capacity, 10 MW capacity electrolyser will be required. If the plant will be operated for 150 days, Rs. 1850 Lakh will be cost per annum. Rs. 2850 Lakh revenue will be generated per annum. Thus, Rs. 1000 Lakh will be profit per annum and payback period will be 5 years.

Agri-Tech Innovations for Crop Damage Quantification: AI, IoT, and Drones in Indian Scenario



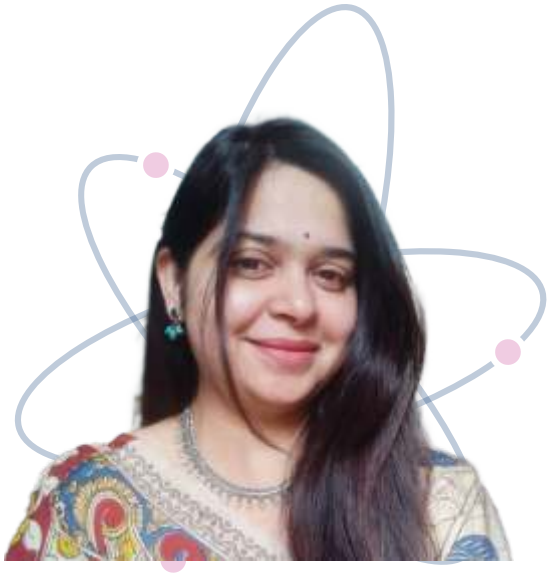
Dr. Parul Jadhav
MIT-WPU

ABSTRACT

Various Government agencies are taking steps to provide financial assistance to the farmers in the flood/drought affected area. The Pik Panchanama is at the center of these financial assistant schemes and is currently being done manually by authorities at local village level by visiting the farm field personally for the crop damage analysis. This is a huge effort due to scale demanding manpower and extended times. This creates delay in the overall process of getting the financial assistance to the farmers. An end-to-end solution incorporating drones for survey with data driven Internet of Things and Artificial Intelligence(AI) Machine Learning(ML) based smart systems will be of assistance to the farmers and Tehsil officers. Several subsystems comprising of Satbara to GPS conversion, drone-based farm field image capturing, field image analysis, use of encryption technique on the captured images followed by damage quantification algorithms can be integrated together. Major challenge of quantification of the crop damage can be handled by integrating Image Processing and Deep Learning techniques. Various deep learning architecture can be exploited for getting the accurate crop damage analysis with the use of the images of before and after the crop damage. Dataset needed for the training and testing of the ML models can be assisted with Generative AI. This whole AI based system will be continually upgrading itself with the new images shared by the farmers during their crop cycle. This assistance mechanism will expedite the process for getting financial assistance to the farmers. Professional Drone fleet based surveyors and/or training locally drone based surveillance will be needed.

Dr. Parul Jadhav is an Associate Professor at Dr. Vishwanath Karad MIT World Peace University and is currently leading the Department of Electrical and Electronics Engineering as Program Director. She has received her B.E and M.E. Electronics and Telecommunications Engineering from Govt. College of Engineering Pune, Maharashtra. She has completed Doctorate at the Govt. College of Engineering Pune Research Centre under Savitribai Phule Pune University. Her areas of interests are Signal processing, AI-ML, Deep Learning Architectures, Video Analytics and allied field. She has guided several Ph.D., Post Graduate and Undergraduate students for the same. She was mentor for Research Grant for KIRAN Division and Women Scientists Scheme B Scheme (WOS-B) which focused on Yield Prediction and Quality Assessment of Grapes in Vineyard Using LiDAR Technology. She has also worked as Principal Investigator on the BCUD Funded project for Implementation of Optimized Video Compression Standard for Real Time Application. She was hhonoured with, "MAEER's MIT Foundation Day Award", as a token of appreciation of contribution to MIT through the noble profession of teaching on the occasion of the 28th Foundation Day of MAEER's MIT on 5th August 2010.

Sustainable Optimization of Agricultural Production



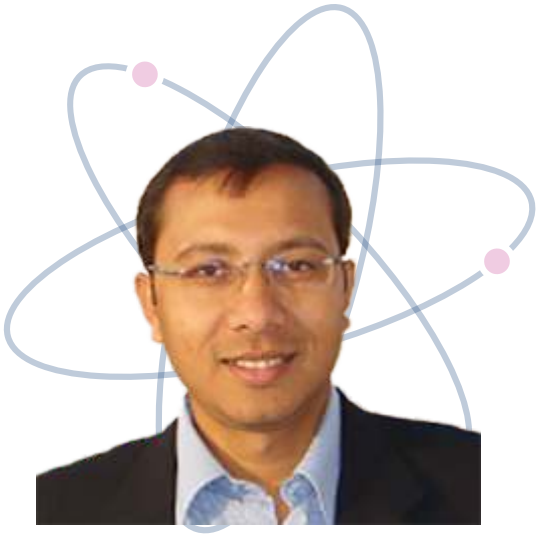
Dr. Apoorva S. Shastri
MIT-WPU

Dr Apoorva S Shastri holds a PhD in Optimization Algorithms and Applications from Symbiosis International (Deemed University), Master of Technology (M.Tech) in VLSI Design and Bachelor of Engineering in Electronics & Product Design Technology from R.T.M.N.U, Nagpur. She has also done Diploma from the Govt. Polytechnic, Nagpur. She worked as a guest faculty at Centre for Development of Advanced Computing (C-DAC), Pune. Currently, she is a Research Assistant Professor at Institute of Artificial Intelligence at the MITWPU, Pune, India. Her research interests include optimization algorithms, VLSI design, multi-objective optimization, continuous, discrete, and combinatorial optimization, complex systems, manufacturing, and self-organizing systems. Apoorva developed socio-inspired optimization methodologies such as Multi-Cohort Intelligence Algorithm, Expectation Algorithm and LAB Algorithm, and Snail Homing and Mating Search Algorithm. She is the recipient of the best paper award in ICISA 2024, Pune, India. Apoorva has published several research papers in peer reviewed journals, chapters, and conferences along with 1 authored and 4 edited books. She is a regular reviewer of different journals of Elsevier and Springer. She has also served as session chair for few international conferences.

ABSTRACT

Crop yield prediction is a challenging task as it requires high accuracy and efficiency in various aspects spanning from efficient use of resources, and seasonal crop management, to an informed decision-making process. Efficient decision-making for Crop handling in accordance with seasons involves the utilization of various datasets including those related to weather, soil conditions, seed varieties, fertilizer usage, and other dynamic influencing factors. Traditional farming methods may not be suitable for every crop, especially in challenging conditions such as low water availability and soil infertility. This makes it imperative to explore alternative approaches to address these agricultural challenges. Traditional farming gives less yield as it mostly depends on natural resources like soil and water, however technology can help to increase quality of soil by providing precise fertilizer leading to healthy crop condition. Artificial Intelligence (AI) plays crucial role for making smart decision approach to increase the crop yield. AI can enhance soil quality through precise fertilizer application, promoting optimal crop conditions. Additionally, deciding which crops to cultivate involves considering various factors. In addition, the AI based optimization methods, based on multicriteria techniques can be used as a tool for the analysis and simulation of agricultural production plans, as well as for the study of impacts of the various policies in agriculture. The model can achieve the optimum production plan of an agricultural region.


Biotechnology



Prof. Dr. Utpal Bora
Tezpur University, Assam

Professor Utpal Bora received his Ph.D. in 2005 under the guidance of Dr R. C. Boruah at CSIR-NEIST Jorhat. He was a recipient of a JSPS postdoctoral fellowship to work with Professor Hironao Sajiki at Gifu Pharmaceutical University, Gifu, Japan during 2005–07. In 2008, he joined Syngene International Limited, Bangalore as Associate Scientific manager and later moved to the Department of Chemistry, Dibrugarh University, Dibrugarh as Assistant Professor in 2008. In 2013 he joined the Department of Chemical Sciences, Tezpur University, Tezpur, where he is currently working as a Professor. His research interests include catalysis, organic synthesis, and C–H activation. He has published more than 110 research papers in reputed peer reviewed international journals and 10 students completed PhD under his supervision.

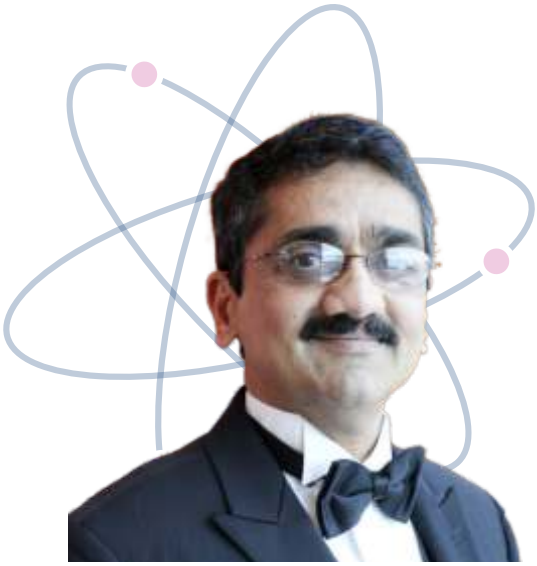
Studies on functionalization of important organic molecules and their potential activity as SGLT2 Inhibitors

ABSTRACT

Halogen bonding triggered by the Lewis basic nature of acetonitrile catalyzes the site-selective C-3 triaryl methylation of indoles and N-triaryl methylation of imidazoles with trityl chlorides under catalyst-, metal, and additive-free conditions at room temperature. UV-Vis and FT-IR analyses indicate the existence of halogen bonding which is the driving force of the reaction. This approach is suitable for a wide range of substrates, furnishing moderate to excellent yields (up to 100%) of triaryl methylated products under ambient reaction conditions. Equimolar amounts of reactants are sufficient to obtain the optimum yield and in some cases pure products can be obtained without column chromatography. Interestingly C3 Benzylated Indole has shown significant activity as SGLT2 inhibitors

Additionally facilitated by the dual role of Ceric Ammonium Nitrate (CAN), we have developed a methodology for the cyanation of aryl iodides/bromides with CAN–DMF as an addition to the existing pool of combined cyanation sources. In addition to being an oxidant, CAN acts as a source of nitrogen in our protocol. The reaction is catalyzed by a readily available Cu(II) salt and the ability of CAN to generate ammonia in the reaction medium is utilized to eliminate the additional requirement of a nitrogen source, ligand, additive or toxic reagents. The mechanistic study suggests an evolution of CN– leading to the synthesis of a variety of aryl nitriles in moderate to good yields. The proposed mechanism is supported by a series of control reactions and labeling experiments.

Controlled Drug Release Medical Devices: Application to Orthopaedics



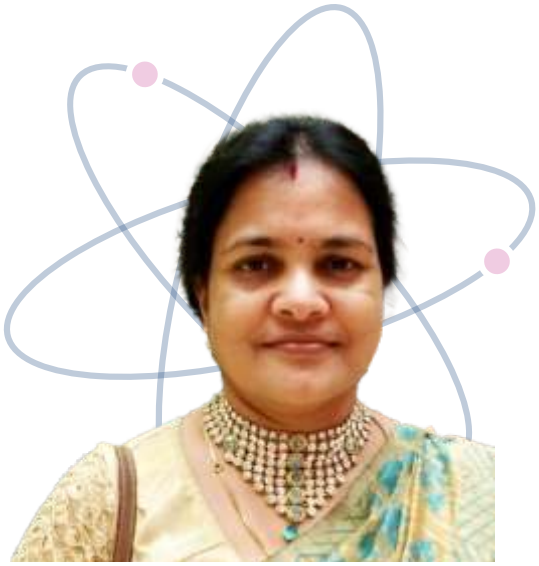
Prof. Dr. Ashok C. Khandkar
University of Utah, USA
CEO, Elute, USA

Dr Ashok Khandkar, is the CEO and board member of Elute, Inc., a clinical-stage medical device company developing and commercializing patented controlled drug release technologies. Prior to that Dr Khandkar founded BloXR, that redefined radia-on protec-on solu-ons to the healthcare markets, and was the founding CEO of Amedica, where he pioneered the development of silicon nitride for a broad range of spine and total joint implants. Prior to that he served as VP of Technology of Ceramatec, where he ini-ated its fuel cell technology, and also served as CTO of SOFCo, a joint venture with McDermoW Inc which pioneered planar solid oxide fuel cell technology. Dr. Khandkar is an inventor 79 U.S. and interna-onal patents. In January 2010, he won the Utah Governor's Science & Technology Medal for successfully pioneering a new class of biomaterials for orthopedics and growing a venture-backed high-tech industry. He won the HAP Paul Award of the Interna-onal Society for Technology in Arthroplasty in 2007 for silicon nitride hip implants. He is an avid mountaineer, and an Adjunct Professor in the Materials Science and Eng. Dept. of the University of Utah. Dr. Khandkar earned his Ph.D. in Materials Science from Arizona State University in 1985.

ABSTRACT

Bone grafts subs-tutes have mul-ple applica-ons in orthopaedic surgeries. However, despite their widespread use, they are contraindicated in for use in trea-ng deep bone infec-ons. Infec-ons are a serious complica-on of bone injury due to pathology or trauma-c injury, with poor bone healing, adverse outcomes, with pa-ents facing mul-ple surgeries, pain and amputa-on. Currently, bone grafts subs-tutes are only used in noninfected cases to which an-bio-cs are added, in the hope of preven-ng future infec-ons. An-bio-cs mixed with in this manner exhibit a burst release in the first few hours, and do not provide sustained levels to treat adherent senescent bacterial colonies and, therefore, are not recommended for infected cases. What is needed is a device that provides sustained an-microbial protec-on to prevent biofilm forma-on, which ul-mately resorbs and is replaced by new bone.

EP Granules with Tobramycin, is a novel patented bone gra) designed to fulfil the unmet need for successful bone regrowth when infec-on is present. To develop this unique device, an osteoconduc-ve biomaterial was combined with biodegradable polymers, and engineered to form a porous granulated ceramic-polymer matrix composite with unprecedented 8 weeks of release. Clinical data has demonstrated its effec-veness in surgical treatment of implant related infec-ons.



Prof. Dr. Anima Nanda

Sathyabama Institute of Science and Technology, Chennai

Dr. Anima Nanda held key leadership roles in academic institutions and has significantly contributed to the advancement of science and technology in India.

Her world-class scientific research primarily focuses on drug-resistant microorganisms and their impact on human health through the application of green nanotechnology offering sustainable solutions to environmental and biomedical challenges. Her contribution on standardizing the synthesis of metal nanoparticles using environment friendly nitrate-reducing microorganisms and evaluating their bioactivity against a range of AMR pathogens alongside their extended biomedical applications.

Her contribution to an innovative research project on the development of an automated staircase climbing heuristic wheelchair with posture stability and anxiety control is a groundbreaking endeavour aims to revolutionize mobility assistance for individuals with disabilities by addressing several critical challenges prevalent in existing wheelchair designs. She is addressing the crucial aspect of the user comfort, particularly focusing on anxiety control and posture stability by wearable sensors monitor for analysing stress levels and heart rate variability, providing real-time feedback and ensuring a more relaxed and secure experience for the users. She has been honored as Fellow of Natural Resources and Conservation (FNRS), Fellow of Applied Biotechnology (FAB), and Fellow of Indian Aerobiological Society (FIAS), International Research Fellow (Thailand).

She is a Member-Coordinator and Assessor for the NAAC, MHRD, Government of India, Bangalore, Assessor for the National Accreditation Board for Testing and Calibration Laboratories (NABL) in accordance with ISO/IEC-17025 and also Editor in reputable journals including Frontier Microbiology and Chemotherapeutics, and PLOS ONE.

Harnessing Green Nanotechnology to Combat Antimicrobial Resistance for a Viksit Bharat 2047

ABSTRACT

Antimicrobial resistance (AMR) is a major public health concern that poses serious risks to health, agriculture, and economic growth as India strives to become a developed nation by 2047. However, Nanotechnology has revolutionized scientific research, with green nanotechnology offering sustainable solutions to environmental and biomedical challenges. This study explores the synthesis of silver nanoparticles (AgNPs) using the environmentally friendly nitrate-reducing isolate, Bacillus subtilis, and evaluates their bioactivity against a range of bacterial pathogens alongside their extended biomedical applications.

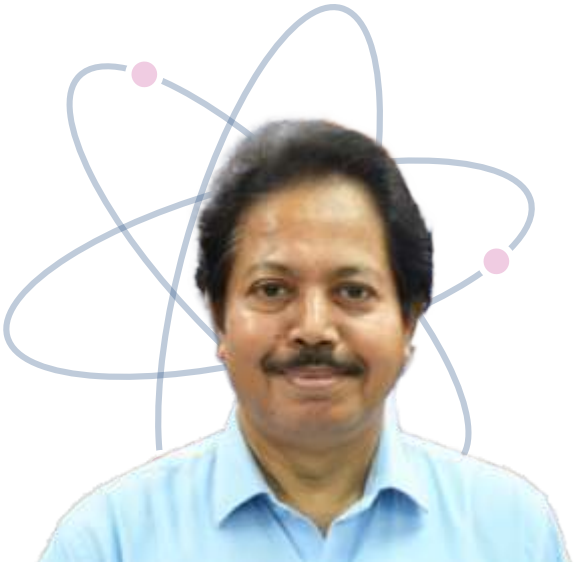
The synthesis process was optimized by varying pH, temperature, concentration, and time, with spectroscopic and microscopic analyses used for characterization. Antibacterial efficacy was assessed through FESEM and AFM, revealing significant membrane damage in Gram-negative bacteria and increased surface roughness. The synergistic potential of AgNPs with antibiotics was demonstrated through UV-Vis spectrum analysis and diffraction patterns, showing a 37.8% increase in efficacy.

Cytotoxicity studies on Hep G2 cells indicated apoptotic cell death with DNA fragmentation, validated by upregulated p53 expression, suggesting a mitochondrial-dependent apoptotic pathway. The synthesized AgNPs exhibited a characteristic SPR at max 420nm, with further studies revealing a face-centered cubic symmetry, spherical shape with a 22.98 nm diameter, and a surface charge of –32.3 mV.

Despite these promising results, challenges such as optimizing pharmacokinetic and pharmacogenetic properties, as well as ensuring safety through in vivo toxicity testing, remain. Strategies to address these challenges include advancing green synthesis methods, enhancing the synergistic potential of AgNPs with antibiotics, and conducting comprehensive safety evaluations.

By addressing these challenges and leveraging the potential of green nanotechnology, India can develop innovative solutions to combat antimicrobial resistance, contributing to a Viksit Bharat by 2047.

Nanobiotechnology: Bridging the Gap between Biology and Nanoscience



Prof. Dr. Absar Ahmad
Aligarh Muslim University

ABSTRACT

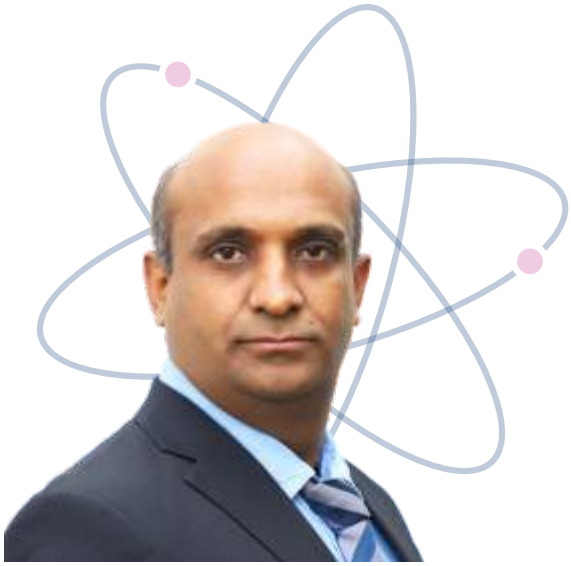
In recent years, the synthesis of nanoparticles through biological routes has been gaining immense popularity, offering an innovative solution to the limitations and challenges associated with conventional chemical and physical synthesis methods. At the forefront of this emerging field, our research team is pioneering the use of biosynthesis, with a particular emphasis on harnessing the unique capabilities of plants and plant microorganisms. This groundbreaking approach offers a myriad of advantages, including enhanced stability, water dispersal, fluorescence, and natural protein capping, qualities that are challenging to attain through traditional chemical and physical synthesis methods. Moreover, biosynthesis is inherently sustainable and environmentally friendly, making it a promising option for applications in various fields, including agriculture.

Our research has primarily focused on the utilization of fungi and actinomycetes, plant microorganisms, for the biosynthesis of biocompatible, water-soluble, fluorescent, and protein- capped nanoparticles. One notable aspect of our research is the symbiotic connection between fungi and plants. The discovery holds significant promise for the agricultural sector, offering innovative applications for improved crop management, disease detection, and soil health assessment. Furthermore, our recent endeavours in extracting anti-cancerous drugs from endophytic fungi and their immobilization on nanosystems for drug delivery and targeted drug delivery applications are poised to make a substantial impact on the field of nanomedicine.

In conclusion, our research into the biosynthesis of nanoparticles, especially those that are challenging to synthesize using traditional physicochemical methods, is dedicated to developing sustainable and environmentally friendly approaches for nanoparticle production for a wide range of applications in agriculture, including precision farming, crop protection, and soil health assessment.

Prof. Absar Ahmad has made pioneering and key contributions to the fields of bio-nano-science and technology which have received high international acclaim amongst peers. Most notably, his entire volume of work has been developed and done in India. His work is noteworthy for its content of innovation and discovery based on imagination, keen observation and application. It has an underlying theme of imaginative implementation of environmentally friendly, green chemistry, room temperature biological and bioinspired methods to emerging areas of modern science with multidisciplinary applicability. In particular, his works on bioinspired synthesis of metal, semiconductor and oxide nanosystems using fungal and plant extract media and related studies on elucidation and control of the biomolecular processes and mechanisms are highly cited. His recent works on anti-cancerous drug extraction from endophytic fungi, and their immobilization on nanosystems for drug delivery applications are expected to have significant impact on emerging field of nanomedicine. He has co-authored many papers in high impact journals and has obtained a number of national and international patents. After 7 years at CSIR-Central Institute of Medicinal and Aromatic Plants (CSIR-CIMAP), Lucknow, and 23 years of service at the CSIR-National Chemical Laboratory (CSIR-NCL), Pune, he was a Senior Principal Scientist at the Biochemical Sciences Division when he was offered the post of Professor and Director at the newly created Interdisciplinary Nanotechnology Centre (INC), at Aligarh Muslim University (AMU).

Prof. Absar has been conferred with several prestigious awards which include the DBT-Tata Innovation fellowship, Govt. of India, VASVIK Industrial Award, Materials Research Society of India (MRSI) Medal, CSIR-National Chemical Laboratory: Scientist of the Year, recipient of "Ross Life Science Innovation Award etc.



Prof. Dr. Rajesh S. Bhosale

Dean, Research & Development
Ganpat University, Mehsana

Dr. Rajesh Bhosale as a Professor & Dean (R&D) at Ganpat University, Mehsana, Gujarat, India (since September 2023). Previously he was Associate Professor (HoD) in the Department of Chemistry, School of Science at Indrashil University, Rajpur, Mehsana, Gujarat, India (2018-2023). Before this he was Scientist Pool Officer (2015-2018) & RMIT-Research Associate (2013-2014) at CSIR-IICT, Hyderabad, India. He done Postdoctoral study at Freiburg Institute for Advanced Studies (FRIAS), Freiburg, Germany (2011–2012) and SNSF-Postdoctoral Fellow at Massachusetts Institute of Technology (MIT), Cambridge, USA (2010). He received a Ph.D. degree in Chemistry under the supervision of Prof. Stefan Matile from the University of Geneva, Switzerland (2005–2009) & master in chemistry from SRTM University, Nanded, India (2002).

He has over 15 years of experience in organic chemistry, supramolecular chemistry, chemo-biosensors & organic electronics. His current research is focused on the development of novel AIE active organic molecules for biological applications and self-assembly.

He is recipient of over 100 international refereed journal papers, 6 book chapters and 3 edited books with over 2500 life citations. He has credential of five Indian patents.

He is an elected Fellow of Maharashtra Academy of Sciences.

Towards the Development of Novel AIE Active Organic Fluorescent Materials: Bio-imaging & Self-assembly Evaluation

ABSTRACT

The discovery of novel Aggregation-Induced Emission (AIE) active organic fluorescent materials has enormous potential for bio-imaging and self-assembly applications. These materials, developed with precise molecular design, synthesis, and assessment, have the potential to transform diagnostic imaging and pave the way for advanced materials research. AIE refers to the phenomena in which certain chemicals that are non-emissive in their molecularly dissolved state become extremely emissive when aggregated. This feature has sparked great attention in a variety of domains, including bioimaging and materials research. Tetraphenylethene (TPE) and hexaphenylsilole (HPS) are two key AIE scaffolds mostly used to transform planar aromatic molecules such as naphthalene, anthracene, phenanthrene, fluoranthene, fluorine, pyrene, perylene, carbazole, triphenylamine, fluorescein, phenothiazine, cyanine, diketopyrrolopyrrole, perylene diimide, naphthalene diimide, and porphyrins into AIE active functional molecules. Functionalized TPE, Naphthalene Diimide (NDI), and cyano functionalized Oligo Phenylene Vinylene (OPV) are molecular systems that demonstrate good AIE capabilities with variable water content and have been successfully used in cellular bio-imaging applications. Scanning Electron Microscopy (SEM) and optical microscopy show that AIE active molecules aggregate to form self-assembled nanostructures. These materials frequently resist photobleaching, making them ideal for long-term photography. The creation of stimuli-responsive smart AIEgens that combine therapeutic and diagnostic capabilities for real-time monitoring of biological processes is a significant challenge.

Biosynthetic Pathways Alphonso Mango Fruit Flavor Molecules

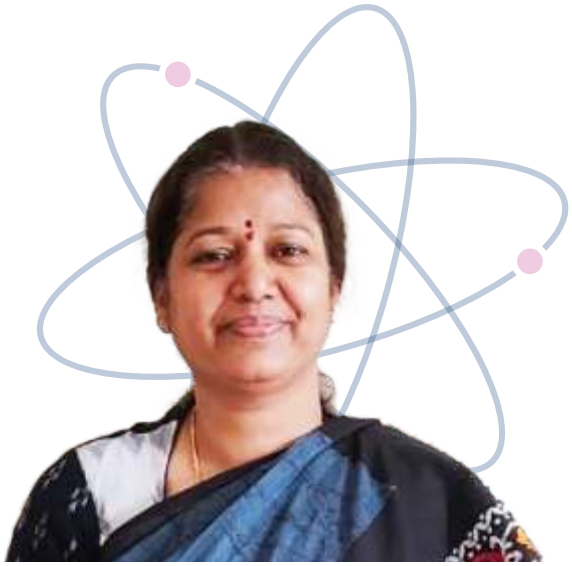
Dr. Ashok P. Giri

National Chemical Laboratory
Pune

ABSTRACT

Mango (Mangifera indica L.) is one of the oldest cultivated tropical fruits. It is popularly known as 'The King of Fruits'. India is the largest mango producer, contributes >30% of total global production and exhibits a large number of cultivars. Each mango cultivar displays a characteristic combination of properties. Analysis of the selected mango cultivars revealed several metabolites in the ripened fruits. Within these cultivars, Alphonso attracts national and international market due to its distinct flavour, attractive colour, low fibre pulp and long shelf life. Alphonso cultivation is concentrated in a 700 km long, narrow coastal belt of western India (Konkan). However, Alphonso fruits exhibit geographic variation in the flavour within Konkan. Our finding on ripe fruit analysis from these localities suggests that Deogad (Ratnagiri) fruits had lower content of terpens and higher content of lactones and furanones compared to other locations. This metabolite profiling of Alphonso mango fruits helped farmers to successfully obtained Geographical Indication. Further, we have characterized and patented several genes involved in biosynthesis these metabolites from Alphonso. At present, we are engineering pathways of important metabolites in heterologous systems. These advancements, challenges and developments will be also discussed in the presentations.

Dr. Ashok Giri coming from a peasant family from Maharashtra, is currently working as a Chief Scientist in the CSIR-National Chemical Laboratory, Pune. His group published 200 research articles/reviews (>10,700 citations, h-index 52 and i-10 index 150), 8-patents granted and filed 7-patents. His major research interest areas include plant-insect/pest interactions, agricultural biotechnology, plant specialized metabolite analysis and metabolic pathway engineering. Till date he has produced 28-Ph. D. graduates and hosted 21-postdoctoral fellows, over 50 project assistants and 75 MSc and MTech students during the last 22-years at CSIR-NCL. He is an elected fellow of the National Academy of Sciences India (2018) and Maharashtra Academy of Sciences (2013). He is a recipient of few prestigious awards, including the Alexander von Humboldt fellowship (2005 to 2007; 2009 and 2015) at Max Planck Institute for Chemical Ecology, Jena and Germany and Technical University, Munich, Germany; JH Weston Visiting Professor (2022 to 2023) at Weizmann Institute of Science, Israel; Raman Research Fellow (2011), India at Weizmann Institute of Science, Israel; Borlaug Fellow (2009) United States Department of Agriculture, USA at University of Nebraska, Lincoln; Scientist of the Year, NCL Research Foundation (2007), India; Max Planck Society Postdoctoral Fellow and Partner group program, Germany (2005 and 2006); Career Development Program (1999 to 2001 and 2003), The McKnight Foundation, USA at Washington State University, Pullman and received fellowship of International Agricultural Co-operation (2001), The Netherlands to work at Plant Research International, Wageningen. His high impact publications include journals like Science, Nature Communication, Nature Plants, The Plant Cell, New Phytologists, Plant Physiology, The Plant Journal, Plant Biotechnology Journal, Plant Molecular Biology, Planta, BMC Plant Biology, Phytochemistry, Food Chemistry, etc.



Dr. C.H. Janaki
C-DAC Bengaluru

India is a country with about 27% of its population being youth, including young adults. Promoting the mental wellness of young Indians is crucial, as it forms the cornerstone for the productivity of a growing nation. A digital solution featuring scientific and evidence-based mental wellness content tailored to the Indian context is one of the viable solutions for preventing mental illness in youth and for early interventions. Keeping this in view, MANAS (Mental Health and Normalcy Augmentation System), a secure and scalable digital platform for mental wellness, is initiated and funded by O/o PSA, Govt. of India, and is implemented by C-DAC Bangalore in collaboration with NIMHANS Bangalore and AFMC Pune. One of the key challenges is the proliferation of such mental wellness digital solution. To address this, it is essential to build an ecosystem bringing together government agencies, educational institutions, psychiatrists/psychologists, NGOs, health centres, parents and all other relevant stakeholders.

Digital Solutions for Mental Health

ABSTRACT

Dr. Janaki is currently serving as Scientist "F" at C-DAC Bangalore. She has more than 23 years working experience at C-DAC and her expertise is in Bioinformatics, Machine learning & data analytics in life sciences and healthcare domains, HPC & Grid Computing. She completed her PhD in Computational Biology from Indian Institute of Science, Bangalore in the year 2020. Currently she is heading projects related to Machine learning & AI in life sciences, Mental health, Indian Heritage & Language computing at C-DAC Bangalore. She published many papers in peer-reviewed journals and conferences.

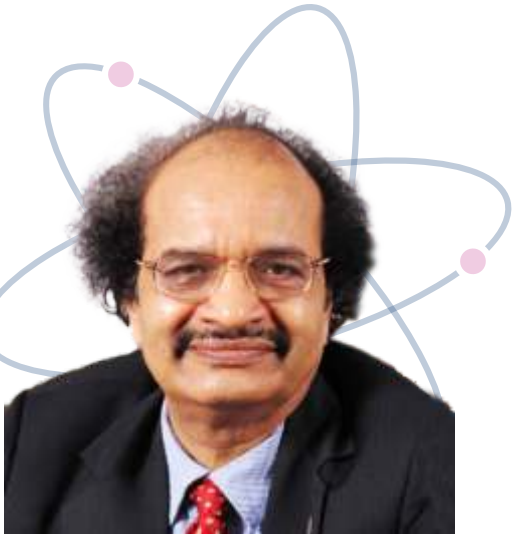
Innovations:

- A scalable and digital platform for Mental Health (MANAS)
- A machine learning based platform for Drug target identification for Anti-epileptic drugs (TREADS)
- Multi-Agentic systems for mental healthcare services
- Data science framework for ATM Fraud Analytics

Breakthrough research:

- Release of a national mental health platform, Mental Health and Normalcy Augmentation System (MANAS) app (Android and ioS), to Jharkhand and Maharashtra University of Health Sciences (MUHS)


Climate Change



Padma Shri
Prof. Dr. Ganapati D. Yadav
Former Vice-Chancellor
ICT Mumbai

One of the topmost, highly prolific, and accomplished engineering-scientists in India. He is the National Science Chair of Govt. of India and is Emeritus Professor of Eminence and is the former Vice Chancellor of the Institute of Chemical Technology, Mumbai. He is internationally recognized by over 150 prestigious and rare awards as an academician, researcher and innovator, including his seminal contributions to education, research and innovation in Green Chemistry and Engineering, Catalysis, Chemical Engineering, Energy Engineering, Biotechnology, Nanotechnology, and Development of Clean and Green Technologies. He serves as the Adjunct Professor at University of Saskatchewan, Canada; Conjoint Professor, University of New Castle, Australia. He was conferred Padma Shri by the President of India in 2016.

He supervised 111 Doctoral and 147 master's Theses, which is the first record for any Engineering Professor in India. Besides, he has supervised 48 post-doctoral fellows, several summer fellows and research staff. His productivity is phenomenal: 551 original research papers, 127 granted national and PCT patents, 8 new patent applications; written 3 books; h-index of 70, i10 index of 357; 18,500+ citations, and given over 970 invited lectures/orations/seminars.

He was elected The US National Academy of Engineering and as a Fellow of the US National Academy of Inventors. He is a fellow of INSA, NASI, IASc and INAE. He received the SASTRA C.N.R. Rao award for excellence in research innovation in Chemistry and Materials Science in 2024. He received the Advantage India Chemical Conclave Awards for the year 2024: Award for Topmost and Best Contributor and Influencer in Academic Research and Industry in 2024. He was declared among the top 100 scientists in 2023 Asia by Asian Scientist in Singapore. During 2023.

Sustainability & Net Negative Paradigm: Hydrogen as the Saviour of the World in Energy & Materials Sectors

ABSTRACT

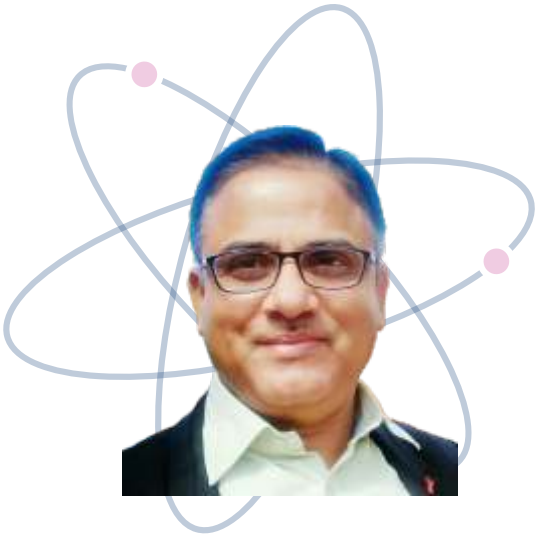
Achieving net zero emissions by 2050 is a crucial global objective. Renewable energy is expected to provide 73% of the required 49,000 TWh, with hydrogen contributing 24%. Solar, wind, and hydrogen form the new scientific trinity for energy production. Leading economies should prioritize green hydrogen production to meet the Paris Agreement's goals. Hydrogen is versatile, converting biomass and CO_2 into fuels and chemicals, aiding in a carbon-negative future alongside solar, wind, and other renewables. Biomass hydrogenation produces valuable products, turning refineries into CO_2 converters, yielding hydrocarbons, methanol, DME, formic acid, alcohols, syngas, electricity, hydrogen, fuel cells, ammonia, and fertilizers. DME is a promising diesel and LPG alternative, utilizing existing infrastructure, contributing to a carbon-negative economy and reducing global temperatures below 1.5 °C.

The current crude oil-based economy is unsustainable. Balancing socioeconomic development with environmental impact necessitates converting biomass into biofuels or a broad range of products. Using carbon for fuel is ineffective for achieving environmental targets. Hydrogen is crucial for converting waste biomass and CO_2 into fuels and chemicals, enhancing the efficiency of oil refineries. Additionally, rethinking single-use plastic policies by implementing deposit-return schemes can aid in source segregation and recycling. Hydrogenation can depolymerize plastics, transforming them into fuels and chemicals while neutralizing harmful elements like chlorine, sulfur, and nitrogen.

ICT-OEC Cu-Cl thermochemical process for hydrogen production is one of the promising technologies which has been patented and being run on pilot scale. We have also developed patented processes for carbon dioxide valorization into methanol, DME, methane and higher hydrocarbons, and plastic waste into monomers and hydrocarbons. There is a tremendous scope for green ammonia, green fertilizer, green steel and green refineries using hydrogen.

Both blue and green hydrogen will rule the energy sector.

Sustainability in Concrete Construction by Utilization of Industrial By-Products and Waste Materials



Prof. Dr. Rafat Siddique

Thapar Institute of Engineering and Technology
Patiala

ABSTRACT

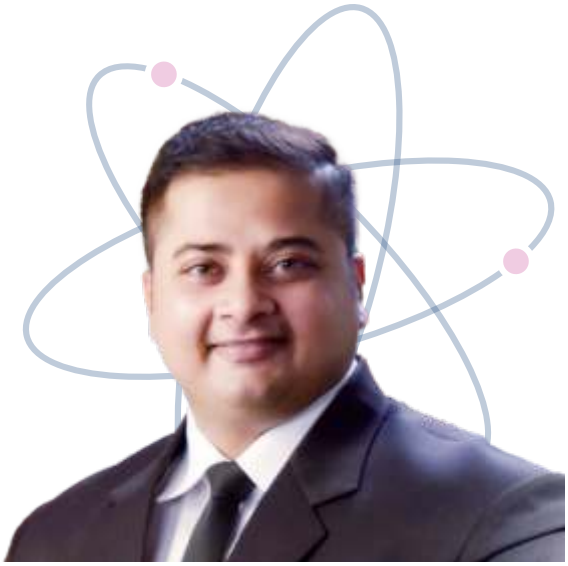
There are several ways to achieve sustainability. Millions of tonnes of industrial byproducts and waste materials are generated every year from manufacturing processes, service industries and municipal solid wastes. In such a scenario, achieving sustainability to solid waste management has become one of the major environmental concerns globally. With enhanced awareness about environment, scarcity of space for land-filling and due to its ever-increasing cost, waste materials and by-product utilization has become an attractive alternative to disposal. Utilization of such materials has gained significant importance in the development of sustainable concrete materials. There are several types of waste materials/by-products such as fly ash, bottom ash, foundry sand, scrap-tires, cement kiln dust, waste glass, recycled plastic, dredged materials, MSW ash, etc.

Extensive work has been reported on the influence of such materials on the fresh, strength and durability properties of concrete. Use of such materials in concrete not only makes it economical, but also help in reducing disposal and environmental related issues.

Rafat Siddique is Senior Professor of Civil Engineering & Dean at Thapar Institute of Engineering and Technology, Patiala. He obtained Ph.D. from BITS Pilani in 1993, and did 22-months post-doctoral work at University of Wisconsin-Milwaukee, USA. He has held several executive positions at Thapar Institute such as Dean, Research and Development, Dean of Faculty Affairs, and Head of Civil Engineering Department.

He is amongst 0.025% of academics as per Stanford University having total citations of 25000+ having H Index of 85 in the area of sustainable construction materials. He has published 250+ Q-1 Journal articles and 80+ conference papers. He is Editor of Journal of Construction and Building Materials (Elsevier), Journal of Materials in Civil Engineering (ASCE), and European Journal of Environmental and Civil Engineering (Taylor & Francis), and Editorial Board Members of several Q1 Journals. His main research interests are Fiber Reinforced Concrete; High Volume Fly Ash Concrete; Use of Industrial By- Products in Cement-Based Materials; Self-Compacting Concrete; Properties of Concrete at Elevated Temperatures. He has been Visiting Professor to number of universities in USA, France, Germany, Finland, Mexico, UK, Australia, Bangkok, and Malaysia.

He has been sought-after speaker, and been to Australia, Bangkok, Belgium, Botswana, Burkina Faso, Canada, China, Czech Republic, Finland, France, Germany, Hong Kong, Indonesia, Italy, Japan, Malaysia, Mexico, New Zealand, Poland, Portugal, Qatar, Saudi Arabia, Singapore, Spain, Sri Lanka, Switzerland, Turkey, United Kingdom, UAE, USA



Prof. Dr. Ambrish Singh
Nagaland University

Dr. Ambrish Singh is working as Professor in the Department of Chemistry, Nagaland University, Lumami, Nagaland, India. He worked in the School of New Energy and Materials, Southwest Petroleum University, China for 10 years before coming to Nagaland. Dr. Singh is included as a Fellow in the Royal Society of Chemistry (FRSC). His research interests are mainly focused on corrosion, electrochemistry, green chemistry, quantum chemistry, smart coatings, polymers, nano-materials, composites, and petroleum engineering. He got the prestigious Sichuan 1000 Talent Award from the Sichuan government, China for his outstanding research contributions as a faculty. He got the President's Award for exceptional post-doctoral research work. He also received the Young Scientist Award from UPCST, Lucknow, India. He has published more than 170 SCI peer-reviewed research papers in high impact journals. He is the Top 2% Scientist of the World for the last three years consecutively according to the list of Stanford and Elsevier. His research paper citations are over 8900; H-Index of 51 and I10-Index of 133. He is acting as reviewer for more than 45 high impact journals and editor for few journals. Dr. Singh has been invited to present his work in several national and international conferences, webinars, seminars and workshops. He is the author / editor of several book chapters and books. He has drafted fifty patents based on his new and innovative findings awarded with one in China, 2 in South Africa, 1 in India, and published 19 in India. He has finished several state and provincial projects in China and India. He was a consultant to KFUPM, Saudi Arabia for an international project. He is the member of ISCA, NESA, AMPP, CRSI, ITS, SPE and ACS.

Progress in the Field of Corrosion and its Monitoring Techniques

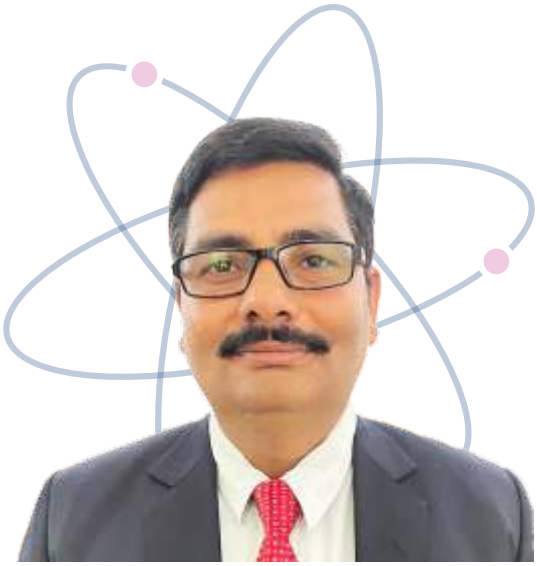
ABSTRACT

Everywhere in the world, corrosion is present in one way or another. It is costing the nations enormous sums of money in repairs, material replacements, and yearly maintenance. Scholars, industry, and research groups worldwide are searching for a solution to this issue. The right answer to the current corrosion issue has not yet been found. As a result, it creates a fresh opportunity to conduct active study in this area and identify a workable solution to prevent financial losses. Corrosion is a hot topic in multidisciplinary research these days.

Corrosion is known by a variety of synonyms, including erosion, deterioration, degradation, and wearing. One option that is readily available, affordable, and simple to utilize is the use of inhibitors. The mechanism of corrosion inhibition, corrosion rate estimation, and corrosion inhibition mechanism elucidation are all made possible by modern technologies. In order to effectively understand the mechanism of corrosion inhibition, the talk will primarily concentrate on the development and testing of corrosion inhibitors using contemporary electrochemical techniques, such as electrochemical frequency modulation (EFM), potentiodynamic polarization (Tafel), and electrochemical impedance spectroscopy (EIS). Using electrochemical frequency modulation, fresh tests were carried out to observe a trend with and without inhibitor in order to investigate further information.

The discussion of localized electrochemical techniques, such as scanning electron microscopy (SEM), scanning kelvin probes (SKP), and scanning vibrating electrodes (SVET), which offer insights into the nature of localized electrochemistry, is essential to a comprehensive understanding of modern technologies. Confirming the inhibitor's mitigating phenomena also requires surface analyses. To support the mechanism of corrosion mitigation, the significance of various techniques, such as contact angle studies, atomic force microscopy (AFM), and scanning electron microscopy (SEM), will be emphasized.

Indigenous Solid-State Batteries: A Step toward India's Self Reliance



Prof. Dr. Yogesh Sharma
IIT Roorkee

ABSTRACT

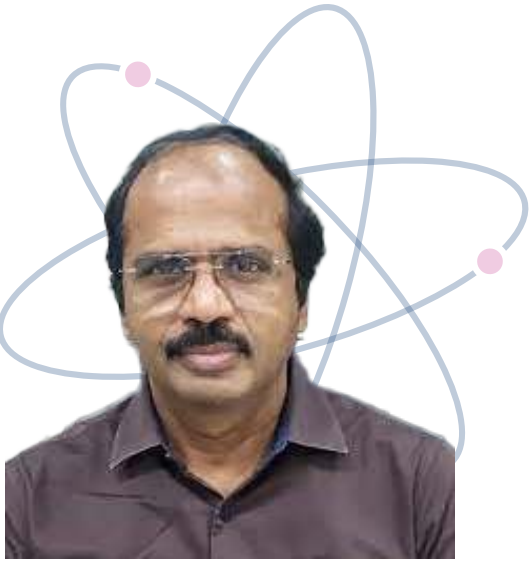
In the global effort to combat air pollution and address climate change, it's inspiring to witness numerous countries making significant progress in transitioning to renewable alternatives. The over-reliance on fossil fuels, coupled with volatile global markets and geopolitical tensions, poses significant challenges. Now, as India transitions toward a sustainable and self-sufficient energy ecosystem, battery technology stands out as a linchpin for achieving energy autonomy, alongside the harnessing of solar energy resources. In this context, India requires for approx. 200 GWh of battery storage capacity over next one decade to bolster the anticipated renewable energy demand. Our vision is to contribute to making India's economic development self-sustained as far as requirements of clean energy are concerned, chiefly due to the imperative nature of aligning economic growth with clean energy sustainability. As a nation on the path to self-reliance, we have been diligently pursuing the development of efficient and sustainable methods for energy conversion, distribution, and storage over the past several years. Also, on a lab scale, we are able to integrate a safe, cost effective technique for more efficient energy storage solution i.e. all-solid-state batteries (ASSBs) using Electrophoretic deposition (EPD) technique. The scalability and cost effectiveness of this technique make it suitable for large scale production of battery electrodes, paving the way to commercial ASSBs. In this context, different solid-state electrolytes (SEs) viz. NZSP, LLZO, LATP etc are being fabricated by cost effective techniques. These SEs integrated with Li/Na as anode and potential cathode using EPD could significantly advance battery technology and hence, energy sector. By intertwining economic affordability with our endeavour towards clean energy.

Prof. Yogesh Sharma is currently a Professor at the Department of Physics and Centre for Sustainable Energy, Indian Institute of Technology (IIT) Roorkee, Roorkee, India. He received the Ph.D. degree from the National University of Singapore, Singapore, in 2010. He is known for his work on conversion-based anode for Li-ion batteries, development of indigenous Na-ion battery technology, binder-free next-generation batteries, and solid-state batteries. He has served as a Visiting Scientist with National Chiao Tung University Hsinchu, Taiwan and a Visiting Professor with the University of Calgary, Calgary, Canada.

He has authored/co-authored about 100 research publications of repute and filled 25 patents (10 granted). Prof. Sharma is involved in the sponsored projects of worth more than 25 crore INR. He is leading a national consortium having 15 institute on board, on Solid State Batteries. He has also guided 12 PhD and 10 Master students, and several undergraduates. He has been serving Member Project Evaluation Committee for various private and Government agencies.

His research interest includes development of Li/Na-ion battery, solid-state electrolytes, fuel cells, flexible supercapacitors/micro-supercapacitors, and modeling & simulation of energy storage devices.

Dr. Sharma is a life member of the Indian Solid-state Ionics Society (ISSIS), Indian Physics Association, Material Research Society Singapore, and Material Research Society, India. He has been recognized as Outstanding Young Faculty of the Year at IIT Roorkee in 2018. He is a winner of National startup award 2022, DRDO's Dare to Dream 3.0 award and many more.



Dr. Tata N. Rao

Director, International Advanced Research Centre for Powder Metallurgy and New Materials, Hyderabad

Dr. Tata Narasinga Rao received his Ph.D. degree in Chemistry from Banaras Hindu University, India in 1994. After working at IIT Madras as Research Associate, he moved to The University of Tokyo in 1996 as a JSPS post-doctoral fellow and subsequently became lecturer in the same University in 2001. He joined International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad, India, in 2003 as senior scientist, and he has superannuated as the Director of ARCI in May 2004. Presently he is Research Advisor at IIT, Hyderabad and Adjunct Professor at IIT-Hyderabad and NIT-Warangal. He is recipient of several awards and honors including 'Material Research Society of India (MRSI) Medal, Tokyo University of Science President Award, Academician of Asia Pacific Academy of Materials (APAM), Technology Day National Award, Bangalore India Nano Innovation Award and Materials Science Annual Prize of MRSI. Dr. Rao has been admitted as Fellow of Royal Society of Chemistry through "Leaders in the Field" scheme in 2023. He has been conferred with Honorary Fellowship of Electrochemical Society of India during August 2023. Dr. Rao is Founder President of Battery Research Society of India. Dr. Rao has published more than 200 research papers and filed/granted more than 20 international and Indian patents. His publications got total citations more than 23,000 (google scholar) with an h-index of 61. He has developed novel, scalable and low cost processes for suspension/powder production of nano-silver, nano-copper and nano-TiO2 for self-cleaning/antibacterial textile applications, high performance Li-ion electrode materials, bio & organic waste-derived activated carbon for supercapacitors, and some of the technologies transferred to industry and commercialized. Recently, Lithium Iron Phosphate (LFP) cathode powder manufacturing technology is transferred to industry for the first time in India, and a pilot facility of 50 Kg/day production is established on ARCI campus.

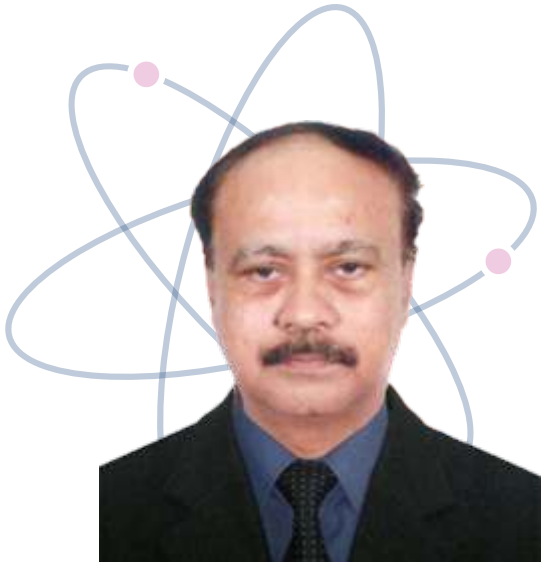
Translational Materials Research in Energy Storage Technologies

ABSTRACT

The necessity of batteries is increasing due to the target set by the Government of India that 30% of the vehicles produced in India should be electric vehicles by 2030. Li-ion batteries are the key storage systems used in EVs due to their capability of storing high energy density and fast charging and discharging characteristics. While the demand is huge, India is totally dependent on imports of these Li-ion batteries. While government is encouraging establishment of Li-ion battery plants, the battery production in India is yet to pick-up. This is largely due to lack of indigenous technologies, which are essential to make the final batteries are cheaper or on par with the imported batteries. Material cost in a Li ion battery is ~ 60% of the overall cost of the Li-ion battery. While it difficult to compete in equipment manufacturing immediately, indigenous production of materials is essential and possible to reduce the import dependence of li-ion batteries. Alternatively, it is need of the hour to look into non-lithium based storage technologies (e.g., Na-ion batteries and supercapacitors) which are already being commercialized globally.

In line with the above requirement and the 'Atmanirbhar Bharat Abhiyan' or 'Self-Reliant India Mission', my team at ARCI had developed indigenous technologies for the production of two key battery grade electrode materials, Lithium Iron Phosphate (LFP) cathode and Lithium Titanate (LTO) anode powders for LIB. The unique know-how developed by our team involves solid state synthesis of LFP/LTO in a single step and these materials have been validated in coin cell and cylindrical cell configurations and they have shown promising electrochemical properties in terms of high discharge capacity, cyclic stability and excellent rate capability on par with the performances of commercial materials. Recently, LFP technology is transferred to one of the Indian companies, and the LTO technology is ready for transfer.

Key Materials Technology For sustainable transport applications



Dr. R. Gopalan

International Advanced Research Centre for Powder Metallurgy and New Materials, Chennai

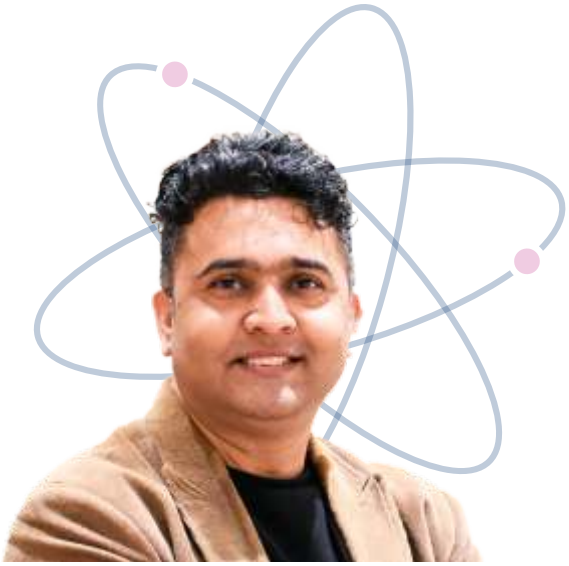
ABSTRACT

Electric Vehicles (EVs) / Hybrid Electric Vehicles (HEVS) are emerging as promising technological solution for energy saving in transportation sectors. In this context, energy materials significantly draw the attention for the design of these vehicles. Among the energy materials, Li-ion battery and motors based on rare earth permanent magnets are the critical components of the system to realize EV / HEV technology. Lithium-ion battery has emerged as a promising candidate due to its attractive features viz high energy density (both volumetric and gravimetric), high current drain, high cycle life, low self-discharge, absence of memory effect, good low temperature performance.

Keeping in view of the rapid growth of the automotive / EV industries in India and the need for the development of the material technology for sustainable transportation, ARCI, has set up the state –of-the art Lithium-ion cells fabrication at the pilot plant scale for EV application. The novelty in the whole approach of the work lies on establishing the Li-ion battery line for EVs and deriving the Materials technology indigenously and test trails with Industry for technology transfer. The other crucial requirement for EVs is the Motor Technology requiring rare earth based Nd-Fe-B magnets and also a cost effective newer soft magnet. The urgent issue facing neodymium magnets, for which demand has increased dramatically, is resource risk. In particular, the resource problem concerning dysprosium (Dy) in Nd-based magnet is a serious concern.

Dr R Gopalan is presently INAE Chair Professor and Adjunct Professor at Indian Institute of Science Bangalore. Prior to this he spent as Regional Director at ARCI, (under DST) for nearly 12 years and established Project Centres of ARCI at IIT Madras Research Park, Chennai for Alternative Energy Materials and Systems. He also spent as Visiting Professor at Indian Institute of Technology(Madras), Chennai & PSG college of Technology, Coimbatore. He obtained his Ph.D in Physics from IIT(Madras), Chennai. In 1985 he joined as Scientist, at Defence Metallurgical Research Laboratory (DMRL,), Hyderabad and worked on various levels for National Mission (DRDO & ISRO) Projects for nearly 22 years. He had a Research stay for 5 years as Visiting Scientist at National Institute for Materials Science (NIMS), Japan.

He has co-ordinated major programmes at ARCI on Materials Technology and components in a Public-Private Partnership (PPP) mode. His dynamic approach in setting up the state-of the art facilities under mission mode has led to a Mega Project from DST on establishing a Technical Research Centre on Alternative Energy Materials & Systems He has published nearly 200 papers and has 14 patents to his professional credit. He is elected fellow of, Indian National Academy of Engineering (INAE), Indian Institute of Metals. Electron microscopy society of India, Telangana Academy of Sciences, Chennai Academy of Sciences, Indian Society for Analytical Scientists. He is honored with several awards and a few of them are :Life Time Achievement Award from Indian Rare earth Association of India, Best Metallurgist of the year award from Ministry of Steel, Govt. of India , Materials Research Society of India Medal Award, Best Ph.D thesis award in Physics at IIT Madras, National Science Day Medal Award at DMRL (DRDO) , Prestigious VASVIK Industrial award , National Award for Project Excellence on Setting up Li-ion Battery Manufacturing Plant at ARCI



Mr. Amol Chaphekar
StrataEnviro Pvt Ltd, Pune

Mr. Amol Chaphekar was an extensive traveller till 2006 and has worked in more than 10 countries on challenging assignments for Government and Fortune 500 Companies. He has been recognised as a Fellow of Royal Academy of Engineering, London in year 2017 and awarded as one of the Top Ten Innovators of India in Year 2012 – by Lenovo and NASSCOM Social Innovation Award -2018. He is Managing Director of StrataEnviro Pvt Ltd Which Manufactures & Installs Outdoor Air Pollution Controllers in India & Abroad with a Unique Revenue Model.He also heads AC Ventures an organisation which is helping businesses to expand operations through the trusted business associations across the globe with his Investments in 9 Portfolio companies from different domains.He has been socially active doing social good projects, a Past President of Rotary Club of Aurangabad Metro & Youngest President to Receive Best Project Award in Year 2009-10 from Rotary International and a Paul Harris Fellow.

By Education he is a Production Engineer and has also completed his Masters in CAD from IndoGerman Tool Room. He was also a part and Invitee at Residential Program of IIM Ahmedabad Program for Business Entrepreneurs as Power of Ideas Program Winner. Present research work includes technology for converting vehicles as air purifiers to address the issue of Road Dust and Road Silt Level and also technology to convert building facades to filter outdoor air pollution levels to cause a greater impact by use of vehicle and building. Some of the related Innovation are "Anticlogging Filters", "Self-Cleaning Filters", "Alternate Power System", "Proximity Alarm Systems for Vehicles" , "Non-Contact Wipers" Plus 12 More Innovations in Food, Recycling and Industrial Automation.

Breakthrough research from you/your group : "Anticlogging Filters", "Self-Cleaning Filters", Water Less Scrubbing for at Source Emission.

Mitigation Initiatives & Measures to Curb Rising Outdoor Air Pollution Level

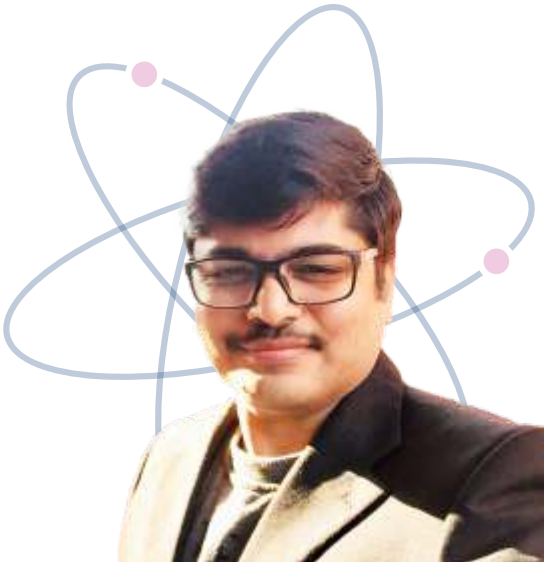
ABSTRACT

Mr. Amol Chaphekar Initiated Effort to work in the domain to address and curb rising outdoor Air Pollution Levels. In year 2016 Air Pollution as a problem was not considered a big threat but gradually over the last few years people have realized the impact outdoor air pollution is causing on Health, Business and Economy. Back in 2016 work started with Identification of High Pollution Hotspots in Urban Context followed by Installation of Outdoor Air Purifiers as a start which showed good results in defined hotspots. Here the challenge was cleaning of the Filters and Regular Maintenance of Units. As a Part of Internal Development the Filters and Filtration system was modified to be "Anti Clogging" and "Self-Cleaning". This reduced the recuring maintenance and upkeep cost drastically and also on the other side as conventional filters were adding up to land fills and causing land pollution the new filtration system stopped this completely. Later during the patch of pandemic, it was identified that only particulate matter or gases where not pollutants in Air but Viruses and Pathogens also largely contributed and the filtration system was further modified to address these pollutants.

Another Breakthru achieved was use water which was predominantly used in at-source type of scrubbing systems which had involvement of ETP Plants and Water is again becoming a scares resource. A waterless – ZLD – Zero Liquid Discharge Units where designed and installed. The Present work includes Standalone Units for Hotspots, At Source Unit Deployed at Crematoriums and Smoke Chimneys, Vehicle Mounted and Integrated Units, Building Panels to Curb Outdoor Air Pollution and more.

Future challenges in this area are that Air Pollution cannot by Dealt in Individually and is interrelates with Land and Water Pollution and hence a joint interdisciplinary effort is required.

Does ferroelectric polarization play meaningful role in electrocatalytic oxygen evolution reaction?



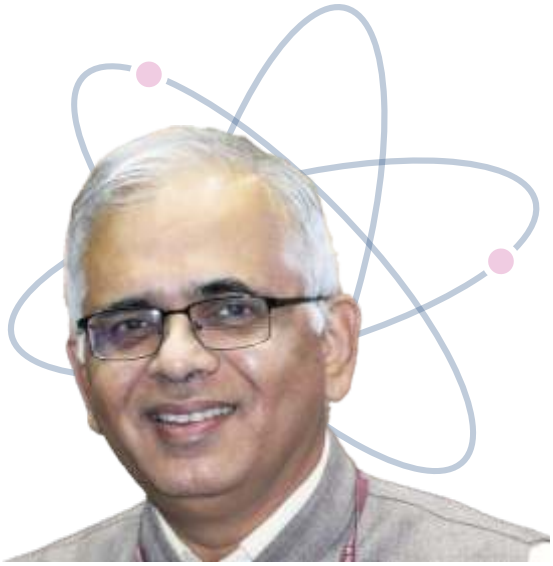
Dr. Pankaj Poddar
National Chemical Laboratory
Pune

ABSTRACT

Thickness-dependent ferroelectric polarization in 2D nanosheets can accelerate the oxygen evolution reaction (OER). The tailored active surface area of exposed crystalline facets improves the electrocatalytic activity. I will also show that in the iron-substituted BiOCl nanosheets of varying thickness the substituted iron enhances ferroelectric polarization and electrochemical active sites on the surface. Our findings show that the exposed (001) facets and higher thickness of the nanosheets have higher ferroelectric polarization and, in turn, superior electrocatalytic activity and remarkable stability, requiring low overpotentials. As the thickness of the nanosheets is decreased from 140 nm to 34 nm, the electrocatalytic performance of iron-substituted BiOCl nanosheets starts to reduce due to the lower Coulomb–Coulomb interaction and the increasing depolarization.

Dr. Pankaj Poddar is currently Senior Principal Scientist and professor at Physical & Materials Chemistry Division, CSIR- National Chemical Laboratory, Pune. Since last 19 years, his group at NCL has worked on basic research as well as industrial projects. His group has helped Indian pharma industry to develop generic medicines for US and European markets and in getting regulatory approvals - mainly injectables, anti-cancer drugs etc. He has also helped Tata Steel, Asian Paints, GE etc. The work in his group resulted in to over 17 PhD theses and over 150 peer reviewed articles and over 200 invited talks and several international and Indian patents. He has also contributed towards the field of electron microscopy, atomic force microscopy techniques for which he was honoured by the Electron Microscopy Society of India as a fellow in 2017. During his initial career at NCL he contributed towards understanding the interaction between hard condensed matter and biological cells (microbial and mammalian) using microscopy techniques for which he was awarded in 2008 the CSIR-young scientist award in physical sciences. Later he contributed towards to advancement in the field of multiferroic oxides, quantum clusters etc. for which he was awarded as the scientist of the year award by 2010 by the National Chemical Laboratory. His overall contributions towards the advancement of the material science (energy materials, phosphors, magnetic materials etc.) was reorganized by the Material Science Society of India (MRSI) by MRSI medal in 2014 and fellow of the Maharashtra Academy of Sciences in 2017.

Technology Adaptation for Sustainable Future in India



Prof. Dr. Shekhar C. Mande

Former DG, CSIR

Distinguished Prof. Bioinformatics Centre SPPU, Pune

Dr. Shekhar C. Mande is a Structural and Computational Biologist. He was the Director General of the Council of Scientific and Industrial Research (CSIR), India, and the Secretary of the Department of Scientific and Industrial Research (DSIR), Ministry of Science and Technology. Prior to this, he was the Director of National Centre for Cell Science, Pune. Currently he chairs the Governing Board of the National Council of Science Museums. He is also the National President of Vijnana Bharati, a large voluntary science movement in India with Swadeshi spirit.

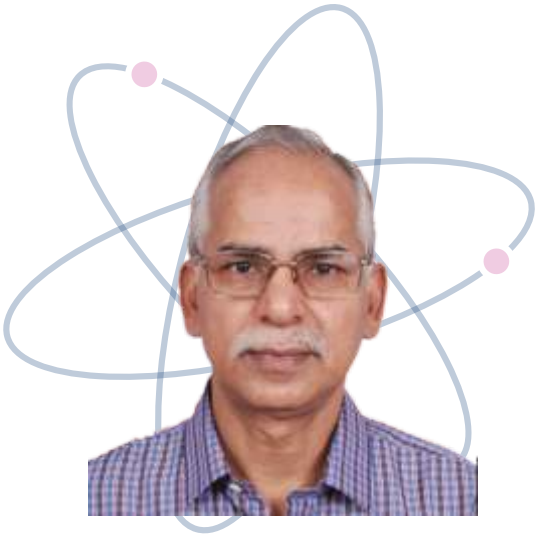
He has made significant contributions using techniques of X-ray crystallography, for structural characterization of Mycobacterium tuberculosis proteins. He has also contributed to Computational analysis of genome-wide protein protein interactions.

- Shanti Swarup Bhatnagar Prize for Science and Technology (2005)
- Fellow, Indian National Science Academy New Delhi, Elected 2010, Fellow
- Fellow, Indian Academy of Sciences, Bangalore, Elected 2003
- Aryabhatta Medal of the Indian National Science Academy, 2021.

ABSTRACT

It is often said that Science (Scientific discoveries) are global in character, but their adaptation for use, shortly technological implementation, are local. If India were to lead the sustainability initiative for the world, many technologies have to adapted for local conditions. These could also pave way for Low and Middle Income Countries for adaptation. Some of the technological implementations might require significant collaborations among different stake holders, which may be facilitated by Governments and Industries alike.

Role of green hydrogen in electricity systems with increasing penetration of renewable power



Dr. Mansa R. Nouni

Adviser (Retd.) Ministry of New and Renewable Energy Sources, Govt of India

ABSTRACT

Climate change, largely caused by increasing use of fossil fuels, is the most daunting challenge faced by humankind today. It is estimated that energy accounts for more than 75% of total greenhouse gas (GHG) emissions globally and nearly 90 per cent of all carbon dioxide emissions.

Along with various countries the need for decarbonizing power sector has been recognized by policy makers in India. Consequently, modern renewable power segment (excluding hydro projects more than 25 MW) in the country has grown nearly 4 times in the last one decade with total power generating capacity increasing from about 35 GW to about 144 GW. With sustained efforts, the share of renewable energy-based power generating systems has reached a level of 33% of the total power generating capacity of 442 GW as on 31 March 2024. However, this segment contributed about 12.6% of total electricity generation during 2023-24 due to lower capacity utilization factors of solar and wind systems.

In modern power systems where renewable energy penetration level is high, renewable energy sources have dispatch priority, and during high generation periods, the demand is largely supplied by them. However, when generation from the renewable energy-based systems falls or halts, the base load plants must be restarted. This poses problems of stability and balancing the grid.

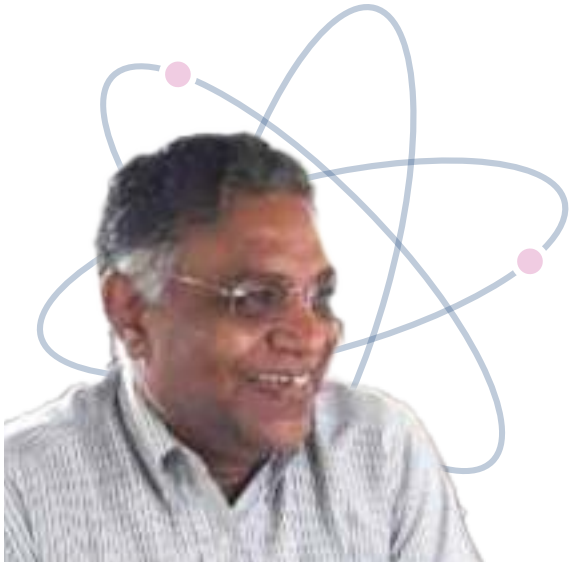
Energy storage technologies such as pumped hydro, compressed air, batteries, and hydrogen energy can be utilized to accommodate fluctuations in renewable generation and energy demand on the grid. Storage can absorb energy during the day of high generation, reduce curtailment, and provide additional operational flexibility through its fast response time.

Green hydrogen is emerging as an important technology in the battle for decarbonization of the energy sector. Producing cost competitive green hydrogen, storing it in large quantities efficiently and delivering it to the users are some challenges associated with green hydrogen. Govt of India has launched National Green Hydrogen Mission (NGHM) to address these issues.

Dr. M R Nouni has been associated with power and renewable energy sectors for nearly four decades. He worked at the Ministry of New and Renewable Energy

(MNRE), Government of India (GoI) in different capacities for about three decades and was involved in policy formulation and implementation of Research, Development and Demonstration programmes of the MNRE. During the last two decades his efforts were mainly focused on activities related to development of hydrogen energy at MNRE and National Institute of Solar Energy, an autonomous institute of MNRE. At MNRE, He was actively involved in preparation of the National Hydrogen Energy Roadmap, 2006 and the Report of the Steering Group on Hydrogen Energy and Fuel Cells in 2016. After his superannuation as Adviser from MNRE in 2016, he worked as a Senior Consultant at NISE for six years and was associated with projects related to hydrogen energy and solar thermal at the Institute. Earlier, he had worked at Bharat Heavy Electricals Ltd in their thermal power business group in 1980s. Presently, he has been working as an independent consultant.

Dr. M R Nouni graduated in Mechanical Engineering from Delhi College of Engineering and acquired his MTech and PhD degrees from IIT Delhi. His research work relating to techno-economics of renewable and hydrogen energy and energy policy has been published in peer reviewed international journals.



Dr. Ilangovan S. A.

Vikram Sarabhai Space Centre
Thiruvananthapuram

Dr. Ilangovan holds a PhD from Indian Institute of Science in the field of Battery, graduated in 1992. Started as a Senior Engineer – Battery at Bharat Electronics (Pune) in 1992 and shortly moved to ISRO in 1993. With his extensive experience, Ilangovan spearheaded several projects and instrumental in Design and Development of Nickel-Hydrogen cells, Lithium-Ion cells, Silicon/Lithium-ion cells Supercapacitors and the recent Supercapattery for space missions. Developed sealed 70 Ah Nickel-hydrogen cylindrical cells powered the spacecrafts for 10 years.

His collaborative efforts resulted in Chemical Systems Modified Cryo insulation system for Liquid Hydrogen and Oxygen tanks New formulations on various Thermal insulation and Protection systems Development of Process engineering – Liquid Propellants (Oxidiser and Fuel) Production and Delivery of solid propellant binder, pyro igniters etc. Medical Oxygen Concentrator and Hand Sanitizer during COVID19

He enhanced the Indigenisation programs on Technology Development and Transfer of Technology to Indian Industries involving Special Polymers, Propellants, Chemical, Energy and high temperature Ceramic Systems, successfully reducing the import content and achieved self-reliance towards sustained delivery of products for space programs. (ISRO-Institute-Industry viewpoint).

Over the years, he assumed various key roles and responsibilities from Section Head to Deputy Director with Outstanding Scientist rank. Dr. Ilangovan is committed to leveraging his experience to contribute to Indian Institutes and Industries continually striving for excellence and innovation in his professional endeavors.

He has been awarded by Astronautical Society of India-Gold Medal, INSAT-4CR Team Award - ISRO and National Energy Efficiency Innovation Award.

Battery Frontiers: Challenges & Sustainability

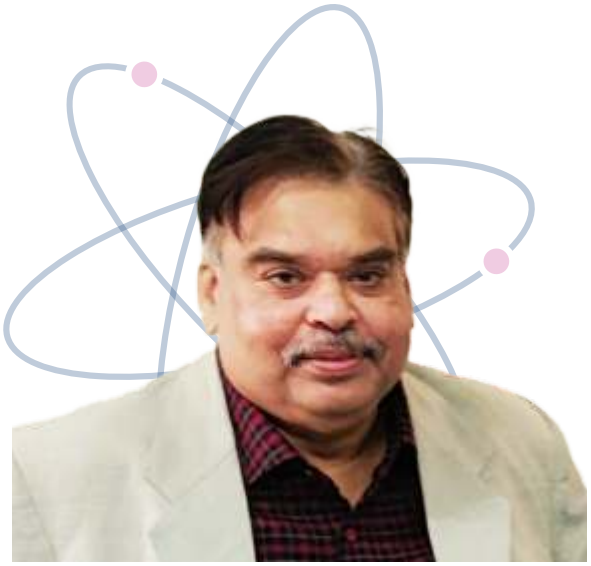
ABSTRACT

Battery based energy storage is pivotal to mitigate the greenhouse gas emissions while nurturing a clean energy landscape. The "battle among several batteries" is a critical technological contest driven by the mounting demand for gadgets, electric mobility, and renewable energy systems. Addressing these challenges requires a multipronged approach to the associated aspects among various energy storage systems viz., performance optimization, cost reduction, safety enhancement mechanisms, and environmental effect.

Ardently, the technological impetus is fundamental to solve the multifaceted challenges to forge the sustainability of battery systems. Through advanced materials science, innovative design and engineering, improved manufacturing processes, and efficient recycling methods, the battery industry can achieve significant upliftment. Advanced battery chemistry is essential to reduce the dependence on scarce and harmful materials. Enhanced recycling techniques and the development of a circular economy for batteries can mitigate waste issues and reclaim the valuable materials. Battery industry can develop robust solutions that meet the growing demand for energy storage while minimizing environmental impact.

The "Battery Frontiers" highlights the need for a holistic approach for the transition to low-carbon future. By countering these challenges, it is possible to align battery technology with the broader goals of sustainability and responsible stewardship of natural resources. Furthermore, a focus on research and development for alternative energy storage solutions, such as solid-state batteries and supercapacitors, could offer more inclusive options.

Impact of Climate change on Renewable Energy Sources



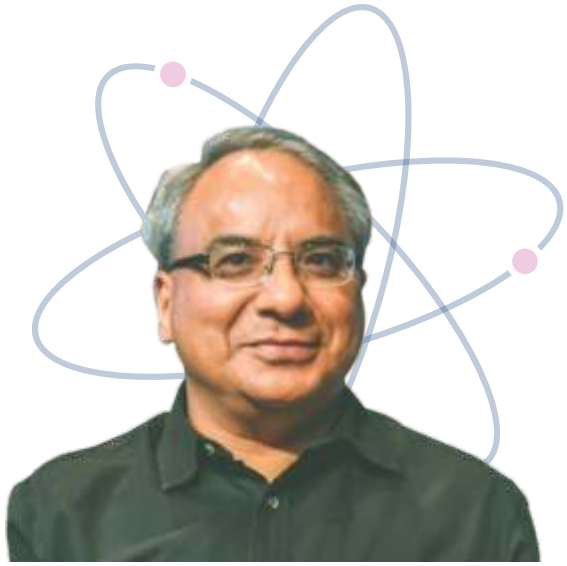
Prof. Dr. Shailendra Kumar Shukla
IIT BHU

ABSTRACT

Outlook towards linking climate change and energy sector are usually centered on mitigation effort because the current fossil fuel based energy generation method is a major contributor to climate change. Developing options of low carbon growth and reducing carbon footprint are important activities towards limiting the degree of future climate change. Energy and water sector are closely and dynamically linked. These consist of four major form-Solar, wind, hydropower and bio-mass. Bio-mass production also gets affected by the quantum of solar energy or sunlight come from the earth. The climate change results from the use of fossil fuel based energy technology, causing the greater damage to the environment and affecting the all three major forms of renewable energy. The climate change which results from global worming or change in the earth environment temperature cause change in different temperatures zone of the earth, therefore, we envisaged a methodology to measure the effect of climate change on wind flow, solar spectrum, and biomass production(crop). For this, we divide the climate into three categories, one is average temperature of the zone (it means temperature of the location closed to average temperature of all the zones), second is lower stream (where average temperature of the location is closed to minimum temperature of all the locations of the zone), third is upper stream (average temperature of the location is closed to the maximum temperature of all the locations of the zone).

Prof. S.K. Shukla is former Pro-Vice Chancellor of Ranchi University and working in the field of Thermal Engineering and Renewable Energy Technology since last 22 years. He is founder Coordinator of Centre for Energy and Resources Development (CERD), IIT(BHU) and Coordinator of CST UP Incubation Centre for Grass-Root Innovators at Mechanical Engineering Department, IIT(BHU), Varanasi.

Recently he has been conferred FRSC, fellow of Royal Society of chemistry, UK. He has been awarded by Japanese Society for Promotion of Sciences, JSPS Fellow Award 2014-15 for Visiting GIFU University, Japan. Also, a recipient of UGC-TEC Consortium Agreement Award 2010 in Sustainable Energy by University Grants Commission, New Delhi, India.



Dr. Dinesh K. Aswal
Bhabha Atomic Research Centre
Mumbai

Dr. Dinesh Kumar Aswal is a senior member of Trombay Council (TC) - the APEX decision making body at Bhabha Atomic Research Center (BARC) - and holds several key positions including Director, Health Safety and Environment Group (HS&EG), BARC. He is a distinguished scientist whose contributions to the field of metrology, thermoelectrics, and gas sensors have significantly advanced the understanding and application of these technologies. He has filed 9 patents and published over 500 journal/conference papers with current H-index of 57 and citations over 12200. He is featured in Stanford University's list of the top 2% scientists in the world. He has vast experience in administration of several national institutes including, Director, National Physical Laboratory (CSIR-NPL), New Delhi; Director, Central Electronics Engineering Research Institute (CEERI, Pilani); Director, Science, Technology and Development Studies (CSIR-NISTADS, New Delhi), Chairman, National Accreditation Board for Testing and Calibration Laboratories (NABL); Secretary, Atomic Energy Education Society (AEES), Mumbai, etc. His academic journey is marked by a profound commitment to research and innovation, as evidenced by his extensive publication record, which includes influential papers on molecular electronics, chemiresistor gas sensors, and thermoelectric power generation. He has contributed to the development of conductive polymers for thermoelectric power generation, addressing key issues in the creation of high figure-of-merit materials and their highly conducting interfaces with metallic interconnects. Dr Aswal had visiting professor/scientist positions at Shizuoka University (Japan), Weizmann Institute of Science (Israel), University of Paris VII (France), Karlsruhe Institute of Technology (Germany), University of South Florida (USA), etc. He is Fellow of International Association of Advanced Materials (FIAAM), Academician, Asia Pacific Academy of Materials (APAM), Singapore etc.

Radiation, nuclear energy and environment

ABSTRACT

Nuclear energy is important to combat climate change as well is important for improving the human development index of a nation. Nuclear energy is low-carbon, clean and reliable source of electricity. In addition, nuclear energy is useful in many beneficial effects related to health, societal and industrial growth. We will present an overview of radiation, which is in an integral part of the civilisation. We will review and analyse the existing radiation protection philosophy, which is based on a linear no-threshold (LNT) model for cancer risk assessment and implies that a single ionising radiation has a risk possibility. The LNT model does not consider the adoptive response of biological systems, and has created unnecessary fear of radiation in public. We will try to analyse the past studies, scientific biases, ethical and moral challenges, nuclear fallout, and the development of international policies. It is emphasized that there is a need to carry out extensive scientific studies (especially at low doses) and to move away from LNT model to a more realistic Hormesis model that considers adoptive responses.

Smart and Sustainable Infrastructure for Viksit Bharat@2047

Dr. Sujata Chaklanobis

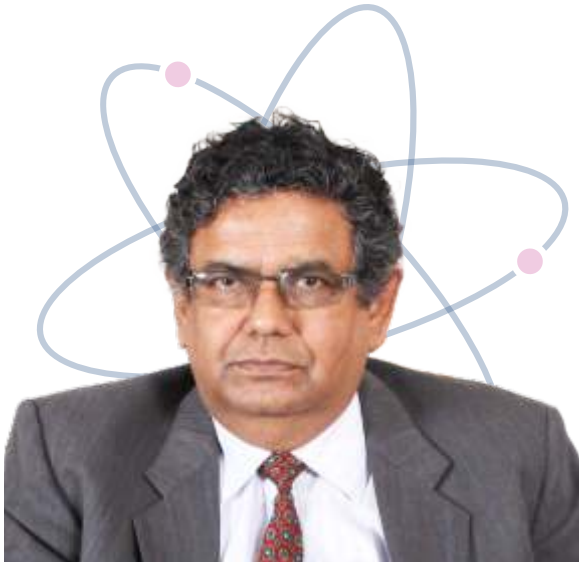
Department of Scientific and Industrial Research
New Delhi

ABSTRACT

In 2021 Independence Day speech, the Hon'ble Prime Minister of India shared his vision for Amrit Kaal and 2047, when the country would celebrate 100 years of independence. India aims at achieving a USD 30 trillion economy with a per-capita income of USD 18,000-20,000 and strong public finances and a robust financial sector. Building world-class infrastructure and facilities in both rural and urban areas is a major area of focus. Fostering green growth and climate action by increasing renewable energy capacity and reducing carbon emissions is foremost on the country's agenda. India is a signatory to the 2030 Agenda for Sustainable development and is committed to achieve inclusive and sustainable communities and settlements. India's urbanisation story is unprecedented and the share is expected to rise to 43 per cent in 2035 . Nearly 60 per cent of India's carbon emissions by 2030 will come from buildings and factories that are yet to be built, and vehicles and appliances that are yet to be bought. India is at an important crossroads where the design of its cities and urban centres may determine how its growth story unfolds.

Dr. Sujata Chaklanobis, a doctorate in Chemistry by qualification, has several years of experience in managing Govt. of India led programs on R&D by industry and programs which cater to the specific needs of women. She has a vast experience in diverse fields. She has a rich R&D experience and has a number of publications to her credit in reputed international journals. She has served in various capacities in the Ministry of Science and Technology and is a member in various Committees in the Government of India, Industry and academic institutions. She has served as Scientist "G" and Adviser in the Department of Scientific & Industrial Research, Ministry of Science & Technology, Government of India. She has contributed in strengthening the R&D ecosystem of the country, formulating policies for Science, Technology and Innovation and creating regulatory mechanisms, forging collaboration among the industry, academia and government for delivery of citizen centric solutions and supporting and mentoring innovative technology development projects of the industry. Her profile and experience include Conceptualization, Formulation, and Implementation of various programs of the Government of India with special focus on industry. Dr. Chaklanobis has more than 28 years of experience in handling technology led interventions in the industry as well as academia, Project Management, Research Grant and Policy Research and has a vast expertise in integrated planning, process improvement and driving performance outcomes. She is involved in S&T Planning and Govt. of India led programs on industrial R&D, innovation and programs addressing various issues of women through S&T intervention and has played a pioneering role in steering the horizontal and vertical growth of various programs of the Govt. of India. She has been the lead catalyst and is instrumental in carving out a new initiative "Skill Satellite Centre" programs of DSIR.

Energy & Environmental Problems Facing India & World and Their Probable Solutions for Sustainable Development and Poverty Alleviation.



Prof. Dr. D. P. Kothari

Honorary Adjunct Professor VNIT, Nagpur
Vice-Chancellor VIT University

Dr. D. P. Kothari obtained his Ph.D. from BITS, Pilani. He was involved in teaching and development of several courses at BITS Pilani. Earlier Dr. Kothari served as Vice Chancellor, VIT, Vellore and Director for Centre of Energy Studies at IIT Delhi. He was visiting professor at the Royal Melbourne Institute of Technology, Melbourne, Australia. He was also NSF Fellow at Perdue University, USA. Dr. Kothari is a recipient of the most Active Researcher Award, has published and presented 840 research papers in various national as well as international journals, conferences, guided 57 Ph.D scholars and 68 M. Tech students, and authored 80 books in various allied areas. He has delivered several keynote addresses, 150 plus Webinars and invited lectures at both national and international conferences. He has also delivered 42 video lectures on YouTube with maximum of 1,00,000 hits! Dr. Kothari is a Fellow of the National Academy of Engineering (FNAE), Fellow of Indian National Academy of Science (FNASc), Fellow of Institution of Engineers (FIE), Fellow IEEE ,Hon. Fellow ISTE and Fellow IETE.

Having received 95 awards till now, his many awards include the National Khosla Award for Lifetime Achievements in Engineering from IIT, Roorkee. The University Grants Commission (UGC), Government of India has bestowed the UGC National Swami Pranavandana Saraswati Award in the field of education for his outstanding scholarly contributions. He is also the recipient of the Lifetime Achievement Award conferred by the World Management Congress, New Delhi, for his contribution to the areas of educational planning and administration.

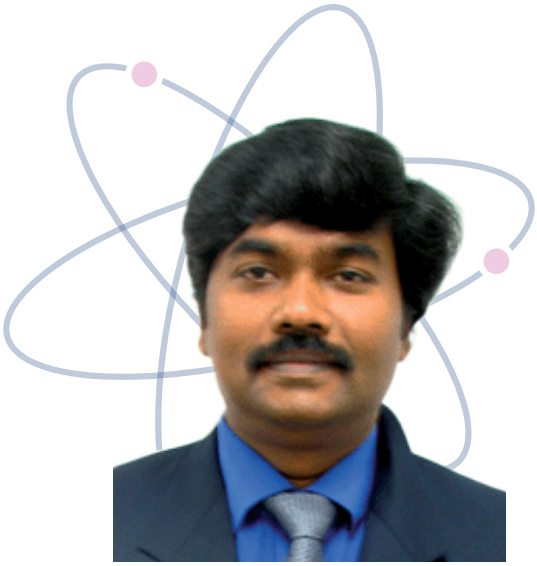
Recently he received Excellent Academic Award at IIT Guwahati by NPSC. He has received 6 Life Time Achievement awards by various agencies. He received 'Living Legend' Award in Chennai Conference.

ABSTRACT

This briefly discusses some important energy problems facing India and World & presents the current electric generation scenario in most of the developing countries with facts and figures in respect of India. It is hoped that, with systematic, advance planning, through measures like co-generation, energy management, and energy conservation, the electric energy supply scenario of AD 2030 will be free of the perennial problems of power shortages, voltage fluctuations etc. Also , problems will be solved using soft computing techniques such as ANN , Fuzzy Logic , GE , PSO etc. Other imprenewable energy sources are GEOTHERMAL, small hydro, nano hydro micro hydro, mini hydro waste power generation, Biomass etc.

- Solar energy and wind farm are increasingly being used.
- By 2070, there will be 0 C credit. Thermal power will be stopped slowly but surely.
- Each house should have roof top solar PV station and rain water harvesting.
- Use of solar cooker solar water pump solar car solar metro solar pond solar architecture should be used. Horizontal and vertical axis wind turbines may be tried.

Latest Advancements and Challenges in Sustainable Sodium Metal Battery Technology for Self-Reliant India



Prof. Dr. A. Vadivel Murugan
Pondicherry University

ABSTRACT

Energy and climate concerns have made an advancing quest for research towards electrical energy storage. In this context, sodium-ion batteries (SIBs) have attracted significant attention lately. Sodium is an abundant resource in India and all over the world, low cost and safe which makes it an attractive alternative to lithium. Its chemical properties are similar to that of Li which makes the transition into using Na-chemistry for ion battery systems feasible. The lower energy density and safety issues of using liquid electrolyte based sodium-ion batteries have been unable to satisfy the ever-increasing demands for large-scale energy storage system. As a low-cost alternative, sustainable solid-state sodium metal batteries (SSMBs) have shown great competitive advantages and extensive application prospects due to their high energy density and desirable safety. However, the solid-state electrolytes (SSEs) often possess low ionic conductivity, the poor interface compatibility and inferior stability between SSEs and electrodes can result in the continuous deterioration in the electrochemical performance. I am addressing the recent progresses made in our lab of sodium-based SSEs, including the sodium ion transport mechanisms of different types of SSEs, some emerging materials in different dimensions, and interface engineering. Furthermore, the critical challenges and new perspectives are emphasized in my presentation. Our work provides deeper insights to construct more comprehensive and effective SSEs for next-generation high-performance SSMBs.

In his 2021 Independence Day speech, the Hon ble Prime Minister of India shared his vision for Amrit Kaal and 2047, when the country would celebrate 100 years of independence. India aims at achieving a USD 30 trillion economy with a per-capita income of USD 18,000-20,000 and strong public finances and a robust financial sector. Building world-class infrastructure and facilities in both rural and urban areas is a major area of focus. Fostering green growth and climate action by increasing renewable energy capacity and reducing carbon emissions is foremost on the country's agenda. India is a signatory to the 2030 Agenda for Sustainable development and is committed to achieve inclusive and sustainable communities and settlements. India's urbanisation story is unprecedented and the share is expected to rise to 43 per cent in 2035 . Nearly 60 per cent of India's carbon emissions by 2030 will come from buildings and factories that are yet to be built, and vehicles and appliances that are yet to be bought. India is at an important crossroads where the design of its cities and urban centres may determine how its growth story unfolds. The important aspects that are required for achieving smart and sustainable infrastructure for Viksit Bharat@2047 will be discussed.

Prof. Dr. Jitendra Sangwai
IIT Madras

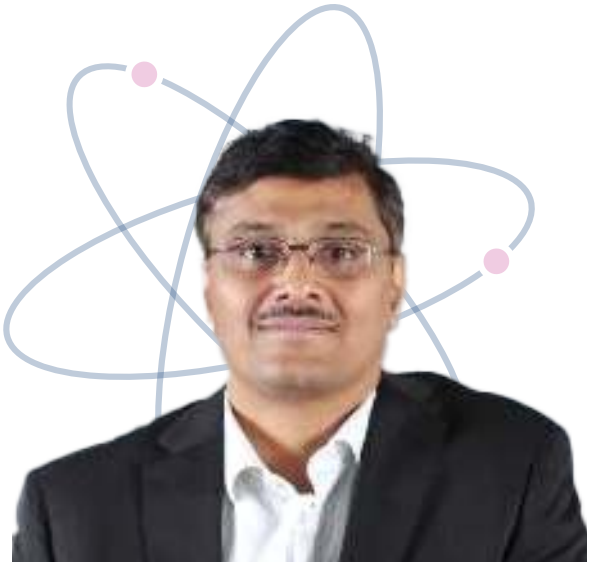
Dr. Jitendra S. Sangwai is currently working as a full Professor at The Department of Chemical Engineering, Indian Institute of Technology Madras. He did his Ph.D. in chemical engineering with Professor Santosh K Gupta at IIT Kanpur. Dr. Sangwai worked with Schlumberger for a brief period before moving to academia. Dr. Sangwai's research interest lies mainly in the field of carbon capture and Sequestration (CCS), gas hydrates, and upstream oil and gas engineering. He has published approximately 170 international journal papers and 90 conference publications. He has h-index of 46 and citations nearing ~ 7000. Dr. Sangwai has filed 20 Indian patents and 18 international patents. He has graduated 24 PhD degree students, most of whom are working as faculty in IITs, and Institute of National Importance. Dr Sangwai has been recognized with various awards. The Government of India awarded him the National Geoscience Award for outstanding research contributions in oil, natural gas, and gas hydrates, as well as two National Awards for the Technology Innovation. He has also received the Society of Petroleum Engineers' Distinguished Award for Petroleum Engineering Faculty of the South Asia and Pacific region and Regional Service Award. IIT Madras bestowed him with the Young Faculty Recognition Award for excellence in teaching and research, the Institute Research and Development Awards (both at Early- and Mid-Career level), and the Shri. J. C. Bose Patent Award. He has been recognized as Top 3% Highly Cited ACS Authors from India, ACS's Energy & Fuels Recognition to Most Cited Articles published in 2019, and Top 1% Highly Cited Author of the Industrial and Engineering Chemistry Research. ACS journal, Journal of Chemical and Engineering Data, has highlighted him as 'One among 25 Emerging Investigators' on the journal's cover page and in the Editorial of the issue, Dr Sangwai also serves as an Associate Editor of prestigious journal Energy & Fuels published by the American Chemical Society.

Environmentally Sustainable Large Scale CO2 Sequestration in Ocean for Sustainable Energy Transition

ABSTRACT

Energy transition will not be abrupt but slow till we find sustainable energy resources for the mankind. In view of increasing global warming and CO_2 emissions, immediate actions are required to address these issues, which may involve storing large amounts of anthropogenic CO_2 in geological and oceanic repositories. In terrestrial storage sites, CO_2 tends to rise due to the underground temperature profile. Therefore, if the reservoir is not properly sealed, stored CO_2 can escape from geological formations. On the other hand, oceanic sequestration holds great potential for long-term CO_2 storage beneath the seabed, supporting the broader scientific and industrial community in achieving carbon neutrality. Subsea CO_2 sequestration holds significant promise for ensuring stable, long-term CO_2 storage and, consequently, can make a substantial contribution to achieving global carbon neutrality and mitigating the challenges of global warming. However, several key factors at the macroscopic level, including salinity, sediment porosity, sedimentary types, and the use of additives, are essential in realizing the full potential of subsea CO_2 sequestration. A deeper understanding of the chemical interactions among CO_2, hydrate-bearing sediments, additives, and marine environments is crucial for comprehending hydrate formation within subsea sediments. These dimensions offer a vast landscape for discussion, paving the way for future technological innovations. Consequently, there exists a broad scope for discourse in this field that will drive the development of novel technologies in the years to come.

Sustainability & Industry 4.0: Challenges & Opportunities for Nonferrous Industry



Dr. Vilas Tathavadkar

Chief Technology Officer, Hindalco Industries Ltd.
Function Head, Metals & Mining Technology, ABSTC

ABSTRACT

Sustainability and industry 4.0 are driving major technology transformations in Nonferrous industry. The industry 4.0 is reality and there is no escape from it. Many service sector industries in the world have already adopted it and started getting benefits of it. However, conventional manufacturing industries are still facing challenges in rapid adaptation and implementation of these new technologies. As expected, the process complexity and cost of implementation are hurdle in implementation. But availability of process data and domain knowledge are critical limiting factors. Same time, industry is also facing challenges in meeting stringent global sustainability norms. The target are already set by nation and industries for zero emission, discharge and landfill.

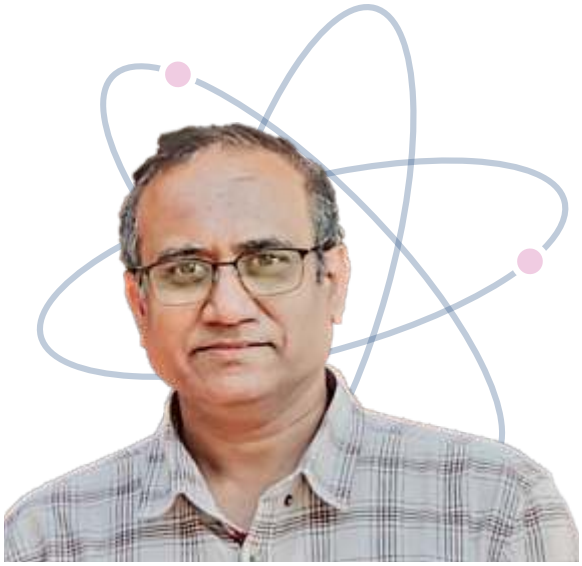
These two transformations will bring new business models and industry players in near future and will also force to change existing processes and business models. Other mega trends such as mobility, energy transitions, circular economy, etc. are also influencing the implementation of new technologies and business models. Collaborations with Academic & research institutes are vital in this journey. These challenges and solutions developed are discussed with specific examples from Nonferrous industry.

Dr. Vilas Tathavadkar presently, leading Technology & Innovation functions with focus on transformation of primary aluminium & copper production processes to deliver sustainable and differentiated products. Hindalco Innovation Centres along with ABSTC has developed the range of new products & applications for specialty alumina, implemented innovative solutions for reduction in specific energy consumption in aluminium & copper smelting through advanced simulation & modelling for design optimisation, advanced process control logic, carbon anode production & characterisation. He is also leading collaborations with national and international research institutes and start-ups in new areas like battery materials, decarbonisation & renewable energy. He has developed strategic technology roadmaps for bauxite & alumina, aluminium smelting, and Copper technology domains.

He received his B. Eng (Metallurgy) from College of Engineering, Pune, M Tech (Materials Sciences) from IIT, Mumbai and Ph. D. (Process Metallurgy) from University of Leeds, UK. Completed Post Doctoral Research Fellowship at University of Leeds, UK and Technical University of Delft, The Netherlands. He has 33 years of research experience in national, academic & industrial research laboratories, including C-MET, Hyderabad, University of Leeds, UK and Tata Steel R&D, Jamshedpur before joining ABG in 2012.

He has filed more than 40 patents of which 20 are granted and published over 75 papers in national & international journals & conference proceedings. He is recipient of Pune University Gold Medal in 1989, Prestigious Tata Innovista Promising Innovation award of Tata Group in 2009 and Hindustan Zinc Gold Medal of Indian Institute of Metals in 2021. He is member of Research Council CSIR-AMPRI and member of National Executive Council of Indian Institute of Metals and MTDC of Bureau of Indian Standards. He is also Chairman of ASSOCHAM National Council on Quality & Productivity.

Sensors Advancements in Climate Change and Possible Future



Dr. Pramod H. Borse

International Advance Research Center for Powder Metallurgy and New Materials, Hyderabad

Dr. Pramod H. Borse is PhD in Physics from Savitribai Phule Pune University and has made several contributions in Applied Physics and its utilization in green hydrogen energy research. He undertook the job of Post graduate teaching and research in SPPU. Later, he was professor at Pohang University of Science and Technology (POSTECH), South Korea. Presently he is working at senior position as a Scientist-G in DST, India laboratory i.e. International Advanced Research Center for Powder Metallurgy and New Materials, (ARCI), Hyderabad, India. He has been, Fellow of Royal Society of Chemistry (FRSC), senior member of OPTICA formerly Optical society of America (OSA), and IEEE societies. He has undertaken research activities in the frontier areas such as Nanomaterial synthesis of semiconductor and oxides systems, Solar energy materials, Solar Hydrogen production materials, IOT-based Sensor fabrication, X-ray based nano-film processing, Photocatalysis, Thermoelectric material, Condensed Matter Physics etc.

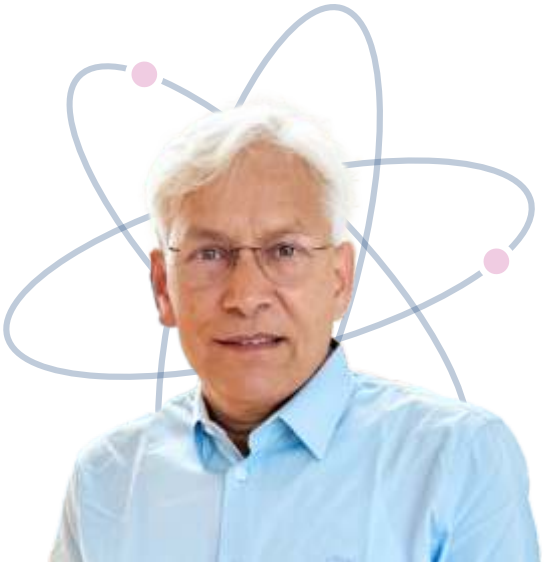
He has developed various ferrite and 2D metal chalcogenide-based materials systems. He has also developed a rapid nano-crystal ferrite methodology for hydrogen production as well as magnetic applications. He has also developed opto-electronic and gas sensors for commercial applications.

He has worked on number of international projects those are sponsored by POSCO steel, Samsung Electronics, General Motors. His Scopus Citation is 5081 and h-index is 36, and has published more than 120 SCI Journal articles with high impact factor journals. Similarly, his Goggle scholar citation index rates to 6209, h-index 39 and i10-index as 78. He has also published 8 book chapters. He has prepared 3 Indian patents and two India patent are granted.

ABSTRACT

The world is witnessing tremendous advancements in the human lifestyle and all related automation in related areas. It not only sweeps the area of commercial applications but also in strategic fields. The presentation will showcase various known sensors, specifically emphasizing climate changerelated areas and corresponding automation. Their pivotal role in enhancing the accuracy of climate models will be considered. The discussion will be further extended to foresee the future of advanced sensors with automation, IOT, and quantum sensors upgrading the climate parametric assets.

2D Materials for Room Temperature NO2Gas Sensor Applications



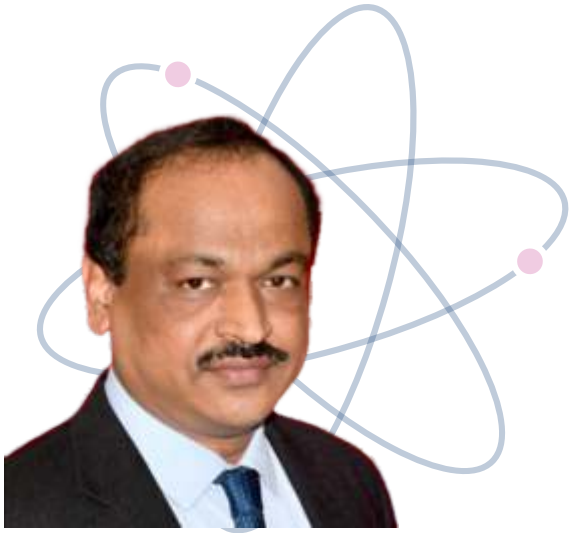
Dr. Ramesh Chandra
IIT Roorkee

ABSTRACT

Gas sensing devices have gained substantial attention by using semiconducting heterojunctions composed of two-dimensional (2D) transition metal dichalcogenide (TMDs) materials, offering increased sensitivity, stability, selectivity, and full recoverability. Herein, the focus centers on the fabrication of a p-n heterojunction consisting of hexagonal molybdenum diselenide-tungsten disulfide (MoSe2-WS2) over a silicon (Si) and an electrochemically anodized porous silicon (PSi) substrates for room-temperature (RT, 27°C) nitrogen dioxide (NO2) gas detection. The MoSe2-WS2/Si sensor exhibited exceptional sensitivity (59.63%), quick response (68.90 s), and full recovery (65.68 s) towards 50 ppb NO2 even at RT with long-term stability of over 60 days, highlighting its strong affinity for NO2 molecules. The MoSe2-WS2/PSi nanocomposite sensor demonstrates a superior sensor response of 34.14% with a fast response/recovery time (17.67 s/41.05 s) towards 50 ppb NO2 gas at RT, outperforming their pristine counterparts (MoSe2/PSi and WS2/PSi). The present nanocomposite gas sensor delivers exceptional selectivity and commendable stability for over 100 days with retention of 90.9% towards 50 ppb NO2 gas, even at RT. The fabricated MoSe2-WS2 nanocomposite over the PSi substrate offers enhanced surface area, facilitating higher adsorption sites for the effective interaction between NO2 gas and the sensing material. The remarkable sensing properties exhibited by the proposed MoSe2-WS2/PSi nanocomposite sensor render enticing possibilities for developing next-generation room temperature NO2 gas sensors.

Prof. Ramesh Chandra currently serving is Professor at Institute Instrumentation Centre & Joint Faculty in Centre for Nanotechnology, Indian Institute of Technology Roorkee and working in the field of Energy Storage (Thin film-based Supercapacitors & Batteries), Gas Sensors and Optical coatings since last 34 years. He received 7900 citations for his commendable research work and have H-index 48. He received PhD degree in Physics from IIT Delhi in1993 and M. Sc (Physics) degree from A.M.U. Aligarh in 1987.

Recently he has been Felicitated by Hon'ble Raksha Mantri Shri Rajnath Singh at the DRDO-Academia Conclave organized by DRDO on May 25 – 26, 2023 at DRDO Bhawan New Delhi, for developing corrosion resistant coating technology for Defence applications. He has been awarded by Dr. A.N. Chatterjee memorial award on fabricating High-Tc Squids in 1990, Commonwealth fellowship at University of Cambridge, (UK) during (2002–03), INSA Fellowship to visit the University of Cambridge, UK (2009–10) and INSA Fellowship to visit Silesian University of Technology, Gliwice, Poland. He served as Visiting Scientist at Tata Institute of Fundamental Research, Mumbai for 3 years (1997-99) and Visiting Associate at Inter University Accelerator Centre, New Delhi, for 3 years (2002-04). He also served as Senate Member of IIT Bhilai during 2024-26.



Dr. Nagahanumaiah

Director
Central Manufacturing Technology Institute
Bengaluru

Dr. Nagahanumaiah was formerly Chief Scientist & Head of Micro-Nano Systems Technology Group at CSIR-Central Mechanical Engineering Research Institute, Durgapur. His academic background includes a Ph.D. from the Indian Institute of Technology Bombay, a Master's in Tool Engineering from Indo-Danish Tool Room, Bangalore, and a Bachelor's in Mechanical Engineering from Bangalore University.

His research expertise covers micro-nano scale manufacturing technologies, modular-reconfigurable machine tools, additive manufacturing, tool design, rapid tooling for injection molding, cost modeling, manufacturing process selection, and manufacturability evaluation.

He has an impressive publication record with 108 research papers and holds 9 patents. He has supervised 9 Ph.D. and 15 M.Tech. students, with 5 more Ph.D. scholars currently under his guidance. In addition to his research contributions, he is actively involved in national and international committees, including governing councils of technical institutions.

He has received prestigious fellowships and awards, including the 'BOYSCAST Fellowship' from DST, 'Raman Research Fellowship' from CSIR, the 'We Think for India' award from the Prime Minister of India, and recognition as a 'Distinguished Scientist' by Venus International Foundation in 2017. In 2021, he received the 'Distinguished Leadership Award' from the International Society of Industrial Engineering and Operation Management, USA, and the 'Eminent Engineering Professionals Award - 2021' from the Institute of Engineers India (IEI). In 2023, has been selected as a fellow of the Indian National Academy of Engineers (FNAE). He is a member of the International Association of Engineers, UK, and the International Institution for Micromanufacturing (I2M2), USA.

Challenges in Engineering Advanced Machines and Equipment During the Innovation Cycle: Product, Process, People, and Production Perspectives

ABSTRACT

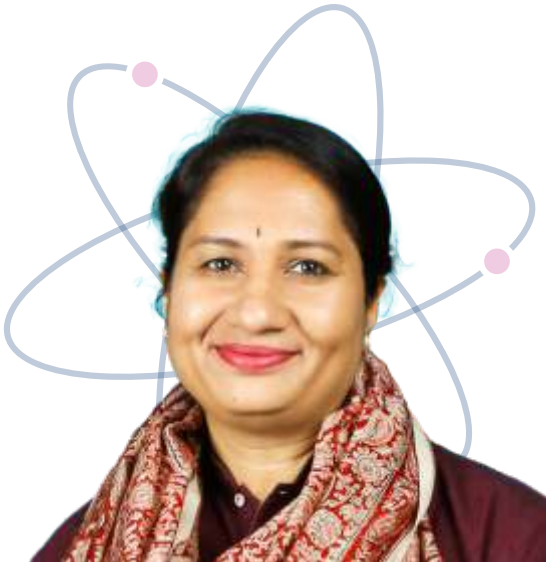
Engineering advanced machines and equipment is a crucial part of the innovation cycle, yet it presents a range of multifaceted challenges. This presentation explores these challenges through four key perspectives: product, process, people, and production.

- Product-related challenges include high development costs, the need for customization, rapid obsolescence, and ensuring reliability and performance standards.
- Process-related issues involve the complexity of integrating new technologies, maintaining quality control, and managing supply chain dependencies.
- People-related challenges encompass the need for specialized skills, extensive training, and managing workforce adaptability to new technologies.
- Production-related difficulties include scaling up manufacturing, minimizing downtime, and ensuring environmental and safety compliance.

By examining these dimensions, this presentation shares the Central Manufacturing Technology Institute's (CMTI) experience in the design and development of advanced machines and equipment. It aims to provide a comprehensive understanding of the obstacles faced in this field and offer insights into strategies for overcoming these challenges to facilitate successful innovation.


Digital Transformations

Cybersecurity for Vikasit Bharath



Ms. Priyamvadha Vembar
Cybersecurity, Bosch Bengaluru

Ms. Priyamvadha Vembar is heading the BGSW Automotive/IT/IoT/OT cybersecurity practice. In a global career spanning 25+ years in the Automotive and IT industries, starting out as a software professional, then onwards as a qualified project management professional, she transitioned into the domain of Information Security and Privacy 20 years ago. She played a key role in establishing the Governance for Information Security and Privacy for the Bosch group in India and Southeast Asia. The next transition was made into cybersecurity for products, starting out at a time cybersecurity for IT was an emerging field, and cybersecurity in products was almost non-existent. She has made pioneering contributions to the evolution of the field of product cybersecurity in general and automotive cybersecurity in particular during her role as a senior expert with the TOP67 project of Robert Bosch Corporate Research (CR), Competence Center Product Security ETAS GmbH Germany, architecting the Bosch Security Engineering Process (SEP) and anchoring the SEP as a part of Bosch product engineering.

As a member of Society of Automobile Engineers (SAE) and German Association of the Automotive Industry (VDA) she played a key role in establishing the ISO/SAE 21434 project. She was nominated to the ISO/SAE 21434 Joint Working Group (JWG) representing Germany and played a key role in establishing the ISO/SAE 21434 project, shaping, and drafting the contents of the standard. Since 2017 she has set up a cybersecurity practice at BGSW, a global team, consisting of experts, professionals and consultants that engages with the emerging trends in the field. She engages with the cybersecurity and privacy ecosystem in India through Bureau of Indian Standards (BIS), and Data Security Council of India (DSCI), academia and continues her efforts in shaping the field, working out of India.

ABSTRACT

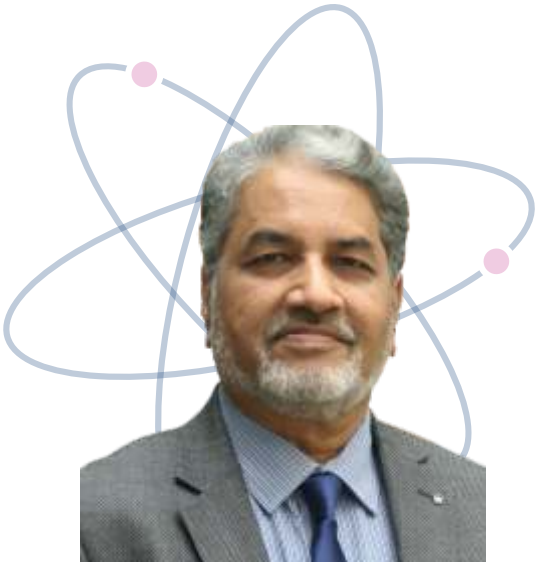
The world is more connected than ever before. The revolution that was started by the Internet, is expected to intensify further into the future, bringing forth, digital transformation that is expected to enable billions across the globe with opportunities, at the same time, bringing with it, threats such as cyberattacks on private and public assets, privacy of individuals, public goods such as critical infrastructure of nations.

This talk looks at cybersecurity today, tomorrow, further into a generation (year 2050) away from us, placing the topic in the context of growth in adjoining technologies and artificial intelligence, understanding current position, future threat scenarios and hence, cybersecurity needs.

The talk proposes a governance framework that would include standards, laws and legislations, private and public infrastructure that "enables" collaboration to achieve and continuously maintain the cybersecurity posture that would be needed to safeguard our digital future and growth.

The talk would highlight the contributions that could be brought in, by the academia into this endeavor.

Digital Transformation for Developed Bharat



Prof. Dr. Raghunath Shevgaonkar
Provost, Somaiya Vidyavihar, Mumbai
Emeritus Professor, IIT Bombay
Former Director, IIT Delhi

ABSTRACT

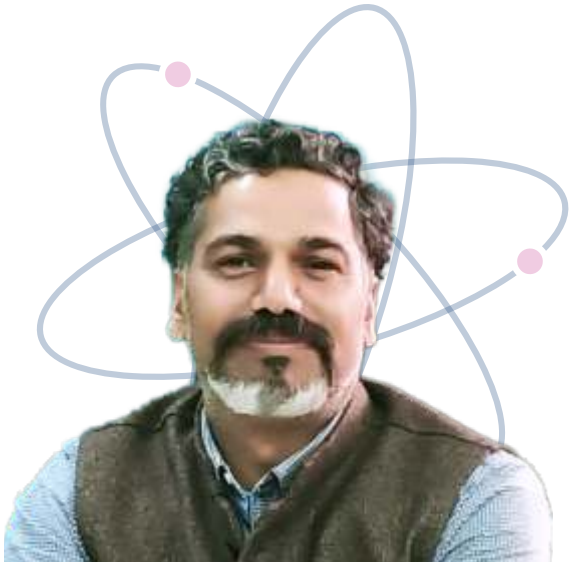
One of the technologies that transformed India and put it on the global map is the Information and Communication Technology (ICT). While most of the countries went through the slow progress via landline to wireless communication, India made a direct leapfrog entry to the world of mobile and internet. The ICT played an important role in development of the country as whole. It provided transparent and efficient governance, e-commerce, healthcare, education to every section of the society, agriculture, navigation, infrastructure and much more. Implementation of Aadhaar is one of the landmark achievements of India that is admired worldwide. Uninterrupted functioning of education system during COVID-19 pandemic is another example.

In 2015 the Prime Minister launched the Digital India program that includes connecting rural India with a high-speed network. These networks are combinations of optical fiber and wireless networks. The digital India program has three components namely, digital infrastructure, delivery of services digitally, and digital literacy. From the internet usage viewpoint, India has become the second largest country in the world. A strong telecommunication network has made India a 3A knowledge society. Along with communication technology, India developed a strong information technology base that made it a software hub of the world. The talk will present an account of how the high-speed commination accelerated national growth and played an important role in creating modern developed Bharat through digital transformation.

Dr. Shevgaonkar has been an active researcher in Electromagnetics, Optical communication, Image processing, Antennas, Microwaves, Radio astronomy etc. He has extensively published in international journals and conferences and published with McGraw Hill Education a textbook namely Electromagnetic Waves, and a monograph on Transmission lines for Electrical Engineers.

He has occupied leadership positions like Director IIT Delhi, Vice Chancellor of University of Pune, Vice Chancellor of Bennett University, and Deputy Director, Dean Resource Mobilization, Dean Student Affairs, Head Department of Electrical Engineering, Founder Head of Centre of Distance Engineering Education Program etc., at IIT Bombay.

He is a Fellow of: IEEE, Indian National Academy of Engineering, National Academy of Science, India, Institution of Electronics and Telecommunication Engineers, Optical Society of India, Institution of Engineers, Maharashtra Academy of Sciences, and Member of International Astronomical Union. He is a recipient of IEEE William E. Sayle Award for his Achievements in Engineering Education, IEEE Undergraduate Teaching Award for his inspirational teaching, SN Mitra Memorial Award of Indian National Academy of Engineering for his contribution to electromagnetics, antenna and radio astronomy, Ram Lal Wadhwa Award of IETE for his outstanding contribution to Optical communication, VASVIK Award in ICT, and the 'Excellence in Teaching' award of IIT Bombay. He has received the Education Leadership Award from Headlines Today, and Dewang Mehta Educational Excellence Award



Prof. Dr. Shailendra Varshney
IIT Kharagpur

Dr. S.K. Varshney is known for his scientific research in fiber-optics, and photonic technologies, including the integrated nanophotonics, metasurface, nonlinear and quantum photonics.

He is currently professor in the Dept. of Electronics & Electrical Communication Engineering, and also serving as a Chairman of the Partha Ghosh Academy of Leadership at IIT Kharagpur.

He has made pioneering contributions to speciality fiber optics, microring resonators based linear and nonlinear devices, fiber-based sources, optical and quantum communications.

He is the recipient of several fellowships UGC/CSIR JRF, the Monbukagakusho scholarship from the Government of Japan, the JSPS fellowship, and the Alexander von Humboldt fellowship and DAAD fellowship from Germany. He is the recipient of Faculty Excellence Award (2019) by IIT Kharagpur and G S Sanyal Faculty Excellence Award (2020) by IIT Kharagpur Alumni Foundation USA. He is a senior member of IEEE and Optica.

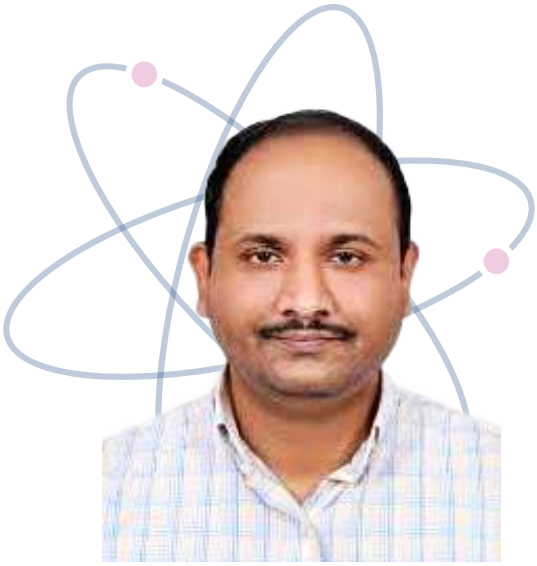
He is the author and co-author of more than 110 research papers in peer-reviewed journals, more than120 papers in conference proceedings.

Integrated Nanophotonics for Quantum Computing Applications, and prospects for 3D/4D printed Photonic Components

ABSTRACT

Optical waveguides made from silicon or silicon compatible materials have gained significant attention over the last few years due to their potential for data-center, healthcare, defense and high-speed connectivity within chip. Microring resonators (MRRs) are one of the important building blocks for linear, nonlinear and quantum computing applications. Microring resonator comprise of a straight waveguide in close-proximity with a circular waveguide. The MRR can be used as filter, modulator, and to generate frequency comb and entangled photon pairs for quantum computing applications.

Single Electron Transistors for realizing Donor Based Spin Qubits in Silicon



Dr. Ranjit Kashid

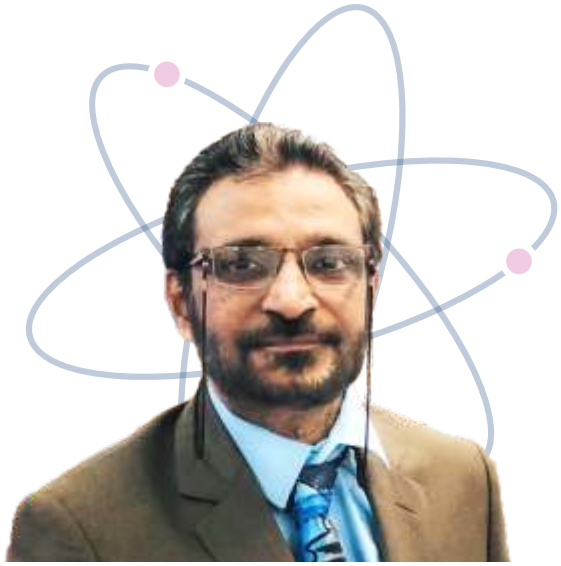
National Center on Quantum Materials Technology
C-MET, Pune

ABSTRACT

Abstract: Downscaling devices well below current critical dimensions is increasingly difficult and introduces quantum behaviour into devices with overall device characteristics becoming strongly influenced by the precise position of dopant atoms and proximity to interfaces. Deterministic placement of dopant atoms with one lattice site accuracy can now be achieved due to recent advances in hydrogen depassivation lithography on silicon (100) surfaces. This approach shows great promise for realizing the various building blocks of a solid-state quantum computer based on a donor architecture in silicon. Although in the context of solid-state quantum computing, single electron transistors (SET) are a vital building block, there are a range of additional applications such as metrology standards, single photon detection, single electron spectroscopy, and electron charge pumps. These applications have in common, a demand for very stable operation SETs. For example, when a SET is used as a sensitive electrometer for spin selective initialization and single shot readout after spin manipulation, any charge movement in the vicinity of the quantum dot/island affects the chemical potential of the quantum dot/island which manifests as an instability of operation in time and compromises fidelity in spin-based quantum operation. Such time instabilities at low frequency are commonly referred to as charge offset drift. In this talk, I will highlight fabrication, cryogenic electrical measurement of atom based devices in silicon.

Dr. Ranjit Kashid, currently Scientist at Centre for Materials for Electronics Technology (C-MET) which is Autonomous body of Ministry of Electronics Information and Technology (MeitY). He completed his Ph.D from Savitribai Phule Pune University in year 2014 in the area of 1/f noise studies in Carbon based Field emitters. After that he received prestigious Dr. D. S. Kothari Post-doctoral fellowship for conducting post-doctoral work at Indian Institute of Science (IISc) Bangalore in the area of "Low temperature Opto and Nanoelectonics of 2D Materials" between year 2014-2017. There after he went to National Institute of Standards and Technology (NIST), US Department of Commerce at Gaithersburg, Maryland USA as a Guest Researcher between year 2017-2021. He was lead there for MBE Growth of delta doped silicon and Cryogenic DC and High Frequency Electrical Measurements under Spin Qubits in Donor Based Silicon Quantum Initiative Programme. He established DC and RF readout schemes for Gate-based readout for Spin Qubits in Silicon. In addition, he was lead for establishing a low-temperature cryogenic measurement facility at NIST USA (4K, 300 mK He-3 fridge and 10 mK dilution fridge). In year 2021 he came back and joined C-MET Pune as Scientist. He is lead of Quantum Materials & Devices programme at C-MET Pune.

So far he has published 27 international research articles in many prestigious journals like Nature communications, Nature Communication Physics, Advanced Materials. Small, Physics Review etc. He is recipient of "PML Distinguished Associate Award" from NIST, US Department of Commerce for year 2021, Yuva Gaurav Puraskar from SPPU in year 2023 and Late Ravi Kumar Bhalla Award from Indian Physics Association in year 2012.



Dr. P. Hanumantha Rao

Director General
Society for Applied Microwave Electronics Engineering & Research (SAMEER), Mumbai

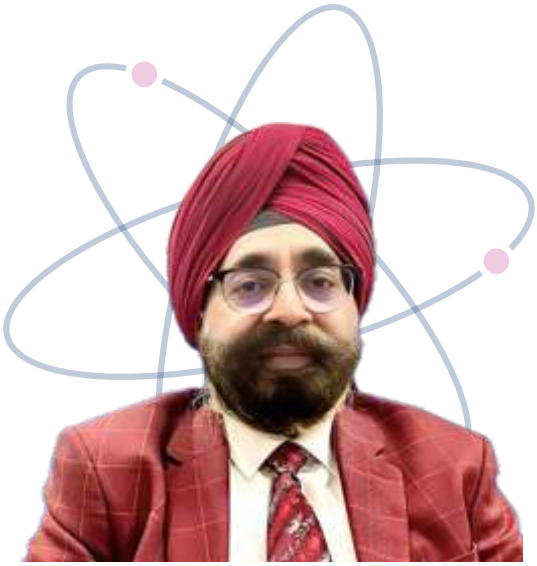
Dr. P. Hanumantha Rao, Director General SAMEER, has been pursuing his research in the areas of RF, microwaves, mm-wave technologies, Antennas and Electromagnetics for 37 years. He has been actively involved in the implementation of various future driven next generation technologies for both strategic and societal applications. His recent contributions include building end to end fully indigenous 5G stack in association with IIT Madras and IIT Kanpur. He facilitated collaborative research between SAMEER-Academia and industry, both at national and international levels. His current research areas include 6G solutions, intelligent reflecting surfaces, UAV detection and deactivation, Spectrum studies and RF SoC and Tiled Phased arrays systems. He served as Visiting scientist at Georgia Tech USA. Dr. Rao's contribution has been well recognized by IEEE Most popular paper Award, IEEE Distinguished Lecturer (DL) /Speaker for Asia Pacific Region. He is fellow of UNDP and British Commonwealth. Dr. Rao is one of the founding member of Bharat 6G Alliance and Member of Apex Body for DYSL –CT (DRDO) on Cognitive Technologies, Member 5G Implementation and Review group (MeitY), Member Technology Innovation Group (TIG) for 6G (DoT) and Senior Member IEEE.

5G and 6G Research with Intelligent reflecting surfaces and Orbital angular momentum

ABSTRACT

The developments in building indigenous 5G solutions including MIMO systems and mmwave Phased arrays will be highlighted. New initiatives of 5G and beyond & 6G communications systems along with THz research and developments will be introduced. The concepts of Intelligent Reflecting Surfaces (IRS) and Orbital Angular Momentum (OAM) as part of 6G research and their demonstrations for large data will also be covered.

Digital Transformation in Higher Education Institutions: A Viksit Bharat - An Outlook



Prof. Dr. Parvinder Singh
Rayat-Bahra University
Greater Mohali

Dr Parvinder Singh is renowned Professor of Chemistry and illustrious administrator with global recognition.With brilliant academic and research work with his expertise research on Shear Relaxation Times of novel complexes of Cu(I)in binary organic solvents and Acoustic studies of non destructive materials.

Dr Singh had published more than 50 papers including research,peer,books,conference proceedings in International and National journals.He is widely travelled to USA,UK,Australia,Italy, Canada on various academic and research assignments.

He is recipient of many Prestigious International and National Awards/Fellowships.

He had been nominated and elected member of various academic institutions including ACS,Fellow of

Science,Academic Council and peer member of GoI,State Government academic affairs where his contributions have been recognised and rewarded.

He had served as HoD,Registrar Exams,

Controller and Dean Colleges Panjab University, Chandigarh.

Presently he is Vice Chancellor of a very progressive State Private University in North India.

Dr Singh is assigned the duty of Chairman of North India Private Universities (CIPU) in recognition of his outstanding leadership in the field of higher education.

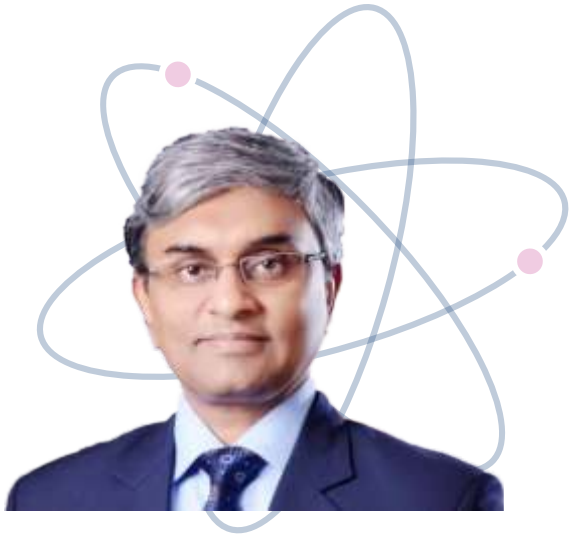
ABSTRACT

In the rapidly evolving landscape of higher education, the concept of digital transformation has emerged as a pivotal force reshaping institution worldwide. Viksit Bharat, translating to "Developed India," embodies a vision of inclusive growth and technological advancement, making it a fitting backdrop for examining how digital technologies are integrated into higher education institutions. Important elements including the use of digital tools to improve instructional strategies, boost administrative effectiveness, and increase accessibility to educational resources are highlighted in the abstract. Globally, technology is revolutionizing higher education, and India, with its enormous and varied educational environment, provides a special viewpoint on this development.

Viksit Bharat, propelled by its mission of inclusive growth and technological advancement, is at the forefront of digital transformation in the dynamic field of higher education. Indian universities are utilizing digital tools to transform their teaching approaches, optimize administrative procedures, and increase the availability of educational materials. Student engagement and

learning results are being revolutionized by the use of digital learning platforms and analytics powered by AI. Despite obstacles such as differences in digital literacy and digital infrastructure, efforts are being made to close these gaps by means of targeted funding and extensive professional development for teachers. Future developments in augmented reality and adaptive learning technologies are part of Viksit Bharat's digital transformation trajectory, offering a more customized and inclusive educational experience. The significance of equitable development, sustainable growth, and ethical considerations in data exploitation is highlighted by this trend. Future obstacles to digital transformation at Viksit Bharat's higher education institutions include filling in

the gaps in digital infrastructure, raising students' and teachers' digital literacy, and managing moral dilemmas when using data.



Shri. Sunil Gupta
Co-founder & CEO
QuNu Labs, Bengaluru

Mr. Sunil Gupta is the Co-founder and CEO of QNu Labs, a company specializing in quantum cryptography. With over 30 years of experience in product engineering and management, he has successfully led multi-million-dollar businesses, ensuring sustainable growth. His international experience spans the U.S., Europe, and APAC, working with Fortune 100 companies and startups. Sunil holds an engineering degree from NIT Trichy, which underpins his strong technical skills.

QNu Labs is at the forefront of quantum cryptography, working on technologies like Continuous Variable Quantum Key Distribution (CVQKD), Quantum Secure Direct Communication (QSDC), Free Space QKD (FS-QKD), and Photonic Integrated Chips for QRNG and QKD. Under Sunil's leadership, QNu Labs has positioned India on the world's quantum map with advanced quantum-safe security solutions, including the Quantum Random Number Generator (QRNG) and Quantum Key Distribution (QKD). They have also developed QShield, the world's first enterprise security platform based on Post-Quantum Cryptography (PQC).

QNu Labs offers a 200Km point-to-point DVQKD solution with Trusted Node technology for extended secure key delivery, a Hub & Spoke QKD configuration for large quantum-safe MAN, and a hybrid QKD and PQC technology for secure Quantum-Safe WAN. Their innovation has earned them accolades like DSCI's Most Innovative Product of the Year (2019) , DST's National Award for Commercialization of Technology by a Startup (2022) and Technology Breakthrough award (Raksha Anveshan Ratn Award) for its 150Km QKD by MoD.

Making India a Leading Player in Quantum Secure Communications

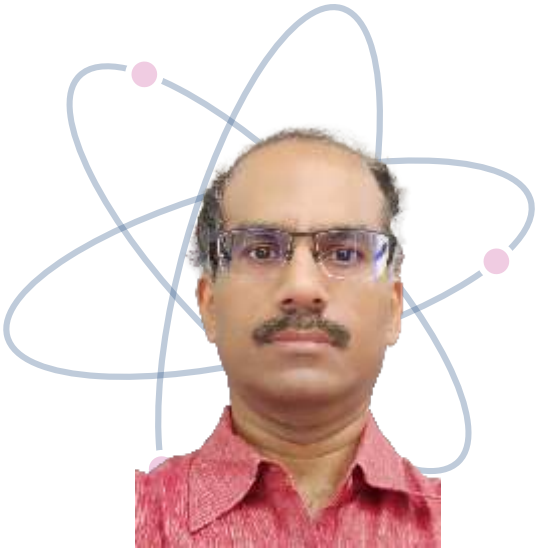
ABSTRACT

QNu Labs is a deep tech company specializing in quantum cybersecurity encryption solutions. QNu has built patented products in the area of quantum cryptography [quantum key distribution, quantum random number generation] and post-quantum cryptography solutions, to meet the industry's crypto agility needs.

QNu Inc. offers unparalleled data security through its advanced quantum technology platform, QShield. QShield serves as a software layer that integrates seamlessly with backend hardware solutions, expanding the opportunity for quantum-secure communication from enterprise-level and government organizations to individual users.

- QNu offers 200Km point to point DVQKD with Trusted node technology to deliver QKD generated secure keys over longer distances
- QNu offers Hub & spoke configuration of QKD to build large quantum safe MAN
- QNu also offers Hybrid technology that brings the security and flexibility of QKD and PQC together to create quantum safe WAN.

The Promise and The Gaps in Quantum Computing



Prof. Dr. M. S. Santhanam

Dean
International Relations and Outreach, IISER Pune.

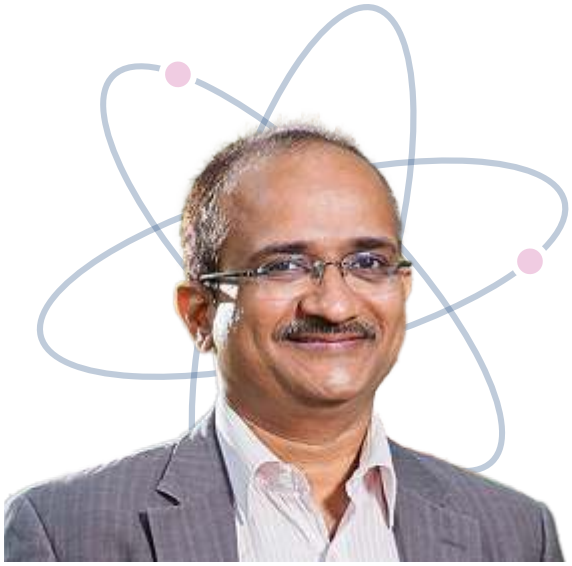
ABSTRACT

Quantum computing is seen as the next big wave on the technology horizon. Quantum computers employ subtle quantum effects such as superposition and entanglement to solve some set of problems that are intractable in the classical computing paradigm. Quantum computers are expected to provide faster solutions, often called quantum advantage, to a niche set of problems. This talk will provide an overview of the promise of quantum computing, its current status and also discuss the applications that might be relevant for industry. Some of the pitfalls and gaps in this emerging technology will also be discussed.

M. S. Santhanam is a Professor (Physics) at the Indian Institute of Science Education and Research (IISER), Pune. He is also the Dean of International Relations and Outreach at IISER Pune. Dr. Santhanam obtained Ph.D (Physics) from Physical Research Laboratory (a unit of Dept of Space, Govt of India) at Ahmedabad in 1999. Since then, he had served as a Research Staff Member at IBM Research division (1999-2002), as guest scientist at Max Planck Institute for the Physics of Complex Systems, Dresden, Germany (2002-2004), as a faculty member at Physical Research Laboratory (2005-2008) and at IISER Pune (2008-present).

He has held visiting scientist positions at Oxford University, UK, Max Planck Institute in Dresden, Germany and at the International Centre for Theoretical Physics, Trieste, Italy. His research interests are mainly in the area of theoretical physics, specifically in quantum computing, quantum chaos and nonlinear dynamical systems and statistical physics. Complete list of publications is available at his website. He is part of I-Hub Quantum Technology Foundation, a section-8 company promoted by IISER Pune and Dept of Science and Technology, Govt of India. His other interests are writing, science education, science and research policy in

India and science popularisation. He has written opinion articles for The Hindu, The Indian Express, The New Indian Express, Hindustan Times, The Economic Times and other periodicals.



Prof. Dr. V. Ramgopal Rao
Group Vice Chancellor
BITS Pilani

Prof. Rao had served as the Director of IIT Delhi for 6 years during 2016-2021 and as a Chair Professor for Nanoelectronics at both IIT Bombay and IIT Delhi. Prof. Rao is an acclaimed Nanoelectronics researcher with over 500 research publications and over 50 patents, which include 20 issued US patents. 15 of his patents have been licensed to industries for commercialization. The IP on CMOS-SoC applications developed in his group is now used in 100's of millions of ICs sold all over the world. Prof. Rao is a co-founder of two deep technology startups at IIT Bombay (Nanosniff & Soilsens) which have successful commercial products in the market. Besides his education and research activities, Prof. Rao is also well known for establishing major Nanoelectronics Programmes in India. For his research accomplishments, Dr. Rao has been elected a Fellow of IEEE, a Fellow of The World Academy of Sciences (TWAS), the Indian National Academy of Engineering (INAE), and all the three major Science academies in the country (IASc, INSA and NASI). 52 Ph.D. students have graduated so far under his supervision and are working in leading academic institutions, semiconductor industries all over the world, including in India.

Prof. Rao's research and leadership contributions have been recognized with over 40 awards and honors in the country and abroad. He is a recipient of three honorary doctorates. The recognitions Prof. Rao received include the Shanti Swarup Bhatnagar Prize in Engineering Sciences, Infosys Prize, IEEE EDS Education Award (the highest international award bestowed by IEEE Electron Devices Society for Education) and many others. Prof. Rao serves on the Editorial Advisory Boards of several leading international journals such as the ACS Nano Letters, AIP Applied Physics Reviews, IEEE Journal on Flexible Electronics etc. Dr. Rao has delivered over 200 Plenary, key-note and invited lectures all over the world.

Navigating the Nexus: Multidisciplinary Research and Innovation in Higher Educational Institutions

ABSTRACT

India's ambitious Semiconductor Mission, aiming for a 10% global market share by 2030 in semiconductor manufacturing, has thrust the nation onto the international stage. As India charts its course toward technological prominence, it must strategically harness the synergy between academia and industry. Among various domains, IoT (Internet of Things) stands out as an area where India possesses immense potential to emerge as a global player.

IoT-based sensor networks have witnessed exponential growth worldwide. However, their adoption faces hurdles in resource-constrained environments, particularly in developing countries. Challenges include inadequate infrastructure, stringent cost constraints, and the need for innovative business models. Addressing these issues requires not only technological innovation but also novel approaches to market penetration. This talk delves into the successful models of academia-industry collaborations, based on the speaker's own track record at IIT Bombay and IIT Delhi, in translating laboratory research to commercial products.

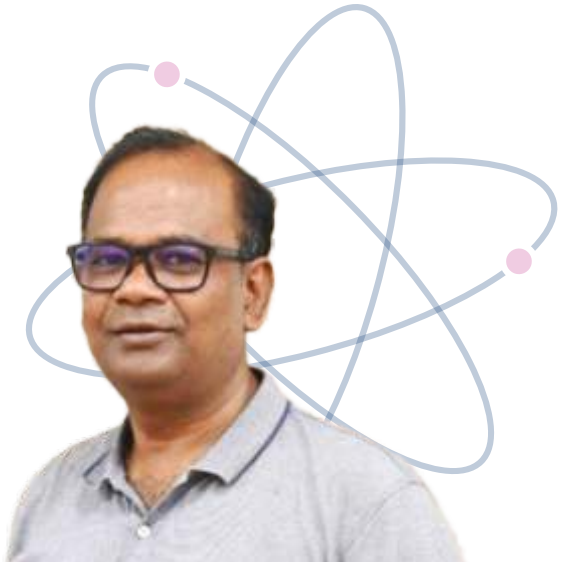
Introduction of Lab Grown Diamonds in Industrial and Scientific application

Shri. Jayam Sonani
Diamond Elements Ltd.
Surat

Mr. Jayam Sonani is Founder & MD of Diamond Elements Pvt. Ltd. The company mainly involved in CVD Diamond growth and production for various industrial applications like Ultra Precision cutting tools, Optical, Thermal management, Quantum materials for sensing and Devices, Electronics devices and detector. He also serves as MD of Sonani Industries Pvt. Ltd., The company work on HPHT processing Technology for Diamonds, HPHT system design and manufacturing, CVD Reactor design and manufacturing and Robotic polishing &laser cutting equipment manufacturing.

ABSTRACT

Diamond is characterised by its exceptional hardness, robustness and its optical and thermal properties; pre-eminent as a gemstone and an industrial tool. Natural diamond has an inherent variability and scarcity that limit its use in engineering applications. Lab grown process firstly developed in the 1950s using high pressure and high temperature and later in the 1980s using chemical vapour deposition to produce the exceptional covalent crystal diamond. Single crystal diamonds have been critical to the development of ultra-precision machining over the last decades. In some applications higher purity type IIa diamond (N < 1 ppm), has an advantage over Type Ib diamond (N >100 ppm), synthesised in the HPHT process due to its superior hardness. Substantial developments have been achieved in growing of chemical vapour deposition (CVD) Single crystal diamonds in recent years, providing engineers and designers with access to a large range of new diamond materials. CVD diamond has a number of outstanding material properties that can enable exceptional performance in applications as diverse as medical diagnostics, water treatment, radiation detection, high power electronics, consumer audio, magnetometry and novel lasers. CVD diamond heat spreaders are used to enhance the performance, reliability and of ASICs, RF power amplifiers, semiconductor and solid state lasers and is found in a diverse range of industries from materials processing, telecommunications, aerospace and space. Experiments on high purity CVD diamond have reported high mobility values and long lifetimes for electrons and holes. Combined with the high breakdown field and thermal conductivity, this makes diamond the preferred material for a number of demanding electronic applications. It can demonstrate stable high sensitivity to radiation in comparison to other solid state detector materials.



Prof. Dr. Bijoy Krishna Das
IIT Madras

Bijoy Krishna Das obtained his master degree in solid state physics from Vidyasagar University, Midnapore, India (in 1996) and PhD degree in integrated optics from University of Paderborn, Germany (in April 2003).

Dr. Das started his research career in the area of photonics at the Microelectronics Centre, IIT Kharagpur nearly about two decades ago (in January 1996) when he was associated in a DRDO sponsored project. He was an FRC Postdoctoral Fellow in the Graduate School of Engineering, Osaka University, Osaka, Japan (2004-2005). He later joined as a postdoctoral researcher in the Center for Optical Technologies, Lehigh University, Bethlehem, PA, USA. In April 2005, he rejoined the Integrated Optics Group in University of Paderborn as Wissenschaftlicher Mitarbeiter and continued his research on integrated nonlinear optical devices. He also worked for a while at Laboratoire Aime Cotton, CNRS, Orsay, France.

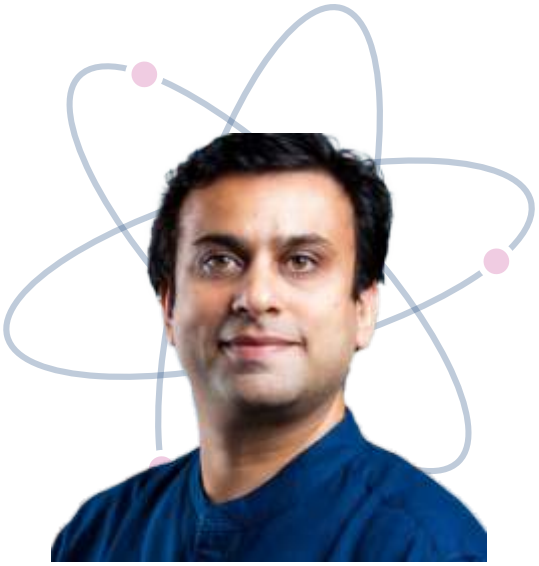
Since August 2006, Dr. Das has been associated with the Department of Electrical Engineering, IIT Madras, Chennai, India, where he is currently holding a full Professor position. He is also one of the core founding faculty members of the Centre for NEMS and Nanophotonics (CNNP) sponsored by the DeitY, Govt. of India. A number of projects sponsored by DRDO Labs (RCI Hyderabad, IRDE Dehradun), DST and DIT/MeitY have been executed by Dr. Das as a principal investigator. He has published more than 75 research articles in peer reviewed journals and conference proceedings. His present research focus is silicon photonics devices and circuits: optical interconnect and quantum optic application; integrated RF photonics signal processing; lab-on-chip biomedical applications.

Silicon Photonics: Technology and Applications

ABSTRACT

Owing to the success of high-speed silicon photonic transceivers for data centres, demand for similar products in several other fields such as 5G/6G, quantum photonic applications, etc. has emerged during recent years. In this talk, we will discuss the present state-of-the-art technology and some recent progress in this direction carried out at the Silicon Photonics CoE-CPPICS, IIT Madras.

Deepfake Technology: A Rising Threat to Cybersecurity



Prof. Dr. Ahlad Kumar

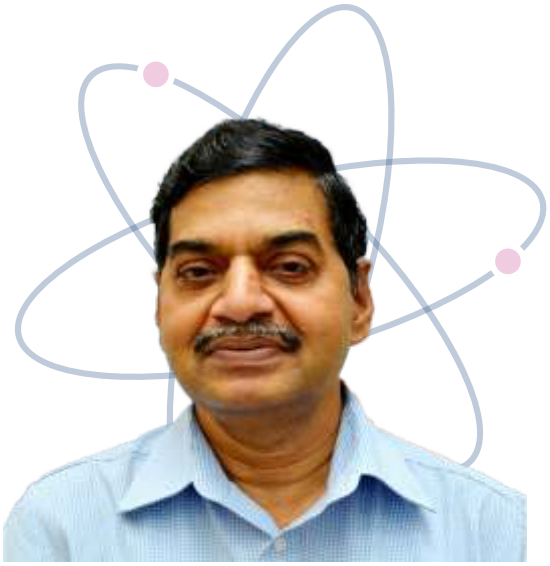
National Forensic Sciences University
Gandhinagar

Dr. Ahlad Kumar received his B.Tech. degree in Electronics and Communication Engineering from Jamia Millia Islamia. He has been honored with a University Gold medal for his academic performance during his M.Tech. (VLSI) from ABV-Indian Institute of Information Technology and Management, Gwalior. Dr. Kumar earned his Ph.D. from the University of Malaya, Malaysia. He was a postdoctoral fellow at Concordia University, where he was awarded with the prestigious Horizon Postdoctoral Fellowship. He worked as an Analog Design Engineer for two years. His areas of interest include machine learning, deep learning, reinforcement learning, and analog design.

ABSTRACT

Deepfake technology, which utilizes advanced machine learning algorithms to create hyper-realistic but fake audio and video content, poses a significant threat to the cyber world. The proliferation of deepfakes undermines trust in digital media, facilitates the spread of misinformation, and can be weaponized for cyberattacks, identity theft, and fraud. As deepfakes become increasingly sophisticated and accessible, the potential for damage in social, political, and economic spheres intensifies. Cybersecurity measures play a crucial role in mitigating these threats by developing and implementing advanced detection algorithms, promoting digital literacy, and establishing robust legal frameworks. Techniques such as deep learning-based anomaly detection, blockchain for content verification, and cross-platform collaboration are vital in identifying and countering deepfakes. Furthermore, public awareness campaigns and international cooperation are essential to create a resilient defense against this evolving cyber threat. This highlights the urgency of addressing the deepfake menace and the pivotal role cybersecurity must play in safeguarding digital integrity.


Health Care



Prof. Dr. Ajit Kulkarni
IIT Bombay

Dr. Kulkarni is known for his research on electrical and optical behaviour of materials that include technology development for energy with primary focus on materials for batteries, Fuel cells, EMI Shielding, Magnetoelectric composites. During his 35 years career at IIT Bombay he has developed ammonia sensors based on Polymer electrolytes, Infra-red transmitting glasses, electronic ceramics for underwater application, multilayer capacitors, polymer gel electrolytes for batteries and engineered defective ZnO and CeO2 quantum dots for biological application and drug free cancer theronsetics.

He joined Solid State Physics Laboratory, DRDO briefly and in 1985 moved to Purdue University as a Research Associate in Department of Chemistry with Prof. C. A. Angell. He joined IIT Bombay as a Faculty Member in 1987, and recently superannuated as a Chair Professor after 35 years' involvement in Teaching, research and administration (as Head Sophisticated Analytical Instrumentation Facility).

His fundamental contributions include Ion dynamics in disordered materials through mechanical and electrical relaxations and Impedance spectroscopy for electrical characterization of materials. He has over 170 publications in National and International Journals, 08 patents, guided 35 Ph. D. students and mentored several post-doctoral fellows. He was awarded prestigious Alexander von Humboldt Research Fellowship. He was a visiting Professor at University of Augsburg Germany and also at IMRAM, Tohoku University Sendai, Japan. He is a Fellow of the Maharashtra Academy of Sciences and member of National Academy of Sciences, India

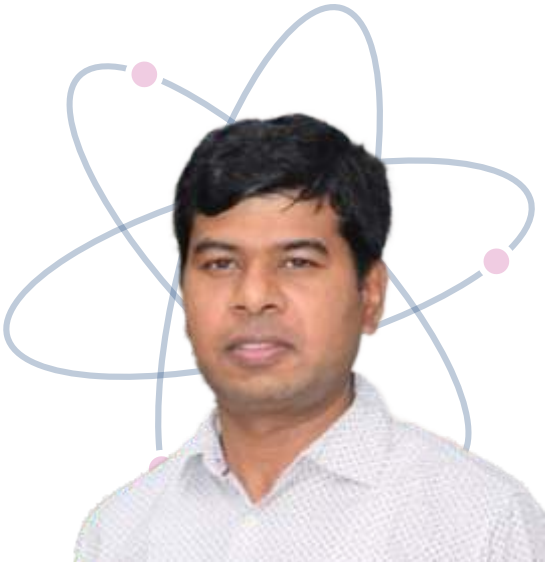
Flow synthesis of defect-rich CeO2 — a potential "drug-free" cancer nanomedicine

ABSTRACT

Bulk CeO2 acts as an oxygen reservoir, which is pivotal from fundamental and technological paradigms for applications in sensing, therapeutics, environmental pollution remediation and catalysis. When the particle size is reduced to sub-10 nm, CeO2 exhibits higher surface area and increased surface defect concentration. Most nano-CeO2 synthesized by wet-chemical batch processes, are plagued by inhomogeneous mixing, temperature distribution and low yield. To tackle these challenges, continuous flow reactors, particularly helical coil reactors (HCR), are beneficial because of their secondary flow-driven hydrodynamics and transport phenomena, facilitating the controlled QD formation. Our research involves scaling up surface oxygen vacancy-rich CeO2 quantum dots (E-CeO2 QDs) by a self-seeded thermal decomposition process utilizing an in-house-designed HCR. The HCR showcased a high throughput of 89.8% and run-to-run reproducibility. HR-TEM, Raman spectroscopy and XPS confirmed the formation of 3 nm-sized, monodispersed QDs with abundant surface defects. Biological studies were performed to rationalize how the altered surface chemistry could help combat cancer. By 2040, cancer cases are anticipated to reach 29.9 million globally, while 82% of patients treated with conventional drug-based therapy or chemotherapy face unwarranted complications. Our findings revealed that E-CeO2 QDs, with high photo-transduction efficiency, could increase the temperature of MDA-MB-231 cancer cells by 19.7±0.6°C and eliminate 86% of them.

They also annihilated 49.2% reactive oxygen species and protected 95.6% human keratinocyte cells (non-carcinogenic), even against H2O2. This offers a first-of-its-kind drug-free therapy with minimal side effects and enhanced efficacy, potentially contributing towards realizing a "cancer-free" world by 2047.

Academic Inventions and their Translation for Sustained Human Health and Societal Benefit



Prof. Dr. T. Govindaraju

Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru

ABSTRACT

Professor Govindaraju has pioneered the development of innovative molecular tools and technologies to tackle complex challenges in human health and society. His multidisciplinary research spans chemistry, biology, and materials science, with a particular emphasis on the chemical biology of "Functional and Disease Amyloids."

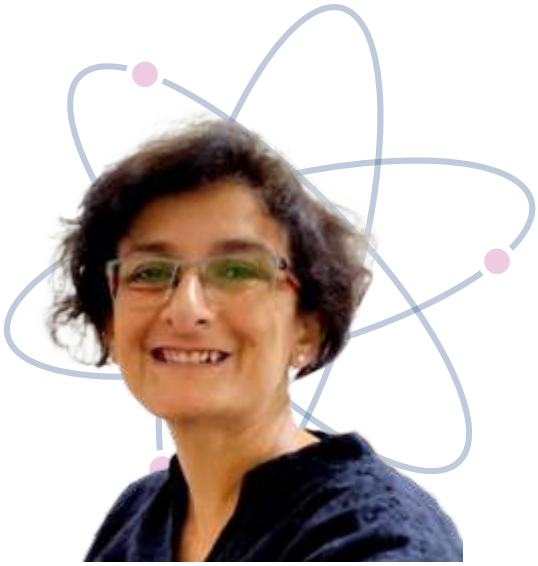
His research has led to fundamental understanding of disease mechanisms and development of novel diagnostics and therapeutics. Using an integrative approach, his work has resulted in comprehensive understanding of the disease mechanisms and tackling of Alzheimer's disease and cancer, and the role of various factors such as protein misfolding and aggregation, phase separation, metals, ROS, inflammasomes, glia, mitochondria, ferroptosis, and noncoding RNAs. These innovative approaches have the potential to address other neurodegenerative diseases, including mixed dementia conditions. His bold ambitious work is truly pathbreaking and serves as an inspiring model for academic research and translation landscape.

He remains dedicated to understanding molecular mechanisms of complex illnesses, seeking out new disease biomarkers and targets, and formulating effective and affordable diagnostic and therapeutic frameworks that bolster enduring human well-being.

T. Govindaraju is a professor at Bioorganic Chemistry Laboratory, New Chemistry Unit, JNCASR, Bengaluru, India. His interdisciplinary scientific research and inventions have led to biomedical and biotechnologies that address critical issues in human health and society. He has contributed to science education through outreach programs for thousands of students and teachers. He was the secretary of Indian Peptide Society (2015-2023) and currently serving as the secretary of Chemical Research Society of India (CRSI).

His work focused on Alzheimer's disease (AD) and lung cancer, enabled development of novel diagnostics, therapeutics, and theranostics based on fundamental understanding of disease mechanisms. These efforts have culminated in over 170 publications, 35 patents, and 4 books. His integrative research approaches have led to ground-breaking inventions and technologies that are commercialized through entrepreneurship and licensing routes. His startup, VNIR Biotechnologies Pvt. Ltd (http://vnir.life) is an inspiring case of a Deep Science enterprise blossomed from an academic Institute. VNIR has the capability to supply indigenously developed high-quality NIR molecular probes and working on novel diagnostic platforms for selected diseases.

He has provided solutions not only to complex health and societal issues such as Alzheimer's disease (AD) and cancer but also established a paradigm of technology and innovation that inspires translational research in developing nations in the domain of molecular diagnostics and therapeutics. He has discovered and licensed a drug candidate (TGR63) with the potential to treat Alzheimer's disease to a biopharma company. This ingenious invention was conceived and developed in India with global impact.



Prof. Dr. Sangeeta Kale

Defence Institute of Advanced Technology
Pune

The author of this presentation has been working in the domain of sensors for past 30+ years. Indigenous sensor development has been a perineal problem in Indian infrastructure and we have to rely on imports for these small devices to build any bigger infrastructure in any industrial sector. In this context, our research group has been working on gas sensors, CBW sensors, electric-magnetic field sensors and healthcare diagnostic sensors using multiple approaches. Sensor development is now closely connected to machine learning algorithms so that the sensors become intelligent and can be used for multiple electronics platforms and from remote locations. This domain is thinly populated by our deep-tech developers and scientists. This domain will be deliberated in this talk. The opportunities, challenges and teething problems related to the mindset of bigger industries in our country are inter-related; which will be discussed.

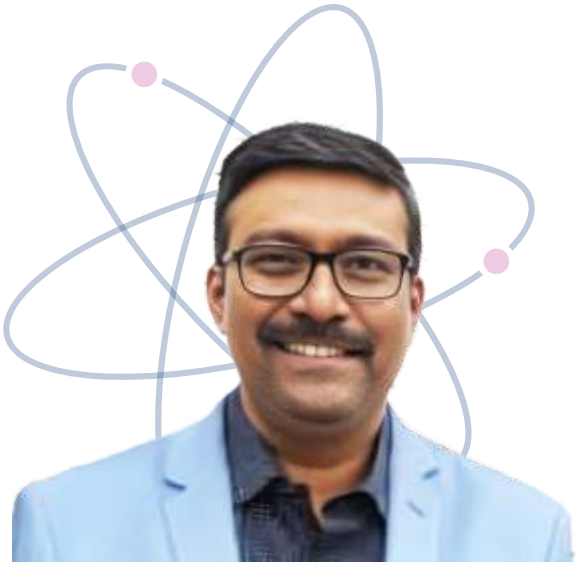
Opportunities in Indigenous Sensor Development for Viksit Bharat

ABSTRACT

Bulk CeO2 acts as an oxygen reservoir, which is pivotal from fundamental and technological paradigms for applications in sensing, therapeutics, environmental pollution remediation and catalysis. When the particle size is reduced to sub-10 nm, CeO2 exhibits higher surface area and increased surface defect concentration. Most nano-CeO2 synthesized by wet-chemical batch processes, are plagued by inhomogeneous mixing, temperature distribution and low yield. To tackle these challenges, continuous flow reactors, particularly helical coil reactors (HCR), are beneficial because of their secondary flow-driven hydrodynamics and transport phenomena, facilitating the controlled QD formation. Our research involves scaling up surface oxygen vacancy-rich CeO2 quantum dots (E-CeO2 QDs) by a self-seeded thermal decomposition process utilizing an in-house-designed HCR. The HCR showcased a high throughput of 89.8% and run-to-run reproducibility. HR-TEM, Raman spectroscopy and XPS confirmed the formation of 3 nm-sized, monodispersed QDs with abundant surface defects. Biological studies were performed to rationalize how the altered surface chemistry could help combat cancer. By 2040, cancer cases are anticipated to reach 29.9 million globally, while 82% of patients treated with conventional drug-based therapy or chemotherapy face unwarranted complications. Our findings revealed that E-CeO2 QDs, with high photo-transduction efficiency, could increase the temperature of MDA-MB-231 cancer cells by 19.7±0.6°C and eliminate 86% of them.

They also annihilated 49.2% reactive oxygen species and protected 95.6% human keratinocyte cells (non-carcinogenic), even against H2O2. This offers a first-of-its-kind drug-free therapy with minimal side effects and enhanced efficacy, potentially contributing towards realizing a "cancer-free" world by 2047.

Wearable Robotics: Intelligent Adaptive Control Approach for Actuated Ankle–Foot Orthosis



Prof. Dr. Kaushik Das Sharma
University of Calcutta

ABSTRACT

To manage an actuated ankle–foot orthosis (AAFO) during walking, an advanced selectively adaptive hybrid fuzzy control system was employed. This system combined particle-swarm optimization with an adaptive fuzzy-logic control in conjunction with Lyapunov theory. The computationally intensive adaptation process was triggered only when the tracking error surpassed a specified threshold defined by a half-Gaussian function. The stability of the entire closed-loop system was rigorously validated using Lyapunov theory. The effectiveness of this innovative control strategy was demonstrated through both simulations and experiments involving five healthy participants. Compared to other existing control schemes, the proposed method significantly reduced both tracking error and required control torque. Moreover, this pioneering control approach for wearable robots holds promise for future application in other orthosis systems, such as those for the hand and hip. It has the potential to enhance rehabilitation outcomes for patients suffering from paralysis due to spinal cord injuries (SCI) or brain strokes, offering a significant advancement in the field of assistive robotics.

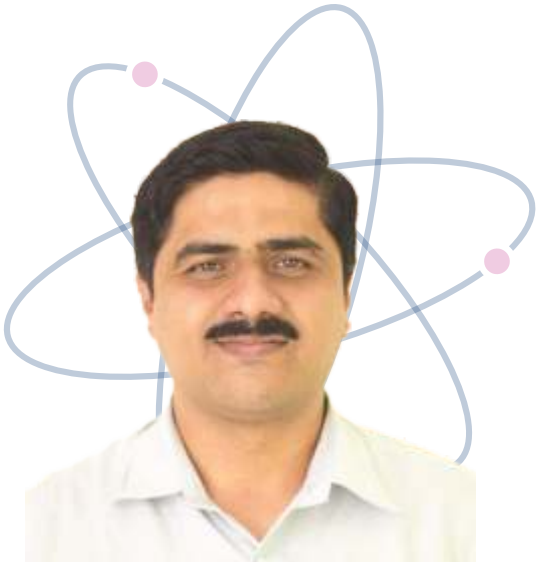
Dr. Kaushik Das Sharma received the B.Tech. and M.Tech. degrees in Electrical Engineering from Department of Applied Physics, University of Calcutta, India, and Ph.D. degree from Jadavpur University, India. He is currently serving as a Professor in Electrical Engineering Section, and also Head of Department of Applied Physics, University of Calcutta, India. He was a Teacher-Researcher Fellow in University of Paris, Est Creteil, France. He is a recipient of the Kanodia Research Scholarship and University Gold Medal from University of Calcutta. He also obtained Graduate Level National Merit Scholarship from Government of India.

Dr. Das Sharma's key research interests include fuzzy control, stochastic optimization, machine learning, robotics and computational biology. Dr. Das Sharma has authored/co-authored 3 books and about 75 technical articles in international journals and conferences.

Dr. Das Sharma is a Senior Member of the IEEE (USA), Member of IET (UK), Member of ACM (USA) and a Life Member of Indian Science Congress Association. He is currently serving as Chair of the IEEE Joint CSS-IMS Chapter, Kolkata and International AdCom Member of IEEE Transportation Electrification Council.

Dr. Das Sharma is currently serving as an Editor of IEEE Transactions of Vehicular Technology and Engineering Applications of Artificial Intelligence (Elsevier).

Advancing Human Healthcare Through Regenerative Medicine: Harnessing the Power of Cellular Restoration



Prof. Dr. Shrikant V. Joshi
UKA Tarsadia University, Bardoli

Dr. Shrikant V. Joshi is an accomplished academician and researcher with a diverse background in pharmaceutical sciences. He completed his B. Pharm from S. N. Institute of Pharmacy, Pusad (Maharashtra), followed by an M. Pharm from R. C. Patel Institute of Pharmaceutical Education and Research, Shirpur (Maharashtra), and a Ph.D. from Veer Narmad South Gujarat University.

His research interests encompass a wide array of topics including in silico drug discovery, drug repurposing, anticancer studies, cardiovascular system, and traditional and herbal medicines.

Dr. Joshi has made significant contributions to academia, having published 2 books, 4 book chapters, 1 patent, and 35 research articles in peer-reviewed journals. He has also demonstrated a strong commitment to mentorship, having guided over 25 M. Pharm and 2 Ph. D. students.

In addition to his academic endeavors, Dr. Joshi has actively participated in various national conferences, seminars, workshops, and refresher courses as a resource person, sharing his expertise on topics ranging from safe disposal of medicines to molecular docking.

Driven by a passion for community outreach, Dr. Joshi has organized numerous awareness programs on healthcare issues such as cervical cancer, HPV vaccination, and safe disposal of leftover medicine. He has also played a pivotal role in arranging blood donation camps and health check-up camps in rural areas, exemplifying his dedication to social responsibility.

Furthermore, Dr. Joshi is deeply involved in professional organizations, serving as an associate editor for the 'Journal of Pharmacy and Applied Sciences' published by Uka Tarsadia University and holding positions in various committees including the Gujarat State Pharmacy Council and the Association of Community Pharmacists of India.

ABSTRACT

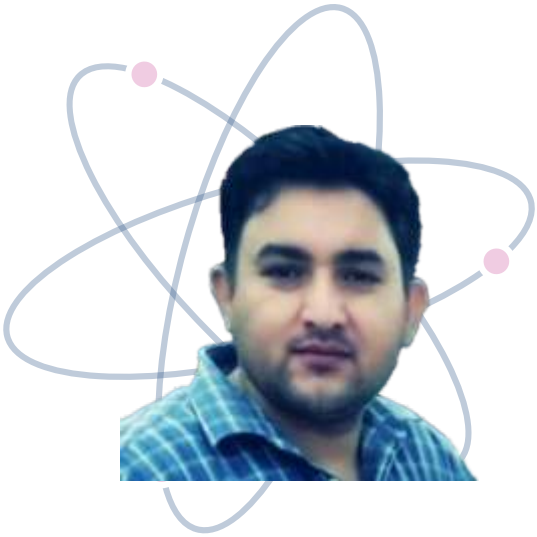
Regenerative medicine represents a transformative approach in modern healthcare, offering promising solutions for treating a myriad of ailments by leveraging the body's innate healing mechanisms.

By harnessing the power of stem cells, tissue engineering, and biomaterials, regenerative medicine aims to restore, repair, or replace damaged tissues and organs, revolutionizing the treatment of chronic diseases, injuries, and congenital disorders. From repairing damaged cardiac tissue after a heart attack to regenerating functional nerve connections in spinal cord injuries, the potential applications of regenerative therapies are vast and diverse.

Furthermore, the integration of cutting-edge technologies such as gene editing and 3D bioprinting holds immense promise in customizing treatments to individual patients, enhancing efficacy and minimizing risks. However, alongside the remarkable progress, challenges such as regulatory frameworks, ethical considerations, and scalability remain significant hurdles to widespread implementation.

Through interdisciplinary collaboration and continued research efforts, regenerative medicine stands poised to redefine the landscape of healthcare, offering hope for improved quality of life and longevity for patients worldwide.

Signal Processing in Healthcare

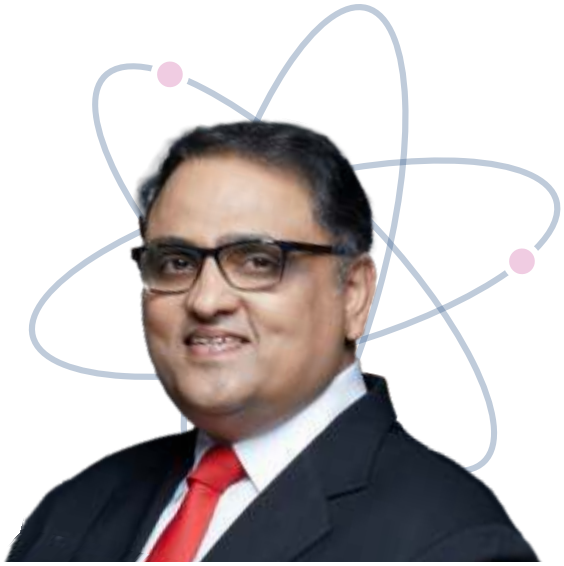


Dr. Omkar Singh
NIT Srinagar

ABSTRACT

Sensors measure the patient's physiological signals and produce electrical signals. A set of electrodes is generally used to sense a potential difference on the body surface such as an ECG or EEG. These medical signals aid in accessing the health status of a patient. The electrical signals produced by the sensors interface to a processor which is responsible for processing and analysis of the signals. Medical Signal processing involves various tools and filtering methods for extraction of few key parameters from a recorded signal based on which clinical decisions are made. The signal processing involves various stages such as data acquisition by sensors/electrodes; pre-processing and filtering; feature extraction; classification and diagnosis. Since medical signals are inherently complex and non stationary, this makes data driven signal processing methods as a natural choice for processing of such signals. The adaptive data driven methods tend to decompose a signal into individual modes that are present in it, thus separating them from each other. Attendees will learn about the latest data driven signal processing methods and their use in healthcare.

Dr Omkar Singh graduated from GCET Jammu in 2008 and received his M.Tech and Ph.D. degree in 2010 and 2018 respectively from National Institute of Technology Jalandhar. He joined the Department of Electronics and Communication Engineering at National Institute of Technology Srinagar as Assistant Professor in 2018. Before joining NIT Srinagar he worked as Assistant Professor in DAV University Jalandhar and Lovely Professional University Punjab for 8 Years. Over the years, Dr. Singh has attended many international conferences in India and abroad to present his work and has many journal papers to his credit in the field of medical signal processing. Dr Singh is a reviewer of many international journals. Dr. Singh's current research interests include biomedical signal processing, wavelets and filter banks and image processing.



Dr. Vijay Deshmukh
Smilex, Pune

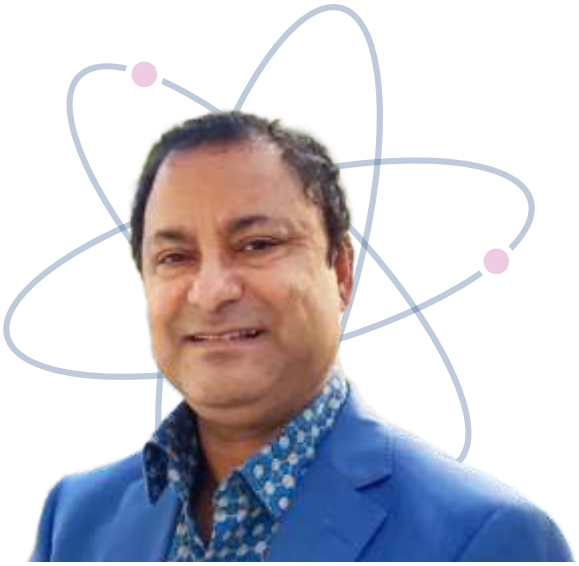
Dr. Vijay Deshmukh, an esteemed figure in Indian dentistry, obtained his Masters in Dental Surgery (MDS) from Nagpur University in 1992. With over two decades of teaching experience at various universities in India, he has also served as the Director and Head of Department at DPU University. As the founder and chairman of the International Clinical Dental Research Organization, Dr. Deshmukh has made significant contributions to dental research, receiving numerous accolades including the Dr. Ratan Memorial Award, Dr. Barucha Award, and the Colgate Gold Medal. He is a pioneer in dental implantology with over 34 years of research and clinical practice. Dr. Deshmukh is widely recognized for his expertise in immediate implantology and has published over 50 research papers. He frequently delivers lectures on dental implants both in India and internationally.

Flow synthesis of defect-rich CeO2 — a potential “drug-free” cancer nanomedicine

ABSTRACT

The cost of dental professional services in India is prohibitive for a significant portion of both the urban and rural populations. Presently, the vast majority (95%-98%) of dental materials, devices, and equipment are imported from countries such as those in Europe, the USA, Japan, and Korea. This import-dependent market is valued at approximately 15,000 crore INR annually. To align with the "Viksit Bharat 2047" vision and the goal of "Atmanirbhar Bharat" (self-reliant India), there exists a substantial opportunity for India to innovate and manufacture dental materials and devices domestically. Achieving this requires robust collaboration among dental colleges, clinicians, engineering and biotechnology institutions, and venture capital firms.

Signal Processing in Healthcare



Prof. Dr. Koustuv Dalal
Senior Health Economist
Mid Sweden University, Sundsvall, Sweden

ABSTRACT

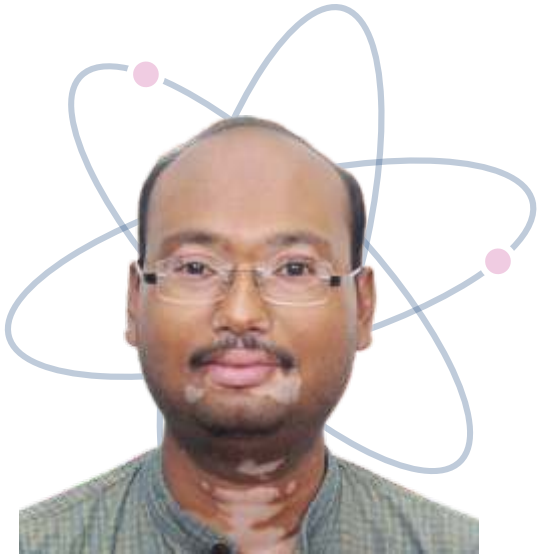
In today's world, sustainability is a paramount challenge, demanding urgent attention from individuals, organizations, and nations alike. We delve into the intricate web of environmental, social, economic, and health factors that define the sustainability paradigm. It examines the pressing need for concerted action to combat climate change, preserve biodiversity, ensure the responsible stewardship of our finite resources, and promote public health and well-being.

Through a holistic lens, the interconnectedness of sustainability across diverse sectors and disciplines, including health, is important. It underscores the imperative of adopting sustainable practices that not only balance human needs with environmental preservation and social equity but also promote population health and resilience. From advocating for clean air, soil and water to promoting sustainable farming, active transportation and green spaces, we emphasize the importance of fostering environments that support healthy living and well-being.

Moreover, the ethical and moral dimensions of sustainability recognize the significant health implications of environmental degradation and social inequities. It calls attention to the disproportionate burden of environmental hazards and climate change on vulnerable populations, highlighting the need for inclusive and equitable approaches to sustainability that prioritize health equity and social justice. Ultimately, we have a call to action, urging stakeholders at all levels to embrace sustainability as not merely a challenge but a collective responsibility and an unparalleled opportunity to promote both planetary health and human health. By integrating health considerations into sustainability efforts, we can forge a brighter, more equitable, and healthier world for generations to come.

Professor Koustuv Dalal, PhD, is a well-known person and leading researcher in the field of health economics and systems research, prevention science, health and safety promotion. Currently, Koustuv is a professor (full) at Mid Sweden University, Sweden, where he is also a faculty board member (Human Sciences) and responsible for the university's internationalization. Koustuv is/was a senior Health Economist at the School of Health Sciences, Mid Sweden University; School of Health and Medical Science/Orebro University; Centre for Medical Technology Assessment/ Linkoping University and Div. of Social Medicine/Karolinska Institutet (provides Nobel Prize in Medicine), Sweden. He is currently a distinguished visiting professor of al-Farabi Kazakh National University (World rank 122), University of Johannesburg, South Africa and an Invited/ Visiting professor at several world-famous universities, worldwide.

Koustuv has several Ministers, Directors, and senior persons of Ministries from different countries as his PhD students. So far, he has supervised more than 70 PhD/ MPhil/ advanced-level theses, led more than 50 international research projects, and has many national and international assignments as an advisor/ committee member. He has developed 40 academic programs and health economics courses in several world-famous universities. He has long and wide extensive experience in higher academic-administrative positions, such as dean, director, program coordination/lead, committee chair, and board member. Koustuv has academic travels in 52 countries and has an enormous national and international network with policymakers, where he has evaluated programs/projects and provided research-based advice.



Dr. Dhiraj Kumar

Group Leader, Cellular Immunology Group
ICGEB, New Delhi

Dhiraj Kumar is a Group Leader of the Cellular Immunology Group at ICGEB, New Delhi. His research is focused on understanding the perturbation of host physiological processes by the human pathogen Mycobacterium tuberculosis. To that end, his group employs cell biological, molecular biology and immunology tools to dissect the multi-layered interactions between the host and the pathogen. His work on host RNA splicing, unconventional cellular niches and autophagy during Mtb infection has opened newer avenues towards developing novel host-directed therapy against TB. For his excellent scientific contributions, he has received several national and international awards.

New Developments in TB Treatment

ABSTRACT

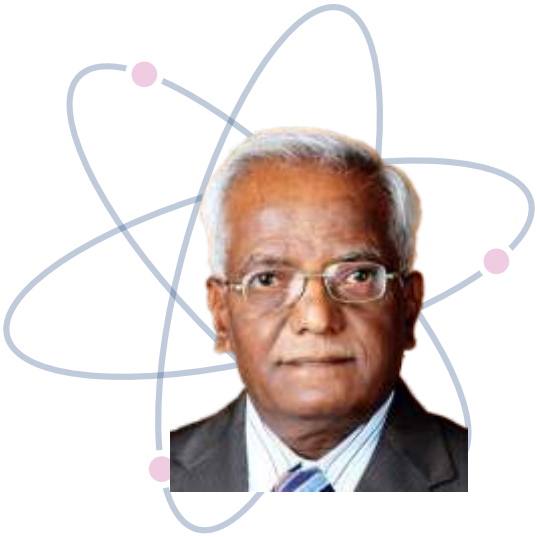
Tuberculosis (TB) remains a global health challenge. The TB elimination target needs transformative new approaches, given that the traditional approaches of prevention and therapy have shown severe limitations.

One of the major challenges is the duration of treatment- TB, despite being a bacterial disease, needs 6-9 months of antibiotic treatment. Compliance with treatment is extremely difficult to ensure for such a long treatment duration. This also contributes to drug resistance and therefore a continued need to discover new antibiotics. New, unconventional approaches, which can bring down this duration to 2-3 months, could transform the TB landscape globally. Secondly, BCG, the only available vaccine, has a poor success rate in controlling adult TB.

We have been trying to develop novel host-directed approaches against TB by first identifying host-dependency factors or host-susceptibility factors. In addition, we are also trying to understand host functions that are directly targeted by the bacteria. All these approaches are expected to provide novel drug candidates, which are not antibiotics but work by inhibiting the host functions that facilitate infection and pathogenesis.

The non-conventional approaches adopted in my group are expected to a) enhance BCG efficacy and b) act against the development of drug resistance in TB.

Nanotechnology Applications in Medicinal Plants : A New Approach for Healthcare in Ayurveda



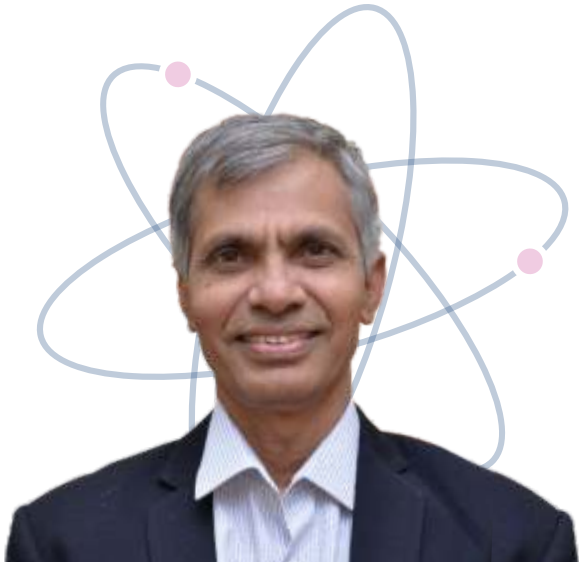
Prof. Dr. Shivaji H. Pawar

Research Director, Center for Research & Technology Developments Sinhgad Institutes, Solapur

ABSTRACT

In recent years, the spread of communicable diseases has created great concern for societal health globally. The spread of the COVID-19 disease is a present example of communicable disease and it was so hazardous that the World Health Organization (WHO) had to declare a pandemic. More worse than the severity of the disease was its persistence in the global community for longer than two years. In light of this situation, our research group which has been involved right from the inception of COVID-19 has taken up the initiative in fighting against this communicable disease based on the backgrounds of nanoscience and nanotechnology. Even before the emergence of COVID-19 disease, our group was working on communicable diseases such as tuberculosis. This talk is focused on our experiences in the field of health care based on advances in nanomaterials and bionanocomposites for their applications in medicinal plants. Nanotechnology applications in medicinal plants is a recent addition to Ayurveda, the ancient Indian medical system. Nanotechnology offers immense opportunities for the improvement of quality of life through applications in nanomedicine and food systems. This talk provides the basic knowledge about the role of nanotechnology in developing a sustainable form of Ayurveda utilising bionanocomposites formed with variety of biomaterials derived from medicinal plants.This month, we have edited a book entitled "Nanotechnology Applications in Medicinal Plants : A New Approach for healthcare in Ayurveda " ,which has been published by Cambridge Scholors Press,U.K.It will be useful to the students of nanosciences, Ayurvedic medicines, biological sciences, medical sciences, physics, chemistry, biotechnology and engineering sciences. The book is the first of its kind, and is based on interdisciplinary research from a variety of experts in their fields and it will be useful for development of" Viksit Bharat " specifically in health care of society.

Prof Dr. S. H. Pawar is presently working as the Director, Centre for Research and Technology Developments, Sinhgad Institutes, Solapur. He is the Emeritus Scientist, CSIR, Delhi, and the Distinguished Professor and former Vice Chancellor, D Y Patil University, Kolhapur. Prior to these positions he has worked as Professor and Head of Physics Department, Director, BCUD, Registrar of University, Dean of Science Faculty and Coordinator, School of Energy Studies at Shivaji University, Kolhapur. He has initiated and worked as Founder Director of three different multifaculty interdisciplinary Research Centers at TKIT, Warnanagar; Sinhgad Institutes, Solapur and Anekant Education Society, Baramati. Prof. Pawar has guided successfully 78 research scholars leading to their Ph.D. degrees, 52 in Shivaji University and 26 in D. Y. Patil University, Kolhapur. He has published more than 1000 Research papers, contributed to 40 book chapters, edited 15 books and obtained 12 patents. By virtue of these achievements, he has been featured as top 2% scientists in the globe. He has worked as visiting Professor/Scientist at many more universities and Institutions all over the globe. Presently he is working as a mentor to many doctoral / post doctoral fellows and guiding more than 60 UG/PG research scholars. His research interest includes Solid State Physics, Materials Science, Energy Science, Nanoscience and Nanomedicine, Nanobiotechnology, Atmospheric Nanoscience, Agricultural Nanotechnology and Ayurvedic Bionanocompsites (Bhasma). Recently he has edited the books entitled "Silk Fibroin: advances in applications and research" published by NOVA science publishers, USA. In January 2023 and " Nanotechnology Applications in Medicinal Plants and their Bionanocomposites : An Ayurvedic Approach" published by Cambridge Scholors Press,UK.June 2024.



Prof. Dr. Suresh W. Gosavi

Vice Chancellor
Savitribai Phule Pune University

Prof. (Dr.) Suresh Gosavi is currently working as a Vice-Chancellor of Savitribai Phule Pune University, Pune. He has more than 30 years of teaching and research experience. He has worked on various academic positions such as Director-School of Physical Sciences, Director-School of Basic Medical Science, Head-Department of Physics, Head- Department of Environmental Science at Savitribai Phule Pune University, Pune. He has also worked as a visiting professor at the University de Franche-Comté, Basancon, France; King Saud University, Saudi Arabia; and the University of Melbourne, Australia.

He is presently working as at PIRC Tokyo University of Science, Tokyo, Japan. His research interests mainly include nanomaterials and nanotechnology/nano-bio systems and applications, besides nanocapsules and targeted DNA vaccines for immunotherapy of cancer; micro and nanofluidics; and solar thermal technology for rural electrification. He has supervised 26 doctoral and 16 MPhil students, besides mentoring 14 postdoctoral fellows. He is fellow of Maharashtra Academy of Science. Dr.Gosavi is on the editorial and reviewer boards of several journals of repute. He has published 305 journal articles so far and has 8 patents to his credit.

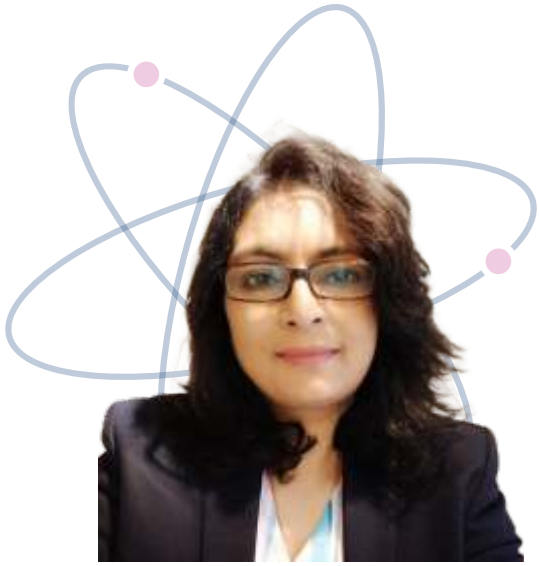
Development of Functionalized Nanoconjugates Membrane (FPMs) : A Simple VOC/VOM based Sensor for Detection of Cancer

ABSTRACT

Development of multifunctional early-stage, non-invasive diagnostics and therapies test for cancer still remains a great challenge. The conventional chemotherapy continues to be an important therapeutic option for different malignancies which lead to serious side effects. However, development of simple, sensitive and robust analytical method along with enhancement in detection limits and cost effective hand held device for early detection of these disease in early stage is always being an interest of research. Recent years have accelerated the use of nanotechnology to prevent, diagnose and treat cancer. To develop the non invasive diagnosis method, recent studies have been focused on to the study of cancer marker from excretory products like urine, exhaled breath or sweat. Several studies have reported on a various metabolic volatiles from urine as a potential cancer marker.

In this study, volatile alcohol metabolites, which are potential cancer marker from urine, were targeted by using detection assembly. Functionalized polymer membrane based chemical sensor, using Nafion-117 (Poly(perfluorosulfonic)acid) + Ag+/Fe2+ and PDMS (Poly dimethylsiloxane) + Spiro-Oxazine membrane has been developed, for detection and quantification of dissolved VOC in urine sample. The standardization of these FPMs is being carried out by using UV-vis, X-ray diffraction, Raman and ATR-FTIR, and FE-SEM technique. Some results on calorimaric changes in response to VOC and its sensing mechanisum will be discussed in detail for quantification and early detection of the cancer marker.

Targeting the Apoptotic Pathway for Therapeutic Intervention Against Cancer



Dr. Kakoli Bose

Advanced Centre for Treatment Research & Education in Cancer
Navi Mumbai

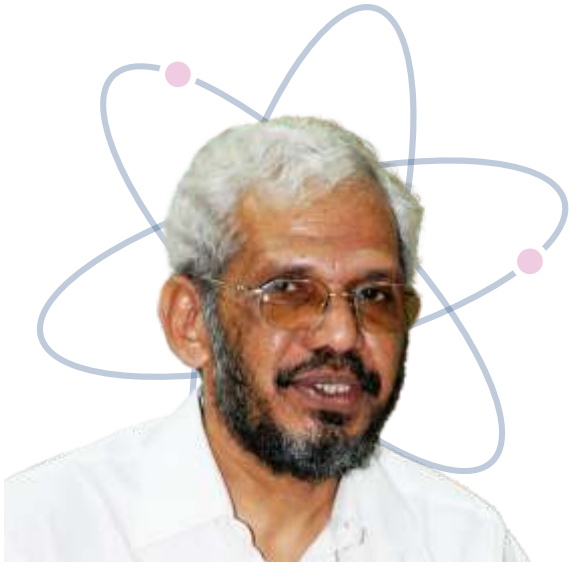
ABSTRACT

Apoptosis and cellular homeostasis are deregulated in several tumors leading to cancer therapy resistance. Several molecules of the extrinsic apoptotic pathway interact with each other forming a complex called Death Inducing Signaling Complex (DISC), which is a prerequisite for apotosis induction. Complex protein-protein interactions involving several pro- and anti-apoptotic molecules play pivotal roles in maintaining a healthy balance between cell death and survival, which otherwise leads to several diseases including cancer. Since, biochemical changes in the apoptotic pathway lead to their resistance to chemotherapeutic agents that are potent apoptotic inducers, it poses a major bottleneck in the efficient cancer treatment regime and hence demands dire attention. Our lab established the basis of DISC formation, and currently investigates cross-talks among different proteins in the pathway such as procaspase-8, cFLIP, and FADD, and their mutations in cancer that might preclude apoptosis activation, using multidisciplinary approach. These study not only provided significant advances on our understanding of DISC regulation but would pave the way toward development of peptide-based therapeutic molecules to combat cancer resistance to current anti-tumor treatments.

Dr. Kakoli Bose is currently serving as a Professor, Scientific Officer 'G' at ACTREC- Tata Memorial Centre, Mumbai. She completed her Ph.D. in Biochemistry and Biophysics from North Carolina State University (NCSU), USA. During her, postdoctoral stay at Tufts-New England Medical Centre, Boston, USA, she worked on cervical cancer. Her present research work focuses on targeting protein-protein interactions in the apoptotic pathway for therapeutic intervention against cancer using a multidisciplinary approach. Some of her breakthrough research findings are the basis of DISC formation in the extrinsic apoptotic pathway, complex allosteric mechanism of action of proapoptotic HtrA2 providing means to modulate its activity for apoptotic induction, mechanism of involvement of HtrA2 in Parkinson's disease by identifying novel mutations in Indian patients. Dr. Kakoli Bose is a Recipient of the National Women Bio Scientist Award, Govt. of India, 2015 (Young Category). She is an Associate Editor of Bioscience Reports, Portland Press, UK. She has also received several national and international research grants. She is an honorary member of the Biochemical Society, UK, and the Royal Society of Biology, UK.

Breakthrough research:

1. Described the basis of DISC formation in the extrinsic apoptotic pathway
2. Described complex allosteric mechanism of action of proapoptotic HtrA2 providing means to modulate its activity for apoptotic induction (includes cover page publication in Structure, Cell Press)
3. Elucidated mechanism of involvement of HtrA2 in Parkinson's disease by identifying novel mutations in Indian patients



Prof. Dr. B. Jayaram
IIT Delhi

Prof. B. Jayaram is currently Mentor, SCFBio, IIT Delhi. Prof. Jayaram received his Ph.D. in 1986 from the City University of New York, USA. He then worked as a Post Doctoral Fellow at Columbia University, NY, USA and as a Senior Research Associate at Wesleyan University, CT, USA. In 1990, Prof. Jayaram joined IIT Delhi and worked as a Faculty at IIT Delhi (1990-2023), as Head of Chemistry Department, IIT Delhi (2006-2009), as Founder Coordinator of the Kusuma School of Biological Sciences, IIT Delhi (2008-2014), and as Founder Coordinator of the Supercomputing Facility for Bioinformatics & Computational Biology (SCFBio), IIT Delhi (2002-2019). He guided 30 PhD students (28 completed and 2 in progress) and dissertations of several M. Tech., M.Sc. and B. Tech. students.

Prof. Jayaram was responsible for the creation of the science and software of the Dhanvantari (Genom Drug pathway) suite and several other molecular modelling and bioinformatics utilities, and making these software tools freely accessible to the global user community through SCFBio website. The Sanjeevini software already delivered experimentally validated molecules against HAV, HBV, CHIKV and fungal infections, breast cancer and malaria.

Prof. Jayaram served as a Member/Co-chair of several technical committees of DST, DBT, MEITY of Govt. of India, IUPAB National Committee and Indian Biophysical Society over the years. Prof Jayaram was a recipient of CRSI Bronze Medal, 2000 and 2014 IBM Faculty Award. He was recognized as one of the top five bioinformaticians in the country (2018). He published over 150 papers in peer-reviewed international journals and delivered over 300 invited talks. Please visit (http://www.scfbio-iitd.res.in/) for details.

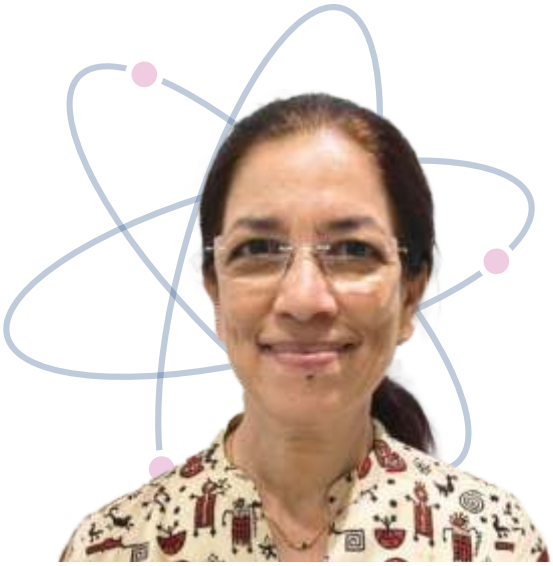
Genome annotation, Protein structure prediction, Targeted directed lead molecule discovery, Multi-targeted multi-phytochemical discovery

ABSTRACT

Over the past two decades, we have been intensely involved in developing the necessary science and software for computer aided drug discovery taking off from genomic/proteomic information. The result is a collection of thoroughly validated softwares named Chemgenome (for genome annotation), Bhageerath (for protein structure prediction) and Sanjeevini (for target directed lead molecule design and discovery), collectively called Dhanvantari suite (for Genom Gen Protei Candidate Drug Molecule discovery), with entry at any point along the pathway. More recently, we have also created a large database of phytochemicals from Indian medicinal plants (https://scfbio.iitd.ac.in/bimp/) comprising 1,02,750 molecules from 5654 plants and designed methods to identify their protein targets. The stage is thus set for molecular Ayurveda.

Working with the hypothesis that the success of Ayurvedic formulations is due to the action of multiple ligands inhibiting or activating multiple protein targets as necessitated by the patient's disease conditions, our challenge is to first identify the molecules and their targets in a few successful formulations, then create a work-bench to propose, based on protein expression profiles specific to patients, a mixture of candidate molecules for further experimental validation. Once stream-lined and validated, this will usher in a new era in personalized medicine linking Ayurvedic and allopathic principles.

Anthracyclines; Cardiotoxicity; Machine learning; Pediatric cancer patients; Risk prediction model



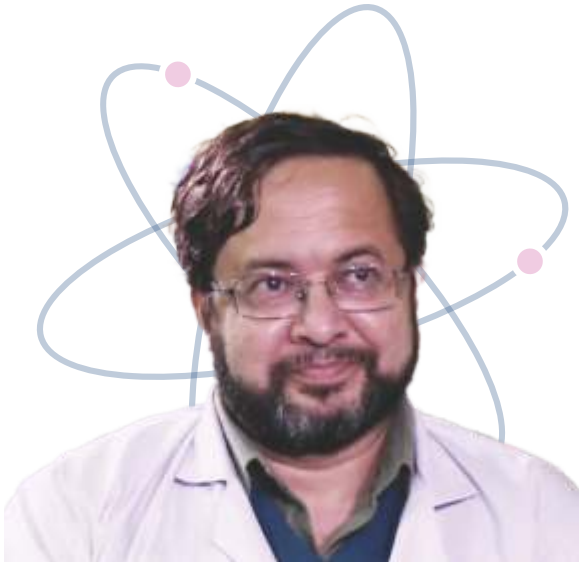
Prof. Dr. Varsha G. Desai
MIT-WPU

ABSTRACT

Anthracyclines are highly potent anticancer drugs extensively used to treat various malignancies in both children and adults. However, severe cardiotoxicity can occur within a year or decades after completion of treatment in some patients. This has become a major concern among the growing population of cancer survivors, particularly those who received anthracyclines during childhood. However, currently used techniques are less sensitive or have limitations in predicting the risk of cardiotoxicity in cancer patients treated with anthracyclines. To address this knowledge gap, a risk prediction model of cardiotoxicity will be developed using machine learning (ML) approach in pediatric cancer patients, a population vulnerable to anthracycline-induced cardiotoxicity.

Sixty children diagnosed with acute lymphoblastic leukemia and recommended anthracycline-based therapy will be enrolled in the study. Assessment of heart function by echocardiography, and detection of myocardial injury by plasma levels of hs-cTnT and NT-proBNP will be performed before initiation, during, and after completion of anthracycline therapy. Patients' demographics and clinical features will be used as inputs and cardiotoxicity measures as outputs in ML algorithms to construct a risk prediction model of cardiotoxicity. Successfully developing a prediction model will aid in identifying children at risk of cardiotoxicity after treatment, enabling oncologists to tailor therapy for each patient. Additionally, it will facilitate timely implementation of cardioprotective measures to enhance heart health among childhood cancer survivors.

Dr. Varsha Desai worked as a Research Scientist for the U.S. Food and Drug Administration (U.S. FDA) for almost 30 years. At the U.S. FDA's National Centre for Toxicological Research (NCTR), she played a key role in establishing high-throughput DNA microarray technology, making it accessible to investigators at NCTR and collaborative institutions. This led to the development of an innovative transcriptional tool: the "mouse MitoChip" — the first mitochondrial-specific gene expression array. It provided novel insights into the mechanisms of mitochondrial dysfunction associated with organ toxicities induced by anti-HIV and anti-cancer drugs. She continued her research endeavors in cardio-oncology with the main focus on anti-cancer drugs, anthracyclines. Although these drugs are effective in treating the disease, they can cause severe cardiotoxicity in some patients. After developing various mouse models, she and her team discovered novel early circulating biomarkers of cardiotoxicity (NOTCH1, vWF, and miR-34a), and also revealed the APJ-APLN signaling pathway as a target for cardioprotection. These findings paved the way to designing a study in pediatric cancer patients treated with anthracyclines to identify early predictive biomarkers of cardiotoxicity. Currently, similar study has been proposed in pediatric acute lymphoblastic leukemia patients. Her research in mitochondria was recognized with the FDA Award of Merit and the NCTR Director's Award, and with the FDA Scientific Achievement Award for her novel research in cardio-oncology.



Dr. Soumen Basak

National Institute of Immunology
New Delhi

Dr Soumen Basak has been leading the Systems Immunology Laboratory at the National Institute of Immunology since 2010. He is known for his pioneering studies in immunobiology. In particular, mammalian cells in their anatomic niche receive signals from a variety of cues that generate crosstalks between concomitantly activated intracellular pathways. Combining biochemistry, mouse genetics and computational modelling tools, he has elucidated how cell signaling crosstalk tunes physiological immune responses and how aberrant signaling crosstalks exacerbate disease pathologies.

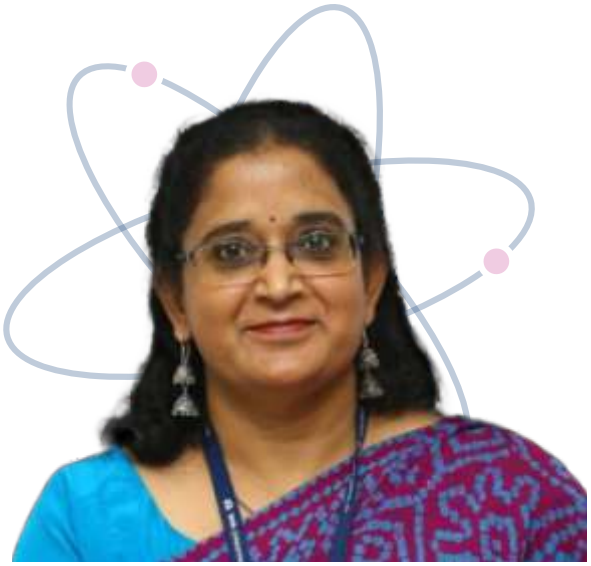
Dr Basak's research has been supported by almost all the major funding bodies in India, and also the Wellcome Trust DBT India Alliance. His significant research contribution has received wide recognition both nationally and internationally. He is a recipient of the National Bioscience Award for Career Development conferred by the Dept. of Biotechnology Govt. of India and Shanti Swarup Bhatnagar Award conferred by the CSIR-India. He also obtained faculty award from the Aegean Conference on Pathway Network and Systems Medicine for excellent research performance. Furthermore, he has been elected as a Fellow of all three Indian science academies, namely Indian National Science Academy (INSA), National Academy of Science India (NASI) and Indian Academy of Science (IASc).

Immunology, cell signaling, systems biology, inflammation, virus

ABSTRACT

Macrophages are critical for limiting viral multiplication in the periphery and restraining infection-inflicted pathologies in various anatomic niches. Macrophage-secreted inflammatory cytokines direct both cellular and humoral immune reactions against invading RNA viruses. However, excessive cytokine production by macrophages also leads to tissue destruction and inflammatory pathologies. Viral sensing by macrophages activates canonical RelA/NF-kB signaling, which mediates the expression of cytokines. However, it remains unclear how macrophage-intrinsic NF-kB signaling impacts the viral pathogenesis. Here we focused on two important RNA viruses frequently associated with human epidemics in India, namely Chandipura (CHPV) and Chikungunya (CHPV) virus. We perturbed the canonical RelA/NF-kB signalling by inactivating the gene encoding IkBa, which inhibits RelA-containing transcription factors, specifically in macrophages. We then challenged these NfkbiaΔLysM mice, which possessed heightened NF-kB signaling in macrophages, and cells derived thereof, with CHPV and CHIKV. Our studies revealed that heightened NF-kB signaling in macrophages limits pathogenesis in mice infected with CHPV and CHIKV involving interferon dependent and independent mechanisms. We argue that our studies may expand the therapeutic opportunities for intervention in viral disease in India.

Bio Digital Twin: An Emerging Technology for Acceleration of Design and Testing of Healthcare and Personal Care Products



Dr. Beena Rai

Tata Consultancy Services
USA

ABSTRACT

Bio Digital Twin is referred to a virtual replica of an organ or whole body, built using technologies such as physics-based or data-based models. Bio Digital Twins could transform the design and testing of formulations and devices in healthcare and personal care applications. The need for this technology has emerged with the shifting focus on sustainability wherein usage of animal testing is either to be eliminated or reduced. The goal of this technology is to enable in-silico tests at organ or body levels thus eliminating or reducing animal tests.

At TCS Research, we are developing purposive Bio Digital Twins built on physics based multiscale models to mimic the underlying functional mechanisms of the target organ. These bio digital twins are further augmented with the power of Artificial Intelligence (AI) and Machine Learning (ML) thus enabling design, rapid screening, and testing of products.

This talk shall highlight one of our solutions - Human Skin Digital Twin. We have applied techniques like molecular modelling and computational fluid dynamics simulations in creating a virtual replica of human skin mimicking its barrier functions and mechanical properties. Further, the usage of Human Skin Digital Twin in replicating the complex interaction of formulations, solvents, injections, and devices with human skin, thereby pushing the boundaries of scientific exploration, will be discussed. Finally, few industrial case studies highlighting the implementation of this technology will be presented.

Beena is Chief Scientist and Head of Research at TCS PacePort CMU, Tata Consultancy Services Ltd. (TCS), Pittsburgh, USA. Her pioneering research in Computational Material Science & Engineering, especially leveraging physics-based models and data analytics tools like AI/ML in the design, development & deployment of materials and chemicals has led to the creation 250+ research publications and 150+ granted patents & patent applications. Her research has not only been instrumental in getting the mindshare of TCS Customers but also resulted in significant dollar values.

Beena is a Fellow of Indian National Academy of Engineering (F.I.N.A.E.). She is a Distinguished Alumnus of National Chemical Laboratory Pune, India and recipient of prestigious Chevening Scholarship, Said Business School, University of Oxford, UK.

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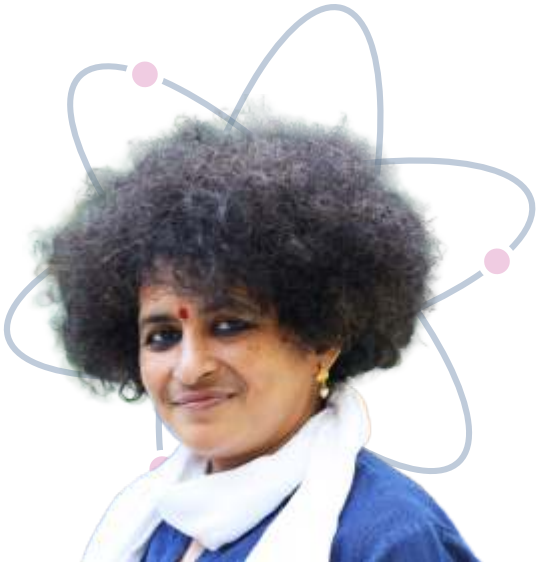


Prof. Dr. Dipshikha Chakravortty
IISc Bengaluru

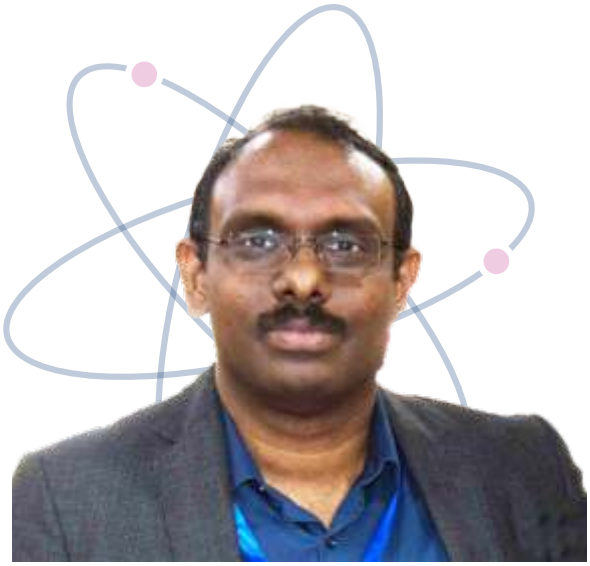
Dr. Dipshikha Chakravortty is a Professor at the Department of Microbiology and Cell Biology, Indian Institute of Science Bangalore, India and was holding "Astra Chair Professorship" till 2022. She is a Humboldt fellow and did her research work at FAU, Erlangen, Germany. Dipshikha did her Masters in Microbiology from Nagpur University and Ph. D. from National Centre for Cell Science, Pune. Her research focuses on infectious diseases and vaccine development. Her work has been published in top biological journals, including Journal of Experimental Medicine, EMBO J., Journal of Immunology, Infection and Immunity, J. Clim Microbiology, AAC, Journal of Antimicrobial Chemotherapy etc. She has won many awards to her credit like DAE Outstanding Investigator award, National Bioscience Award, DBT, NASI-Reliance Industries Platinum jubilee award etc. She is a fellow of National Academy of Sciences, India and Indian National Science Academy. She is involved in the Editorial board of many journals like Virulence, Innate Immunity and PloS One. She serves as reviewer in reputed journals like, Lancet, Nature Communications, MMBR to name few. Her research has been supported by grants from the Department of Science and technology, India, Department of Biotechnology, India, Indian Council of Medical Research, DAE. She has more than 150 papers in International Journal and has guided 20 students so far towards their Ph.D. Most of her PhD students are faculties in reputed Institute like IISc, BITS Pilani, NIT etc. She was the Chair of Wardens, from 2019 to 2021 and during Covid time, it was a daunting task for her to take care of all the students. She also served as Chair- ICASH from 2015-2021. Currently, she is serving as Integrated PhD Co-ordinator.

Micro shock wave, bacterial infections, diabetic wounds

ABSTRACT

We have developed a novel shockwave device exclusively for treating chronic wounds of various origin. In the animal models, we have tested the device for healing diabetic wounds as well as wounds arising out of frostbites. Application of shockwaves using this device is completely non-invasive. Precisely, a sterile dressing gauze is placed over the wound and then shockwaves are applied at the site. The dosage required for efficient wound healing is as low as 6 shots/cm2/day as opposed to a conventional lithotripter where the number of shots is in multiples of 1000. In our laboratory experiments, we have observed that shockwave exposure induces VEGF expression and triggers NO pathway. These molecules are well-known for their role in wound healing. In systematic invitro studies, we find that shockwaves induce wound healing by cell proliferation and not by cell migration. We are investigating the molecular mechanism associated with this phenomenon. The prototype of the shockwave device for wound healing has been tested in the laboratory. Device packaging for human use in clinical trials is being currently performed.

Emerging Strategies for Managing Chronic Diseases: A Call for Innovative Approaches



Prof. Dr. Ajaikumar B. Kunnumakkara
IIT Guwahati

ABSTRACT

Chronic diseases, also referred to as non-communicable diseases (NCDs) including cancer, diabetes, cardiovascular diseases, neurological disorders, and nephrological conditions, represent a significant challenge in contemporary times, accounting for approximately 60% of all deaths. Addressing these diseases through effective prevention and treatment methods is paramount. Over the past couple of decades, extensive efforts have been made from our laboratory towards understanding the pathogenesis of chronic diseases and exploring diverse approaches for their prevention and treatment. Our research has elucidated various molecular mechanisms underlying the onset and progression of these diseases, identifying potential molecular targets for novel therapeutic interventions. Additionally, we have developed a range of safe, efficacious, and cost-effective drugs aimed at combating these conditions. Presently, our focus extends to the development of biopharmaceuticals tailored specifically for treating chronic diseases. This presentation will provide an overview of the latest advancements originating from our laboratory for the better management of these diseases.

Dr. Kunnumakkara's research interests center on elucidating the role of inflammatory pathways in cancer development and identifying novel molecular therapeutic targets for oral and triple-negative breast cancers. Additionally, he is actively involved in the development of innovative therapeutic strategies and chemosensitizers for cancer treatment.

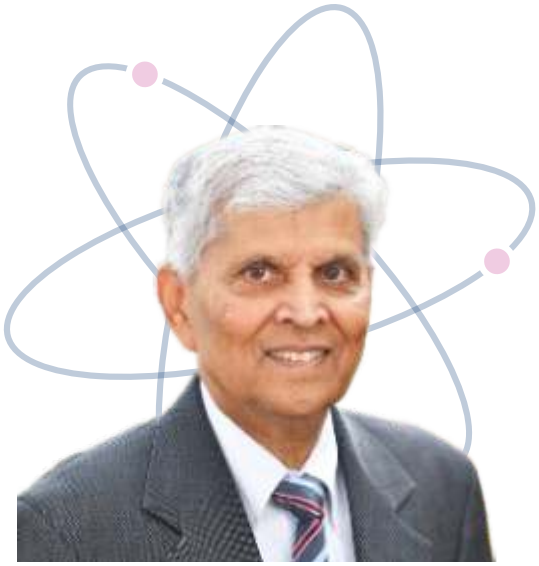
His studies have led to numerous clinical trials across various institutes aimed at combating cancer and other chronic diseases. Furthermore, he has contributed significantly to clinical studies investigating natural compounds/formulations for cancer and chronic diseases.

He has identified several potential novel molecular targets and drugs for the treatment of various chronic diseases including cancer.

His contributions to the field have been acknowledged through numerous awards, including Fellow of the Royal Society of Medicine, United Kingdom; Honorary Chair Professor in Nanoscience and Nanotechnology by Mahatma Gandhi University, Kerala; the recent accolade of "The Most Research-Proficient Faculty of India in the Field of Medicine" conferred by Career 360; Research.com Biology and Biochemistry in India Leader Award and Highly Ranked Scholar by ScholarGPS. In addition to his research endeavors, Dr. Kunnumakkara serves as the Executive Secretary of the Society for Nutraceuticals and Chronic Diseases and Joint Secretary of the Society for Translational Cancer Research.

Science, Scientific Temper & Spirituality

Understanding Consciousness



Dr. Ashok Joshi

Founder, Microlin Technologies
Founder, Clean Joule, USA

Dr. Joshi is a well-recognized innovator and high-technology entrepreneur. Dr. Joshi has developed several technologies in the Energy, Environmental and Biotech fields. He is an inventor of more than 150 issued US patents and has over 20 pending US Patents. He was responsible for commercializing six products (two used for institutional use, two for medical use, and one for industrial use). In recent years, his efforts are commercializing sustainable products in Air Care as well as in Surface Care.

Dr. Joshi is a philanthropist engaged in the development and building of three schools serving 2000 under-privileged children in rural India. One of the schools focuses on mentally challenged children. He helped build a center for learning life skills for children in Mumbai's slum area. He collaborated with Westminster College for the "Room to Read" project to be implemented in a rural Indian Village. Dr. Joshi is also actively involved in community development serving on various Boards.

Dr. Joshi is the recipient of numerous awards, including Pioneers of Progress Award for Science & Technology, Days of '47 State of Utah – 2014, 2014 Maxell Lifetime Achievement Award at the hands of Hon. Sharad Pawar, Utah Genius Award for the recognition of creative people behind Utah's economy – 2012, Industrial Research Institute (Washington) Achievement Award for Exceptional Work as a Entrepreneur, Scientist, and Philanthropist in the R&D Industry – 2009, Utah Asian Chamber of Commerce Award "Asian of the Year" – 2009, Utah Governor's Medal for Science and Technology – 2004, India's National Small Business Entrepreneurial Award by the President of India Honorable Zail Singh – 1983, India's Parkhe Award for Innovation – 1982.

ABSTRACT

Dr. Vishwanathji Karad, the founder and President of MIT Group of Institutions use Swami Vevekananda's quote as a guiding force behind his passion to promote and implement Universal Value based education in his institutions.

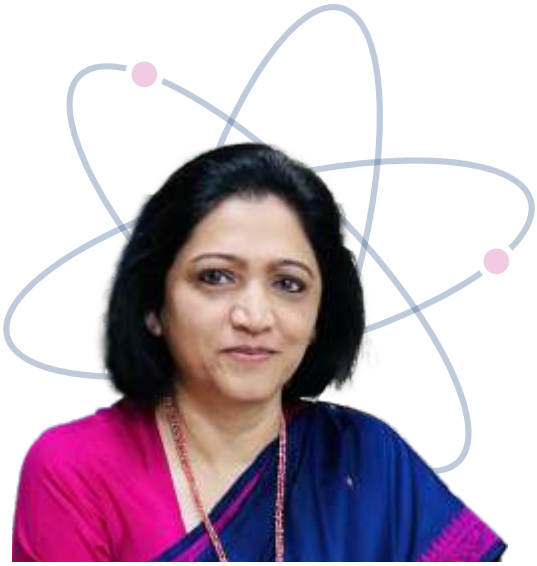
Swami Vivekananda's quote is "Union of science and religion alone will bring harmony and peace to the humanity." This is profound quote but to understand its meaning on deeper level, we have to understand what science means and what religion means.

What I understand from thought leaders is that Science means all knowledge tested and verified.

Here the religion refers to spirituality and not rituals. Having understood these definitions, there are still concerns regarding how to implement the intent of the quote to realize harmony and peace to humanity.

I will present one point of view to make progress on achieving this goal of Peace and Harmony from Indian Context.

Inculcating Scientific Temper and Peoples Participation in Protection of the Environment



Dr. Atya Kapley

National Environmental Engineering Research Institute, Nagpur

ABSTRACT

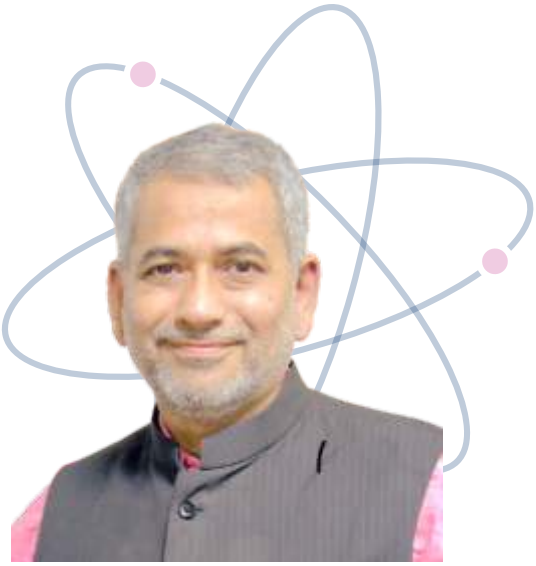
Sustainable environmental protection/ remediation and wellness index of the citizens are interlinked and the key drivers of Viksit Bharat. However, environmental remediation is not possible without peoples' participation. Highlighting the case of water as an example; India today is in a situation of water crisis. Even though the country is blessed with abundant natural resources, potable water is not available at every rural or urban space. The 'Jal Jeevan Mission', of the GoI, is striving towards the "Har Ghar Jal" scheme since 2019, but the sheer volume and geographical distance makes this a mammoth task. Besides, domestic wastewater treatment facility is poor, and data of Class I cities suggests that the country has a capacity of treating about 40% of sewage generated. The rest 60% flows untreated and pollutes the nearest water bodies. The Smart City scheme has been unsuccessful in dealing with sewage woes.

It is time to encourage people's participation and have responsibility sharing with citizens. CSIR NEERI's foray into setting up decentralized sewage treatment in towns demonstrated a successful bridge of taking science to society. Unfortunately, without people's participation the endeavor resulted in loss of treatment due to theft and rampant dumping of solid waste into the treatment units. Hence, it is time to build scientific temper in the citizens if we aim to corelate development with wellness index. In this direction, the GoI has implemented four major policies namely, Scientific Policy Resolution (SPR 1958), Technology Policy Statement 1983 (SPR 1958), Science and Technology Policy 2003 (STP 2003), and Science Technology Innovation Policy 2013 (STIP 2013), to inculcate scientific temper.

Dr Atya Kapley is a Chief Scientist at CSIR NEERI and heads the Sustainable Environmental Processes Vertical. She is a biotechnologist with 30 years of research experience in the field of environmental genomics and remediation. Her scientific career brings in three important domains: (i) Generating knowledge via basic research (ii) Taking science to society and (iii) Working in the area of gender equality and empowerment of women in science. She uses a multi-disciplinary approach to address rising levels of environmental contamination, specially focussing on rejuvenation of degraded land and wastewater. She has spearheaded the team that worked on the field-scale implementation of in-situ drain treatment at the Sangam Point, Ganga River, Prayag Raj, during the Kumbh Mela of 2019. She also works on improving the efficiency of biological wastewater treatment via a metagenomic approach. She leads a team that prepares the Environmental Status Report of Nagpur city for the Nagpur Municipal Corporation and advises the NMC on improving environmental parameters.

Besides environmental remediation, she is also leading a team that maps the microbial diversity of the Ganga River, from Gangotri to Diamond Harbour. Her work highlights the bio-geochemical cycles and demonstrates the ecosystem services of the river. She works on analysing and increasing awareness on the rise of antimicrobial resistance in the environment. She works to empower women in science, functioning as the Vice President of the Organization for Women in Science for the Developing World (OWSD), Asia Pacific region. OWSD, a unit of UNESCO with Headquarters at TWAS, Trieste, Italy.

Spiritual Practices for Holistic Wellbeing



Prof. Dr. Milind Pande
Pro Vice-Chancellor
MIT-WPU

Dr. Milind Pande is recognized as a transformative leader in higher education. Under his dynamic leadership, MIT School of Telecom Management has achieved recognition as one of India's top 50 premier B-Schools in the NIRF rankings. With over three decades of experience, Dr. Pande currently serves as the Pro Vice Chancellor of MIT World Peace University (MIT-WPU) in Pune. His visionary approach fosters innovation through platforms such as Smart India Hackathon, HackMITWPU, RIDE (Research Innovation Design Entrepreneurship), Robocon, and Drone competitions.

Dr. Pande leverages emerging technologies to cultivate new business models and encourage startup development, showcasing his foresight and expertise. He aims to transform MIT-WPU into an innovation hub that nurtures an entrepreneurial spirit among students. His dedication and strategic corporate and community partnerships have propelled the university towards excellence, enhancing the holistic development of students.

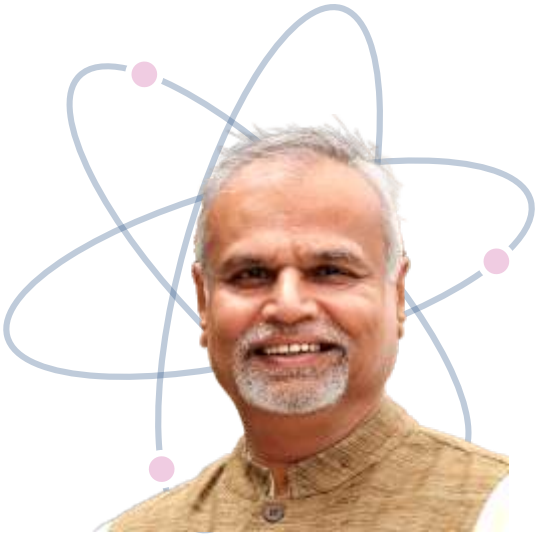
Dr. Pande has launched significant technical events in India, including Robocon, Smart India Hackathon, RIDE, and HackMIT-WPU. He has been the National Convenor of the G20 Interfaith Summit and the Chief Convenor of UNESCO's 'Endowment Lecture Series,' promoting universal education and peace globally. A recipient of a Post-Doctoral Fellowship in Technology Transfer from the Ministry of HRD, he has over 70 research publications and 11 internationally granted patents. Honored with the VASVIK Industrial Research Scientist Award and the Rotary International Peace Fellowship, Dr. Pande envisions integrating innovative technology with Indian talent, encapsulated in his belief of IT+IT=IT, "Innovative Technology + Indian Talent = India Tomorrow."

ABSTRACT

"Science, Scientific Temper & Spirituality" delves into the synergistic relationship between scientific inquiry and spiritual understanding, emphasizing their combined roles in shaping Bharat@100. The cultivation of scientific temper is crucial for Bharat, as it fosters a mindset grounded in rationality, critical thinking, and empirical evidence, which are essential for innovation, problem-solving, and societal advancement. The scientific method and philosophy provide a framework for understanding the world through empirical evidence and logical reasoning, while spirituality offers insights into the human experience beyond material phenomena. This dual approach enriches our comprehension of existence, balancing material progress with deeper existential insights.

The intersection of neuroscience and spirituality reveals how spiritual practices can influence brain function and structure, promoting mental health and cognitive flexibility. Studies in neuroscience demonstrate how meditation, prayer, and other spiritual activities activate specific brain regions associated with emotional regulation, empathy, and overall well-being. Neuroscientific research strives to correlate neural activities with conscious experiences, while spiritual philosophies often view consciousness as a fundamental, transcendent aspect of existence. Spiritual practices play a significant role in promoting holistic well-being by integrating the physical, mental, and spiritual dimensions of health. Practices such as mindfulness, yoga, and meditation are shown to reduce stress, enhance mental clarity, and foster emotional resilience, aligning with both scientific findings and spiritual wisdom. This integration paves the way for a balanced, enlightened, and progressive Bharat, where scientific innovation and spiritual wisdom coexist to enhance human flourishing and societal well-being.

Evolving Journey of Modern Science into Meta-science



Prof. Dr. Bhushan Patwardhan

Former Vice Chairman, UGC
SPPU, Pune

ABSTRACT

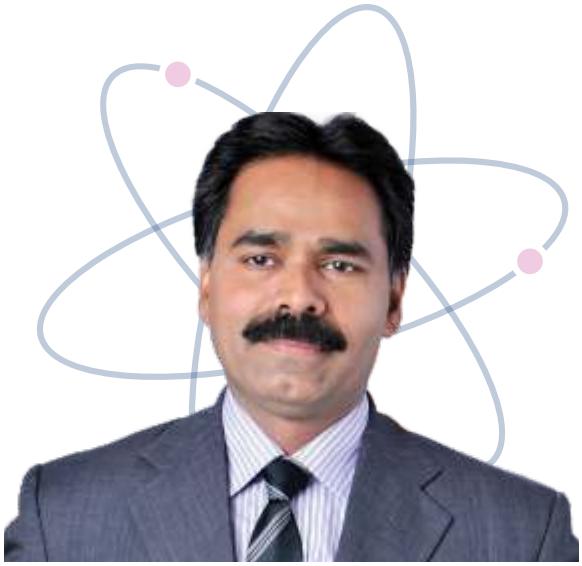
Over the last few centuries, modern science has excelled in studying the intricate details of the physical world – atoms, molecules, cells and genes. We have also witnessed spectacular advances in cutting-edge technology. This success, however, has come at a cost. Science and technology have been often used for human comfort at the expense of nature and sustainability. This has triggered the early onset of the Anthropocene era, marked by environmental degradation leading to existential crises. Standing at this crossroads, we must pause to choose the right path of sustainability and peace. This demands a confluence of science and spirituality, a synthesis evolving into meta-science. In this journey, the diverse and profound knowledge systems from Bharat can offer rich sources of ideas and innovation. It distinguishes between external (Apara Vidya) and internal (Para Vidya) knowledge and further categorizes knowledge into information (Jnana), specialized knowledge/empirical science (Vijnana), and profound wisdom (Prajnana). This journey is a call for a new scientific paradigm, one that integrates the pursuit of knowledge, science and spirituality with the pursuit of a harmonious relationship with nature for the larger cause of universal well-being and peace. The need for transition to meta-science will be discussed with examples from health and medicine disciplines. The Upanishadic declaration Prjnanam Brahma – Consciousness is Supreme and the spirit of Vasudhaiva Kutumbakam – World is One Family summarize a unique holistic view and shall continue to guide us as we move towards Vikasit Bharat 2049.

Professor Bhushan Patwardhan is a highly accomplished academician with over 40 years of experience in higher education, scientific research, and institutional governance. He is widely recognized as one of the most influential biomedical scientists. He is a distinguished Fellow of both the National Academy of Sciences and the National Academy of Medical Sciences in India. He serves as an Adjunct Professor at Western Sydney University in Australia and Co-chair of the WHO Expert Group for the Global Center for Traditional Medicine and the First Global Summit on Traditional Medicine.

He has also been involved in policy-making committees and task forces for esteemed organizations like the National Knowledge Commission, Planning Commission, NITI Aayog, and the World Health Organization Geneva. Beyond his scholarly pursuits, Professor Patwardhan has actively contributed to raising awareness about predatory publishing and has served as the Chairman of the Consortium for Academic Research Ethics (UGC-CARE) and his World View article on predatory journals, published in NATURE, has garnered widespread appreciation. He has contributed significantly to quality mandate of the UGC and innovative concepts including Academic Bank of Credit recommended by the National Education Policy 2020.

He is recipient of numerous orations and awards, including the Sardar Vallabh Bhai Patel Award, Sir Ram Nath Chopra Oration, Waldemar Haffkine Oration among many others. Professor Patwardhan has received numerous research grants, supervised the research of 20 PhD students, and holds 8 Indian Patents and 2 US Patents. With scientific publications, numbering over 175, Scholar h-index 59, and 14,000+ citations he is recognized as one of the world's top 2% of biomedical scientists in the Stanford University list.

Relation Between Brain, Mind and Consciousness



Prof. Dr. Milind T. Patre

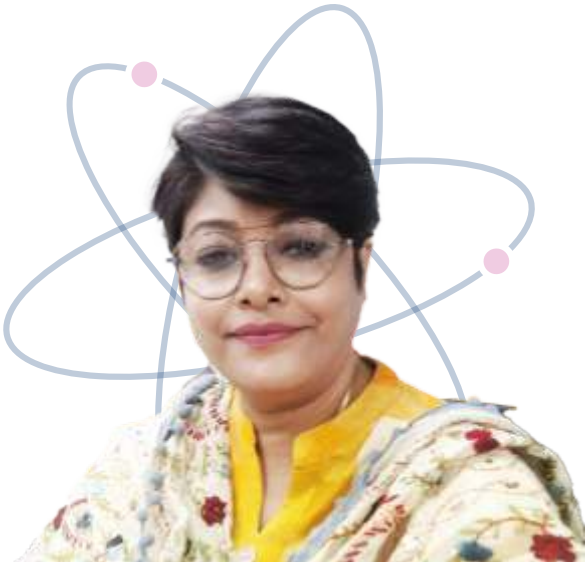
Associate Dean
Faculty of Peace Studies, MIT-WPU

Prof. Dr. Milind Patre graduated in B.E. (Civil Engineering) from Govt. College of Engineering, Amravati (Maharashtra) and received his M.A. (Philosophy) from SPPU, Pune. Prof. Dr. Patre developed contents for the Peace program of MIT World Peace University, Pune. It comprises 7 Peace Subjects for ex. Philosophy of Science and Spirituality, Indian Tradition, Culture and Heritage etc. He has organized several tailor-made yoga modules for students, parents, and elderly as well. He is also a renowned motivational speaker for youth's well being.

ABSTRACT

Humanity has always been intrigued by the mystery surrounding Brain and Mind. The argument seems to be never-ending whether the seat of mind is brain. Looking from the perspective of science, the brain is a physical organ as much as the heart is a physical organ. The mind is very subtle, yet a bridge between the world of physicality and the realm of consciousness. The mind is not a definitive thing, it's a process. It is a bio-computer. It is much better to call it as 'minding' than 'mind'. In Yogic parlance, we call man as a three-layer phenomenon; the Gross, the Subtle and the Causal. The Gross is physical (which includes the Brain), the Causal is imperishable, eternal, beyond birth and death (which is Soul). It is only at the Subtle layer where human evolution is possible. The Subtle layer is the interplay of Chitta (Consciousness), Manas (Mind), Buddhi (Intellect) and Ahankar (Ego). If we use the analogy of a sublime painting artwork, the Chitta is like a canvas to a painter, and the fine refinement of manas, buddhi and ahankara are like ones discerning ability to work with the colors in such a way to manifest the most beautiful creation of one's life. The real transformation is therefore the transformation of the subtle body, the transformation of human consciousness. Once that process sets in, everything changes. The way we begin to look at our priorities, our challenges, our insecurities etc., everything takes on a new higher dimension. And, in fact, that should be the highest goal of education, to create an ecosystem wherein the refinement of subtle body occurs during teaching-learning on its own accord.

Impact of Artificial Intelligence on Young Generations and the Power of Spirituality for Well-Being



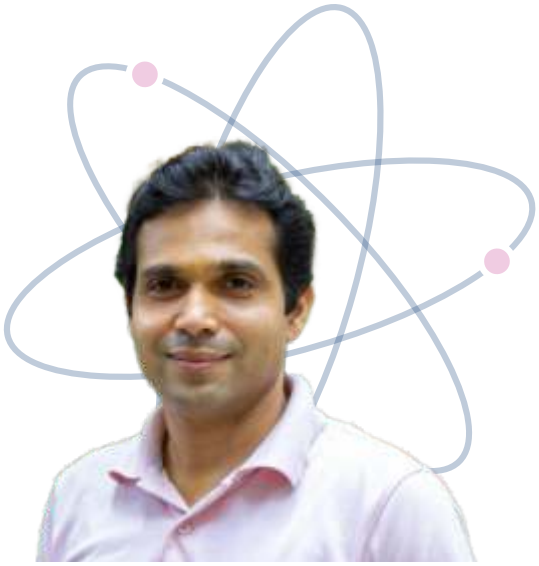
Prof. Dr. Dayeeta Roy
MIT-WPU

Dr. Dayeeta Roy obtained her post-graduate and undergraduate degree in Philosophy from Calcutta University in Kolkata. She has completed her M.Phil degree in Indian Philosophy from Savitribai Phule Pune University and also received her Doctoral degree in Philosophy from Savitribai Phule Pune University. During her research, she was awarded JRF from ICPR (Indian Council of Philosophical Research, New Delhi). She completed her Diploma Degree in Indology from Ramakrishna Mission Institute of Culture, Kolkata. Her primary emphasis is on exploring the role of Peace in our society in the light of Indian Philosophy. Her interest area is: Indian Philosophy especially Buddhism, Nyaya and Advaita Vedanta, Logic, Indology, Indian Culture, Art, and Music. She has been appointed as a panel examiner at Calcutta University and IGNOU.

ABSTRACT

This paper provides a practical approach and tools for the development of "Spiritual Power" within us and for maintaining well-being for all, even though we live in the era of Technology. Artificial Intelligence (AI) and Spirituality represent two powerful forces where AI with its transformative potential, is revolutionizing education, career opportunities, and social interactions, offering unparalleled access to information and personalized learning experiences. However, this technological boon has not been without its challenges, including ethical dilemmas, privacy concerns, and the risk of social and emotional disruption. Whereas spirituality remains a steadfast pillar of human well-being. Amidst the growing influence of AI, the power of spirituality to nurture mental and physical health, foster community connections, and promote holistic personal development is more crucial than ever. By examining the benefits and challenges posed by AI, alongside the enduring strength of spiritual practices, we can gain a comprehensive understanding of how these forces interact to shape the well-being and prospects of younger generations. This exploration highlights the importance of balancing technological advancement with spiritual growth, ensuring a harmonious development path in an increasingly digital world.

Intertwining Science and Spirituality for the Conscious Planet



Prof. Dr. Ramakrishna Bhat
IISER Pune

Prof. Dr. Ramakrishna G. Bhat (RGB) received his M. Sc. (1998) from Karnatak University, Dharwad. He obtained his PhD degree (2004) from the Department of Organic Chemistry, Indian Institute of Science (IISc) Bengaluru under the supervision of Prof. Srinivasan Chandrasekaran. Subsequently, he joined Prof. Brian M. Pinto's research group as a postdoctoral fellow at the Simon Fraser University, British Columbia, Canada.

Later in the year 2006, he began his independent career at the Indian Institute of Science Education and Research (IISER) Pune and he was promoted to Full Professor in 2019.

His research focusses on 'Organic Synthesis and Catalysis' encompassing the broad research areas on Photoredox catalysis, Photoinduced as well as metal catalyzed Carbene transfer reactions, C-H bond functionalization and Organocatalysis. He has been actively involved in the outreach educational activities and Teachers' training programs.

IISER Pune conferred on him the Excellence in Teaching in the year 2021. Prof. Dr. Ramakrishna G. Bhat is also a part of Editorial Board of 'Tetrahedron and Tetrahedron Letters' – Scientific Journals.

Prof. Dr. Ramakrishna G. Bhat had early exposure of Sa skruta with minimum required knowledge and he has been reading Upani hads, rimad Bhagavadgeeta Bha hya and Darshānas. In order to connect science (rational thinking) and Spirituality (Adhyatmā), he has been attempting the path of practicing the Nitya and Naimittika karma, Meditation etc, so as to balance the inner and outer life spheres.

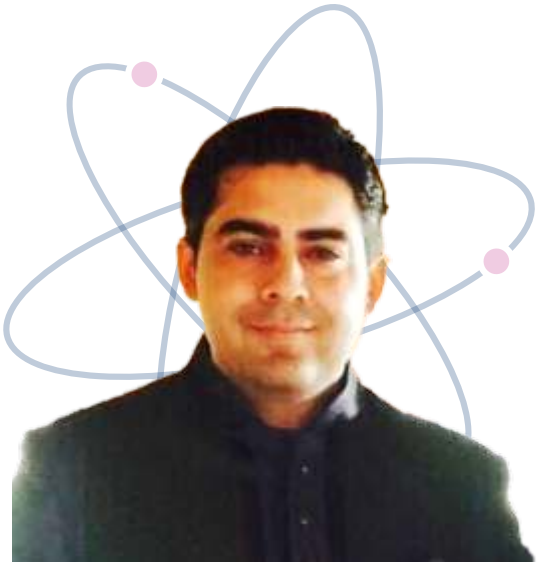
ABSTRACT

Even though, modern scientific world has successfully created solutions for the problems of humans at the physical realm, yet emotional breakdowns, inner voids, and ethical and moral transgressions are challenging humanity. With the integration of spirituality in everyday chore, one can achieve greater humanity and peace that may impart the reductionist to wholistic (holistic) view of the world. Scientific temper along with spiritual journey would surely help in achieving our age-old concept of 'Vasudev Kutumbakam' leading to unbiased, universal and integrative society. India (Bhārata) has been the mother of Spirituality emphasizing to see the divine in everyone and everything.

My actual goal has been exploring the novel 'catalytic strategies' to synthesize the molecules of industrial relevance and bioactivity. Along with my scientific research, throughout my personal and professional journey, I have been consciously interacting with young students. I have been attempting to understand the agony, depression, humiliation, and failures faced by many students. At the same time, in my view, the laboratory space is not only for the scientific work, but also for the inner growth of one's personality.

Along with scientific quest, one needs to follow the 'Dharma' (Not Religion) – set of duties bound by law of nature driven by utam. Spirituality through Karma yoga helps in avoiding depression and maintaining positive frame of mind. Teaching the next generation students to be competitive with intrinsic motivation along with the milestone motivation is crucial. The practicality of intertwining the Science and Spirituality, and its positive effect on moral order of younger generation for the better society will be discussed in the lecture.

Union of Science & Spirituality



Shri. Gautam Kumar Ailani
Renowned Pranic Healing Trainer

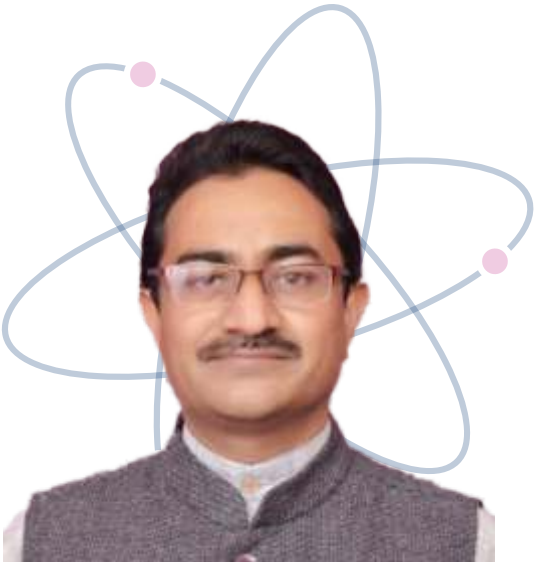
Bachelor of Electrical Engineering from the University of Minnesota, U.S.A. Practising Arhatic Yoga & Pranic Healing since over 17 years. Teaching Meditation & Pranic Healing for 14 years in West Africa, East Africa, Morocco, Middle East and India. Currently a Trustee of the Yoga Vidya Pranic Healing Foundation of South Mumbai and Executive Committee Member of World Pranic Healing Foundation India. He has a passion for Esoteric Studies and Understanding how Spirituality can be integrated into our daily material lives.

ABSTRACT

"At the present moment, science sometimes seems to be incompatible with spirituality. What we call spirituality is actually inner sciences or sciences not dealing with the physical world. The process of union between science and spirituality is already in progress." – Master Choa Kok Sui, Founder of Modern Pranic Healing & Arhatic Yoga.

This can be seen in the field of quantum physics, artificial intelligence, and other such fields. One such union is seen in practice of certain yoga techniques & advanced meditations such as the Twin Hearts Meditation which aims at spiritual development but also has a direct relation to the Heart-Brain Coherence.

Understanding Consciousness



Prof. Dr. Bhag Chand Chauhan
Central University, Himachal Pradesh

Dr. B.C. Chauhan is Campus Director at the Shahpur Campus of Central University of Himachal Pradesh (CUHP), Dharamshala. Earlier he worked as Dean of School of Physical & Material Sciences, and Head of Department of Physics & Astronomical Science, Member, HP State Higher Education Council, Task Force of NEP2020 implementation, and many other important committees in the field of academia.

Prof. Chauhan has an excellent research career mainly in the field of Neutrino Astrophysics. After Ph.D. he worked as a Post-Doctoral Fellow (PDF) in abroad and currently, he is working as a Professor of Physics and also as a Visiting Associate of IUCAA, Pune (since 2010).

He has published 100+ well cited and quality research Papers, Preprints, and Articles in Journals, Magazines and Newspapers. He is an Editorial Board Member and Referee of a number of prestigious Research Journals.

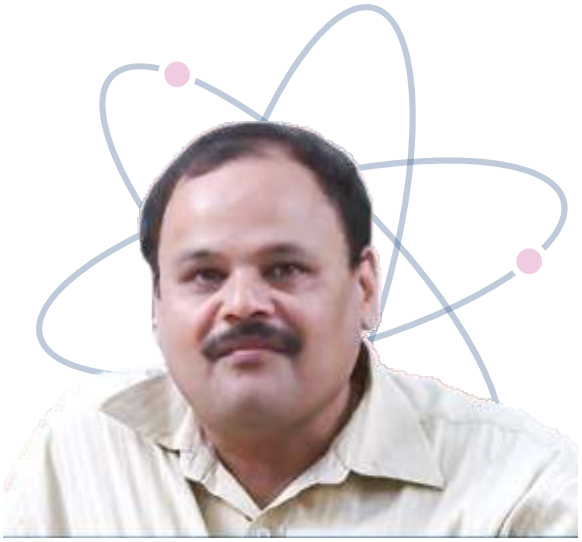
He has recently written two Books on Indian Knowledge System (IKS): 1. IKS- The Knowledge System of Bharata (A Textbook based on NEP2020 guidelines) (462p), 2. History and Culture of Science in Bharata (800p).

In the light of his excellent academic career and active participation in social activities, he has been conferred with several Honours/ Awards/ Distinctions by a number of organizations.

ABSTRACT

Modern Science offered a solution to a number of anomalies related to the nature of matter and light, the behaviour of solids, the structure, and function of DNA, super-conductivity, properties of super-fluids, and burning of stars etc... Despite of extraordinary successes, the quantum theory is suffering with serious conceptual and foundational complexities, like the collapse of wave function, intrusion of observer, measurement problem, and spooky connections. Digging into the foundation of quantum theory reveals that the observer is treated as an entity independent of the observation. One should not forget that the observer is nothing but the conscious being, which makes perception possible, and validates the existence of a phenomenon. In principle, it is an integral part of the phenomena, and inclusion of the consciousness is imperative in the formalism of foundational understanding of nature. On the other hand, progression of science and technology has increased the physical comfort, which in turn raised the level of human happiness resulting endless desires and greed. It is evident that human thinking, perception, and values are at the root of most of the global, social, and personal tribulations. More than ever, we need to re-examine our way of thinking in order to liberate ourselves from the inner barricades so that human could experience the potential of the true nature. In order to check the negative impact of scientific developments, the understanding the nature of consciousness is must. Therefore, inclusion of the consciousness in the scientific theories, although a big challenge, can eradicate the foundational flaw of modern science and facilitate the humans to create a peaceful and prosperous world. As such, a revolution of consciousness, i.e. a paradigm-shift is imperative, which can radically transform our world-view of reality, identity, social relationships, and human purpose.

Neuroscience of Spirituality



Prof. Dr. Deepak M. Ranade

Consultant Neurosurgeon
Author, Speaking Tree
Times of India

Dr. Deepak Ranade was a Professor of Neurosurgery in a University Hospital in Pune. He set up the Department in 2001 and since then the Department has become one of the most reputed with state-of- the-art technology and equipment. It is a recognized center for Neurosurgical Training and admits 3 students each year for the MCh Neurosurgery course. He has recently started his own centre of Spine Surgery.

Dr. Ranade has published more than 30 papers in International Journals.

He has trained in endoscopic discectomy in Arizona, USA. He has also trained in Seoul, South Korea and in Bern,Switzerland.

He has one of the largest series in the country for anterior approaches to the dorsolumbar spine.

He is an avid trekker having completed more than 14 high altitude treks in the Himalayas.

He is also a writer of repute and has contributed more than 120 articles in the Speaking Tree column of the Times of India, the national newspaper in the fields of Consciousness, Quantum Physics, Spirituality.

He is also a self taught Saxophonist and has given more than a dozen public performances.

Presently, he is pursuing a PhD in 'Role of the Default Mode Network in genesis of

Consciousness and the Sense of Self.'

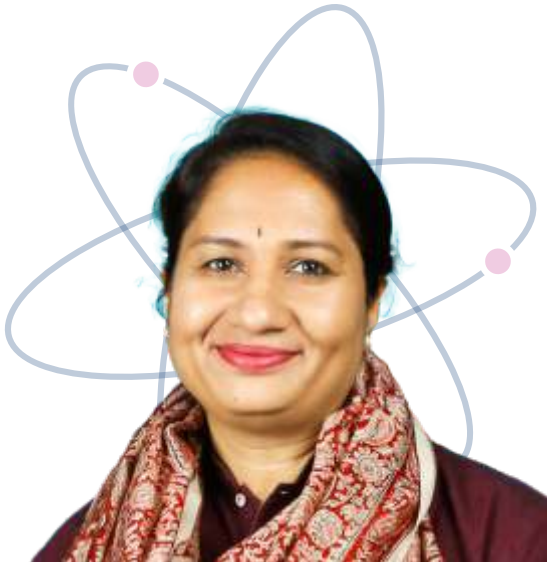
He is married to Sonal, who is a corporate lawyer.

ABSTRACT

Spirituality largely is considered an esoteric domain. It has widely different connotations. Can the technological advances in Neuroscience offer any tangibility to the existence of transcendental states, experiences? There has also been speculation of whether there exists in the brain a God centre. A researcher revealed that when a person was subjected to pain stimulus before and after being shown the picture of a deity he had faith in, his tolerance to pain was significantly better than it was before seeing the picture. So was the increase in tolerance the result of conditioning? Such a premise would imply that a similar outcome were possible if the patient was shown the picture of a mountain, if he had been conditioned to believe that mountains are objects of devotion. Then theoretically, if this God centre were to be stimulated, one could experience calm, bliss, even ecstasy. Would this imply that all spiritually advanced souls have, over a period of time, been able to devise an intrinsic mechanism to stimulate the God centre? That would reduce realisation to a mere neurochemical phenomenon. Meditation could be just a process that converts all eccentric thought processes into a concentric pattern with the God centre as the epicentre. All thoughts pertaining to mundane activities may be eccentric in nature. These eccentric patterns would be a deterrent to stimulating the God centre.

Happiness is most often cause-based, a consequence of perceptive modalities giving a positive feedback via established neuronal circuits. Familiarity, sensory gratification, and above all a very tangible cause-effect relationship permeates this sense of joy. But, if happiness could be devoid of a cause, it may explain the detachment that most masters talk about. Happiness would then be independent of a cause and also stimulation of specific neural paths. It could become the background electrochemical activity, where any external object is not recognised as a separate entity and analysed and assigned relative values of joy or pain. This Advaita or Oneness could be identified as the baseline firing of zeta neurons in a specified locus in the non-dominant hemisphere. It would create a perception shift. It could also deconstruct the "i" entity as having a discrete identity; the equivalent of dissolution of ego. There would be no subjective element to any sensory stimulus. Which is why many masters seem to revert to a child-like innocence. Maybe, then godhood would be a neurochemical alteration in the milieu of the neuronal networks, resulting in a perceptive variance. And spiritual progress could be monitored by an imaging modality.

Business Relevance of Self-Awareness



Ms. Priyamvadha Vembar
Cybersecurity, Bosch Bengaluru

Ms. Priyamvadha Vembar is heading the BGSW Automotive/IT/IoT/OT cybersecurity practice. In a global career spanning 25+ years in the Automotive and IT industries, starting out as a software professional, then onwards as a qualified project management professional, she transitioned into the domain of Information Security and Privacy 20 years ago. She played a key role in establishing the Governance for Information Security and Privacy for the Bosch group in India and Southeast Asia. The next transition was made into cybersecurity for products, starting out at a time cybersecurity for IT was an emerging field, and cybersecurity in products was almost non-existent. She has made pioneering contributions to the evolution of the field of product cybersecurity in general and automotive cybersecurity in particular during her role as a senior expert with the TOP67 project of Robert Bosch Corporate Research (CR), Competence Center Product Security ETAS GmbH Germany, architecting the Bosch Security Engineering Process (SEP) and anchoring the SEP as a part of Bosch product engineering.

As a member of Society of Automobile Engineers (SAE) and German Association of the Automotive Industry (VDA) she played a key role in establishing the ISO/SAE 21434 project. She was nominated to the ISO/SAE 21434 Joint Working Group (JWG) representing Germany and played a key role in establishing the ISO/SAE 21434 project, shaping, and drafting the contents of the standard. Since 2017 she has set up a cybersecurity practice at BGSW, a global team, consisting of experts, professionals and consultants that engages with the emerging trends in the field. She engages with the cybersecurity and privacy ecosystem in India through Bureau of Indian Standards (BIS), and Data Security Council of India (DSCI), academia and continues her efforts in shaping the field, working out of India.

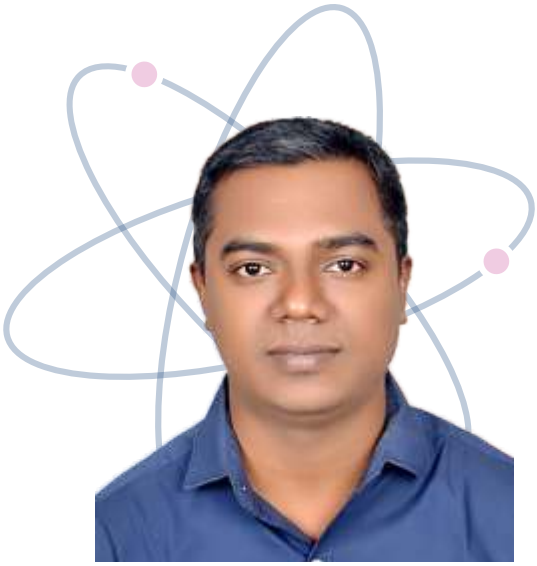
ABSTRACT

I, me, myself. Almost all the active-voice sentences in the English language, have these words as the anchors. But how often do we give a thought as to "What do they mean to us and to others around us? Many of us consume words like self-awareness, sell-aggrandizement, self-mastery, self-help, self-goal, self-this and self-that, without perhaps an inquiry into the concept of the self.

Life and Consciousness-awareness are unsolved problems in science. With the understanding of the DNA, life to an extent, is understood to have been decoded. But consciousness? Spirituality, specially the "Dharmic traditions" of Bharat have inquired into life and consciousness over millennia and continue to do so, even to this day.

In the above backdrop, keeping our focus limited to "self-awareness" and its utilitarian value in the business-context, with examples of literature available today, the talk makes a case for a move towards self-science; hinting as to how this could be achieved. The talk makes a case as to why "Bharat" should lead this movement; with the vision that the citizens of Bharat are engaged in self-mastery as their goal. We discuss the need for this transformation, role of society and academia in this transformation.

Yantras—Sacred Geometry for Better Living



Prof. Dr. Gopinath Thirunavukarasu
MIT-WPU

ABSTRACT

It has been said that "mathematics is the language of the Gods". God consciousness manifests expression through mathematics and geometry. Dr. Michio Kaku, physicist, has stated that "we might imagine God as we know him, to be a mathematician". On a universal scale, there is a direct relationship between mathematics, sound, and form. The sacred geometrical form (yantra) and the divinized sound (mantra) are inseparable and constitute tantra. Thus, it is often said that "yantra plus mantra equals tantra." Typically, yantras are made of geometric figures and can be either very simple, or quite complex and consist of various geometric forms, numerals, bindu, and a relevant mantra. Yantras are believed to hold great magical power and the cosmic forces that connect yantra holders with the universe and deities. As the key to unlocking the celestial power, yantras are incorporated in many ancient rituals and practices and their sacred symbols can be drawn on any surfaces or objects. Here, we will see the science behind different yantras for universal better living.

Dr. Gopinath Thirunavukarasu received his Bachelor's degree in Automobile Engineering from University of Madras (Chennai, India); Master of Technology in Quality, Reliability, and Operations Research from Indian Statistical Institute (Kolkata, India); and Master of Engineering in Metallurgy and Materials Engineering from Bengal Engineering and Science University, Shibpur (WB, India); and received his PhD for his research on Diffusion Bonding of Dissimilar Materials from the Department of Metallurgy and Materials Engineering from Indian Institute of Engineering Science and Technology, Shibpur (WB, India).

Dr. Gopinath received Post-Doctoral Fellowship (2018–2020) from the Department of Mechanical Engineering, IIT Bombay. He joined as a Senior Engineer, Quality Department, Accu Forge, Hindustan Motors Limited, Kolkata (WB, India), and resigned as The Head of the Department. He was also working as a Project Associate in The Department of Metallurgy and Materials Engineering, Bengal Engineering and Science University, Shibpur (WB, India).

To his credit, Dr. Gopinath has published 18 research papers in the field of Welding Metallurgy, Mass Transport, Solid State Diffusion, Diffusion Kinetics, Advanced Welding Processes, and Corrosion Science. Dr. Gopinath received International Travel Grant from Department of Science and Technology, Government of India, and Innovative Student Projects Award for his research during his Master's program from Indian National Academy of Engineering. He also received Silver Medal for his academic excellence from Indian Institute of Engineering Science and Technology, Shibpur.

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- **Shravani Katke**
  - Secured 3 Golds and 2 Silvers at MIT-WPU summit

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