IGSTC
INDO-GERMAN SCIENCE AND TECHNOLOGY CENTRE

INDO-GERMAN SCIENCE AND TECHNOLOGY CENTRE

ANNUAL REPORT
2024-25

IGSTC
INDO-GERMAN SCIENCE AND TECHNOLOGY CENTRE

INDO-GERMAN SCIENCE AND TECHNOLOGY CENTRE

ANNUAL REPORT
2024-25

विज्ञान एवं प्रौद्योगिकी विभाग
DEPARTMENT OF
SCIENCE & TECHNOLOGY
सत्यमेव जयते

IGSTC
INDO-GERMAN SCIENCE AND TECHNOLOGY CENTRE

AN INITIATIVE OF THE
Federal Ministry
of Education
and Research

The Indo-German Science & Technology Centre (IGSTC) has been established to facilitate Indo-German R&D projects and networking through substantive interactions among Government, academia/research systems and industry to foster innovation for the overall economic and societal developments of both the countries.

IGSTC AIMS TO

01

Play a proactive role in facilitating participation of industry in joint R&D+I projects.

02

Provide/assist in mobilizing resources to carry out industrial R&D+I projects.

03

Promote electronic exchange and dissemination of information on opportunities in bilateral science & technology cooperation. The Centre will also prepare/compile state-of-the-art reports on topics of interest with the help of highly qualified scientists and technologists from both the countries.

04

Provide advice to institutes and industries from both the countries on the possibilities of Indo-German cooperation and help identify suitable partners.

05

Facilitate and promote Indo-German collaboration in Science and Technology S&T through substantive interaction among Government, academia and industry

06

Encourage Public-Private Partnerships (PPP) to foster elements of innovation and industrial application and cultivate a culture of cooperation between science and industry

07

Nurture networking between young and mid-career scientists and technologists to develop a sense of mutual trust, leadership and entrepreneurship.

08

Develop cooperation through the identification of scientists and scientific institutions of the two countries.

09

Develop cooperation through the identification of scientists and scientific institutions of the two countries.

CONTENT

The Year 2024-25 at a Glance

The Indo-German Science & Technology Centre (IGSTC), instituted as a joint initiative of the Department of Science & Technology (DST), Government of India, and the Federal Ministry of Education and Research (BMBF), Government of Germany, has been a forerunner in promoting applied research and innovation between the two nations. Established with the vision to strengthen bilateral scientific collaboration, IGSTC has, since its inception 15 years ago, played a pivotal role in cultivating a vibrant Indo-German S&T ecosystem. Through a diverse portfolio of bilateral programs like 2+2 projects, scientific workshops, early career fellowships, funding support for women researchers, and seed grants, IGSTC is fostering partnerships across academia, research institutes and industries. These collaborations are driving real-world technological applications and advancing sustainability-focused innovation.

The year 2024 marked a momentous milestone, the 50th anniversary of Indo-German S&T Cooperation, celebrated on 7th March 2024. To commemorate this historic partnership, a series of events were organized throughout the year, highlighting the enduring collaboration and shared commitment to scientific advancement. The celebrations commenced in Darmstadt, Germany, where H.E. Parvathaneni Harish, Ambassador of India to Germany, and Dr. Jens Brandenburg, Parliamentary State Secretary to the Federal Ministry of Education and Research (BMBF), jointly unveiled the official logo of 50 years of Indo-German S&T Partnership. A high level IGSTC Workshop was also organized at Darmstadt as part of the 50 years of partnership.

H.E Parvathaneni Harish, Ambassador of India to Germany and Dr. Jens Brandenburg, Parliamentary State Secretary to the Federal Ministry of Education and Research released the logo of 50 years of Indo-German S&T Partnership

On 24th October 2024 in New Delhi, India, The Department of Science & Technology (DST), Government of India in collaboration with IGSTC organized a landmark event commemorating the Golden Jubilee Celebration of Indo-German S&T cooperation, involving prominent dignitaries from both countries.

Golden Jubilee Celebration of Indo-German S&T cooperation at New Delhi, India

The celebration was inaugurated by the Indian Union Minister Dr. Jitendra Singh and German Federal Minister of Education and Research of Germany, Ms. Bettina Stark-Watzinger. In their keynote addresses, both the ministers commended the existing robust and long-standing collaboration between the two countries in yielding remarkable achievements in S&T. They inaugurated the science exhibition at the event showcasing the achievements and ongoing projects under the Indo-German collaboration and engaged with scientists and researchers involved in cutting-edge programs.

IGSTC Project Awardees explaining their project to Dr. Jitendra Singh and Ms. Bettina Stark-Watzinger at the Golden Jubilee Celebration of Indo-German S&T cooperation

The inaugural session at the event featured the presentation of the prestigious WISER Award to the 2024 awardees and felicitating the winner of the 50 Years of Indo-German Partnership logo competition. The panel discussion on 'Indo-German Cooperation in Industrial Research' in the session conducted by IGSTC featured distinguished panelists, including both the ministers. The event also highlighted Indo-German cooperation through interactive sessions and panel discussions featuring agencies like DAAD, DFG, and Mega Science.

Audience at the Golden Jubilee Celebration

A key highlight of the celebration was the signing of a Memorandum of Understanding (MoU) between IGSTC and Bharat Petroleum Corporation Limited (BPCL). This partnership aims to foster research in innovative sustainable technologies by supporting joint research projects and bilateral workshops focused on these crucial areas.

In the Year 2024-25, IGSTC has extended support to several research initiatives. A glimpse of different programmatic activities is presented below.

2+2 projects, the flagship program of IGSTC supports joint R&D&I projects of industrial relevance in a "2+2 Mode of Partnership" i.e., involvement of at least one research/academic institute and one public/private industry from both the countries. Project proposals are aimed to exploit applied research to provide insights and deliver results leading to new technologies, products, processes, patents and/or services. To date, the 2+2 scheme has supported 60 projects, partnering research institutions, academia and industries, creating a network of more than 240 organisations.

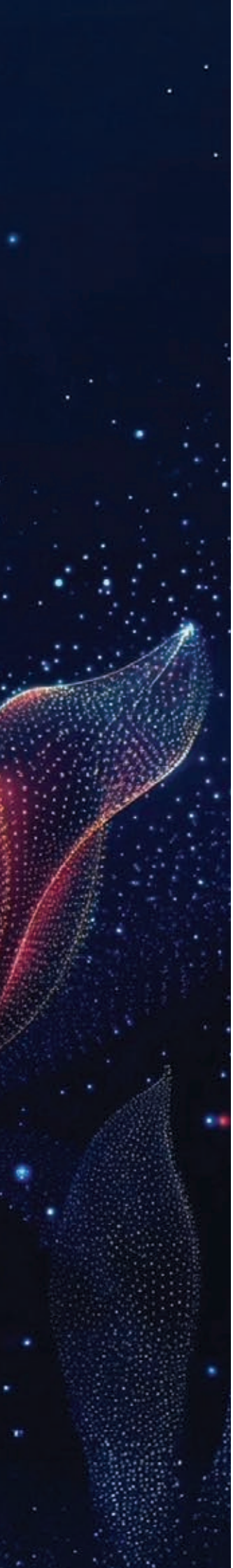
During the year 2024-25, IGSTC has provided funding support to 16 ongoing 2+2 projects in emerging areas of sustainable

energy, advanced manufacturing, biomedical devices, and water & wastewater technologies. Under the 2+2 Project Call 2024, 5 projects have been selected to carry out collaborative academia-industry research in the thematic area of AI for Sustainability. IGSTC Partners' Meet 2024 served as a dynamic platform for fostering collaboration and knowledge exchange among researchers and industry experts. Held in the historic town of Mahabalipuram on 11th September 2024, the event brought together all six projects from the 2+2 Call 2020 in the field of Additive Manufacturing.

IGSTC Partners Meet 2024 at Mahabalipuram

The bilateral workshop program of IGSTC creates a networking platform for substantive interaction between academic and industrial scientists/researchers from both India & Germany to explore new Indo-German scientific collaborations. This year IGSTC supported 17 workshops in various topics, such as personalised medicine, biomanufacturing, next generation electrical power drive, metamaterials, etc. The workshops networked more than 1000 academicians, industry personnel, policy makers and early career researchers.
The IGSTC Industrial Fellowship program, a unique fellowship provides exposure to PhD students/young researchers from India at a German industrial setup to promote applied research and technology development. Fellowships are offered annually at two levels, PhD Industrial Exposure Fellowship (PIEF) and Post-Doctoral Industrial Fellowship (PDIF). In 2024, eighteen (10 PDIF and 8 PIEF) awardees were awarded the prestigious fellowship. The fellowship has provided young researchers a distinct opportunity to conduct cutting-edge research in an international applied R&D setup.

The Women Involvement in Science and Engineering Research (WISER) program provides an opportunity to women researchers from India and Germany to embark on international collaborations in the field of S&T. In 2024-25, 15 women researchers (10 from India & 5 from Germany) were selected for the prestigious WISER award, and they have made significant progress through collaborative research in proteomics, energy storage, artificial intelligence, low-carbon technologies, electrocatalysis, and polymer composites. From the year 2025, WISER program has been launched in "paired mode", wherein, women researchers from India and Germany form a pair to submit proposals by utilising



their complementary expertise. The paired WISER Call 2025 has garnered exponential interest, with more than 170 paired applications received. WISER has emerged as a key IGSTC initiative that empowers women to lead cutting-edge research through collaborative partnerships.

IGSTC Paired Early Career Fellowships in Applied Research (PECFAR) nurtures early-career researchers by providing them with an opportunity to explore and bridge the Indian and German S&T landscape by encouraging entrepreneurship, innovation, and the sharing of laboratory & infrastructural facilities, all the while fostering long-term institutional linkages. Through the IGSTC PECFAR Call 2024, seventeen pairs from various parts of India and Germany were selected to build lasting research networks in different areas of STEM, including smart grids, nanocomposites, water management, biopsy biomarkers, metal recovery from waste, zero liquid discharge, and bioprinting.

IGSTC Small Immediate Need Grants (SING) supports proposals/initiatives that require modest funding to kick start or has the potential to embark on good bilateral Indo-German collaborations. Under this programme, seven candidates have been funded during the year.

IGSTC has been extending its reach and visibility through targeted outreach events at various locations in India. IGSTC successfully organized three major outreach events this year in Tirupati, Jammu and Silchar, attracting participation from over 500 individuals representing more than 16 academic and research institutions and industries, disseminating information about IGSTC's programs, and fostering new connections. With a stark increase in the status of number of applicants in different IGSTC programs 2025, the outreach events have proven to be a successful campaign in expanding the IGSTC network.

Outreach at IIT Jammu

As part of its Outreach initiative in Germany IGSTC participated in the BAU Munich Fair 2025, the World's Leading Fair for Architecture, Building Materials and Systems. IGSTC stall at the fair showcased its various Indo-German funding opportunities and attracted a huge number of visitors from around the world interested in Indo-German collaborations.

IGSTC at BAU Munich 2025

IGSTC abides steadfastly by its commitment to fostering robust networking channels that enable wider Indo-German collaborations for researchers from India and Germany.

This year IGSTC bid farewell to Dr. P.V. Lalitha, Chief Scientific Officer who superannuated on 31st Dec 2024.

Dr. Lalitha has contributed to IGSTC since 2011. IGSTC also bid farewell to Mr. R. Varadarajan, Manager (Accounts & Administration), on 31st March 2024. IGSTC welcomed two new core staff members: Mr. Inderjit Singh, Chief Administrative officer who joined on 16th July 2024 and Ms. Isha Goel, Deputy Scientific Officer who joined on 1st Jan 2025.

Farewell: Dr. P V Lalitha

Farewell: Mr. R Varadarajan

Welcome: Mr. Inderjit Singh

Welcome: Ms. Isha Goel

Governing Body

Praveenkumar Somasundaram
DST, Indian Co-Chair

Rohit Kumar
DST

K K Pant
IIT Roorkee

Tata Narasinga Rao
ARCI

Raju Kadam
Bharat Forge Ltd.

Kathrin Meyer
BMBF, German Co-Chair

Martin Goller
BMBF

Michaela Wilhelm
University of Bremen

Viktoria Apitzsch
German Embassy

Clas Neumann
SAP

2+2 PROJECTS

The Indo-German Science & Technology Centre (IGSTC), a joint initiative by the Department of Science and Technology (DST), Government of India and the Federal Ministry of Education and Research (BMBF), Government of Germany aims to support joint R&D+I projects of industrial relevance by means of "2+2 Mode of Partnership" with the participation of research/academic institution and industry from both India and Germany. Project proposal is expected to produce insight and exploitable research results leading to new technologies, products and/or services.

Partners

- **India:** One academic/ research institute + one industry
- **Germany:** One academic/ research institute + one industry
- Minimum 4 and Maximum 6

Funding

- **Indian side:** ₹ 350 lakhs (includes ₹ 150 lakhs for industry)
- **German side:** € 500000 (includes funding for industry according to De-Minimis or AGVO)

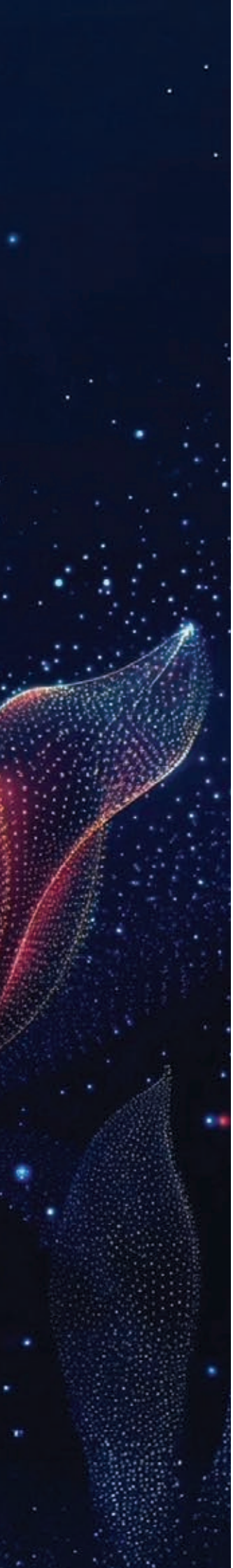
Duration

- 3 years
- Selected projects may be considered for extension phase up to 2 years

Phase II of 2+2

It is an opportunity to selected 2+ 2 projects with promising results to apply for an extension up to two years with additional financial support to cover the gap between the validation in relevant environment and system qualification.


AgriTech



CirCulTex

Circular Urban Cultivation Systems with Re-useable Textile Growing Substrates

PROJECT BRIEF

Urban agriculture is an integral part of sustainable city development for providing ecosystem services like air quality regulation, cooling, appealing appearance and food production. Urban agriculture moved as a trend into urban environments in the form of vertical farming, rooftops and community gardening. Besides space, soil as a cultivation substrate is scarce. Textile is lightweight and adaptive compared to other substrates and thus very suitable for soilless urban cultivation systems. The proposed project aims at the development of a reusable textile cultivation substrate following a plant performance-based approach. In addition to plant and system-specific properties, the dimensional stability of the textile will be taken into account during the development to allow for the re-usability of the substrate through cleaning. Thermo-mechanical and biological cleaning processes will be developed and evaluated. Subsequently, existing urban farming systems will be technically adapted to the textile substrate to improve resource-use efficiency and include an appropriate substrate cleaning process. In combination with market analysis and target group segmentation (community gardening, urban farming for self-sufficiency, professional indoor, greenhouse and vertical farming), the value proposition and the financial feasibility will be translated into novel business models to support the market growth of urban farming. Circular, lightweight and resource-efficient urban farming with re-usable substrate may inspire urban inhabitants, trigger sustainable consumer behaviour and lead to a societal transition towards bioeconomy.

CONTACT DETAILS

hpal@kol.amity.edu
sdbckv@gmail.com
hrid@globopex.com
b.winkler@uni-hohenheim.de
Christoph.riethmueller@ditf.de
Michael.walz@eschler.de

Project Investigators

Harshata Pal
Amity University, Kolkata (AUK)

Bastian Winkler
University of Hohenheim (UHOH)

Sanjit Debnath
Bidhan Chandra Krishi Viswavidyalaya, Kalyani (BCKV)

Christoph Riethmuller
German Institutes of Textile and Fiber Research, Denkendorf (DITF)

Suhrid Chandra
Harimitti Agro Pvt Ltd, Kolkata (HMA)

Michael Walz
Eschler Textil GmbH (ETF)

Progress made/achieved

Amity University Kolkata

Research achievements at Amity University, Kolkata, in the final phase of the project include the successful cultivation of lettuce on polyester-based textile substrates provided by the German partner, using a lab-scale hydroponic system (Nutrient Film Technique). All essential hydroponic parameters—pH, EC, temperature, and TDS were appropriately maintained. To reduce costs, a segment without net pots was included. It was observed that leafy greens grew comparably well in both conditions, with and without net pots. The study aimed to evaluate the performance of polyester-based textile sheets as a low-cost, reusable alternative growing substrate for tissue culture applications in developing countries.

Bidhan Chandra Krishi Viswavidyalaya, Kalyani (BCKV)

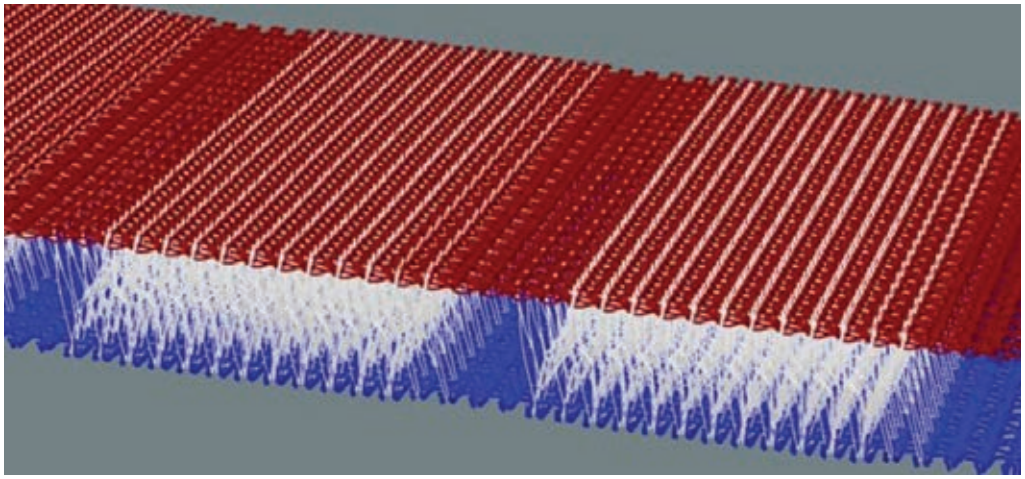
At the BCKV, the 4th crop cycle was conducted from June to September 2024 to evaluate the reuse potential of textile substrates. This cycle included seven substrate variants—three from 2022, three from January 2023, and one new variant from September 2023, along with rockwool (RW) as the reference substrate. All textile substrates were used in a rolled arrangement. Cultivation was performed in hydroponic and aquaponic systems using Nutrient Film Technique (NFT), Deep Water Culture (DWC), and Dutch Bucket methods. Spinach, Italian basil, and Swiss chard were grown in NFT and DWC systems, while cherry tomato was cultivated in Dutch Buckets. Yields. The data showed no significant reduction in yield with repeated reuse of textile substrates across all cycles and crop types. Furthermore, yields were comparable between reusable textile substrates and single use rockwool.

Cherry tomato growing on textile substrate at Bidhan Chandra Krishi Viswavidyalaya, Kalyani

University of Hohenheim (UHOH), German Institutes of Textile and Fiber Research, Denkendorf (DITF), Eschler Textil GmbH (ETF)

In the final project phase, three cultivation and cleaning cycles using reused textile substrates were completed and evaluated. The literature review and compilation of a requirement list continued. The cleaning concept, jointly developed by project partners, included root removal, disinfection (via autoclave or chemical treatment), mechanical removal of large root masses, washing with detergent, air drying, and preparation for reuse. Cleaning effectiveness was evaluated using a light table. Adaptations for the Nutrient Film Technique (NFT) and terrabioponic systems were developed and tested. In the NFT system, the textile substrate was modified for direct use without net pots, reducing cost and waste. Terrabioponic trials combined small containers with textile layers and vermicompost and were evaluated for performance. A cost model was further developed to estimate the pricing of the textile substrate, including production, cleaning, and logistics. Industry expert interviews supported this analysis. Consortium partners maintained regular communication through meetings, emails, calls, and messaging. A jointly authored white paper was finalized to communicate project results to industry stakeholders.

Warp knitting machine at Eschler Textil GmbH



Model textile

Growing lettuce without a net pod

Basil growing in Nutrient Film Technique (NFT) at German University of Textile & Fibre Research

GENERAL PUBLIC INTERACTIONS:

- Participation at the international exhibition GreenTech 2024 for vegetable production in Amsterdam in June 2024.

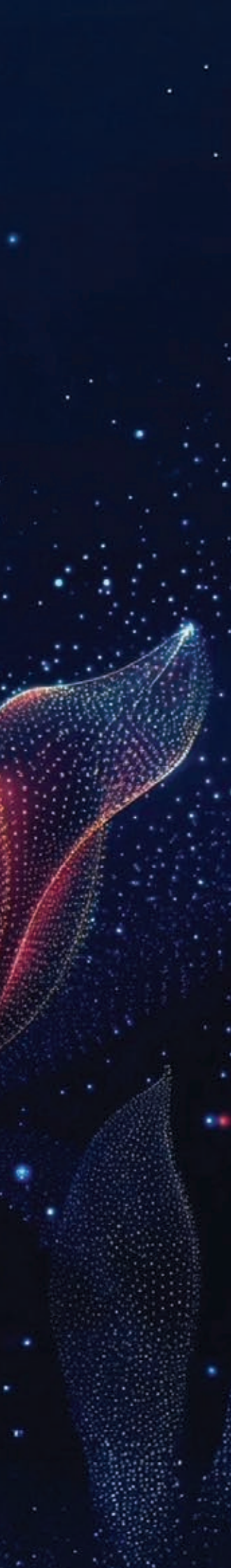
PUBLICATIONS

1. Cichocki, J., Trenkner, M., Vanicela, B., Riethmueller, C., Walz, M., Chandra, S. and Pal, H., 2025. Demystifying the integration of hydroponics cultivation system reinforcing bioeconomy and sustainable agricultural growth. Scientia Horticulturae, 341(11397), p.3. https://doi.org/10.1016/j.scienta.2025.113973

2. Germany: 'We cannot keep producing substrates that aren't fully recyclable' 2024. https://www.verticalfarmdaily.com/article/9682701/germany-we-cannot-keep-producing-substrates-that-aren-t-fully-recyclable/?utm_medium=email.

3. Chatterjee, A., Ghosh, P., Sharaff, M., Bhattacharya, P.M. and Pal, H., 2024. Biopriming of Solanum lycopersicum seeds with novel root endophytic bacterial consortium retrieved from halotolerant Sundarban mangroves to sustain growth and yield with salt resilience. Biocatalysis and Agricultural Biotechnology, 62, p.103414. https://doi.org/10.1016/j.bcab.2024.103414

4. Ghosh, P., Chatterjee, A., Sharaff, M. and Pal, H., 2025. Unveiling the threat of lead, cadmium, and nickel toxicity in salient commercially grown vegetables in Kolkata, India. Environmental Monitoring and Assessment, 197(1), pp.1-29. https://doi.org/10.1007/s10661-024-13471-8



SensVert

Development and Evaluation of Automated Sensors for a Highly Efficient Nutrition Management System in Indoor Vertical Farming

PROJECT BRIEF

In hydroponic systems, the nutrient solution is usually monitored via the electrical conductivity (EC) and pH value, as well as the temperature. For greater nutrient use efficiency, higher plant productivity and better control of desired crop characteristics such as secondary metabolite profiles, taste and appearance, an additional continuous monitoring of the ion ratio of nutrient solutions seems a promising solution. Significant advances have been made in recent years in overcoming the technical obstacles on the way to an ion specific fertigation system. Most of these works addressed the control of the ion interference effect, which makes obtaining accurate measurements of the concentration of single ions in complex solutions difficult. Although successful strategies for reliable and accurate measurements of nitrate ion (NO_3^-), potassium ion (K^+) and calcium ion (Ca^{2+}) have been developed, fully functional automated fertigation systems measuring and controlling the concentration of the five major macronutrients also including phosphate ion (PO_4^{3+}) and magnesium ion (Mg^{2+}) are still lacking, as well as information on how automated ion specific fertigation management performs compared to traditional, EC and pH, based fertigation management. Therefore, the main objective of the SensVert project is the development of an automated Iot-based, ion-specific sensor system for the integration into hydroponic systems, allowing continuous monitoring of nitrogen (N), phosphorus (P), potassium (K), Calcium (Ca) and Magnesium (Mg).

CONTACT DETAILS

hasaniari40@gmail.com
shivendra@bartonbreeze.com
heike.mempel@hswt.de
mohamed.bourouah@hahn-schickard.de
georg.brueckner@smbbrueckner.de

Project Investigators

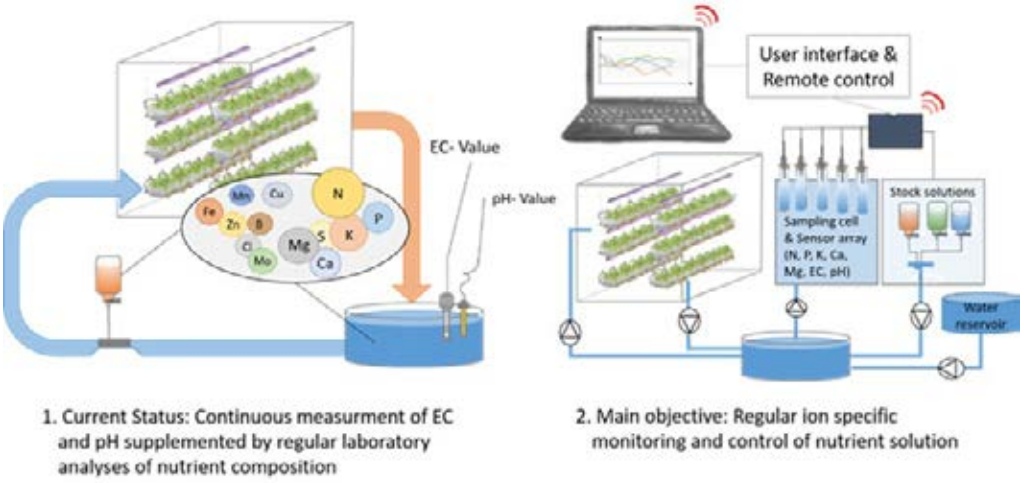
Murtaza Hasan
ICAR-Indian Agricultural Research institute, New Delhi

Shivendra Singh
Barton Breeze Gurgaon

Heike Mempel
Hochschule Weihenstephan-Triesdorf Freising

Mohamed Bourouah
Hahn-Schickard Villingen-Schwenningen

Georg Brückner
Sondermaschinenbau Bruckner GmbH Marktgraitz



Main objective of the SensVert project

Progress made/achieved

ICAR-IARI

Participated in the installation and operation of hydroponic test units within a climate-controlled greenhouse for plant cultivation trials. Developed sensor-based fertigation scheduling strategies for horticultural crops like lettuce and pakchoi. Contributed to defining target ion values at different crop growth stages. Validated the fertigation system and its scheduling under practical cultivation conditions.

Barton Breeze, Gurgaon

Barton Breeze collaborated in designing and integrating the microfluidic sampling system for the sensor platform. Supported testing and demonstration of the sensor system in a commercial hydroponic setting, providing practical feedback for real-world application.

Hochschule Weihenstephan-Triesdorf (HSWT), Freising

Led horticultural validation and testing of ion-selective electrodes (ISEs). Installed and ran hydroponic test units for evaluating nutrient solution dynamics and system integration. Developed ion-selective fertigation strategies for lettuce using the sensor platform. HSWT also defined standardized sensor target values for key crop stages. Disseminated project findings through academic lectures and outreach.

Experimental set up in the hydroponic test unit for vertical farming at Hochschule Weihenstephan-Triesdorf

Hahn-Schickard, Villingen-Schwenningen

Responsible for designing and developing the core ion-selective electrodes (ISE) based sensor platform capable of measuring key macronutrients such as nitrate (NO_3-), potassium (K^+), calcium (Ca^{2+}), and phosphate (PO_4^{3-}). Created a microfluidic sampling system integrated with control electronics for efficient solution handling, and developed the potentiometric system used to process and report raw sensor data. The contributions extended to designing the automated fertilizer dosing hardware and IoT-enabled software interface. They also implemented a hybrid communication system using LoRa (Long Range) and Narrowband Internet of Things (NB-IoT) to ensure reliable remote data transmission. The complete Mixing Flow Sensor System (MFSS) system was showcased at Embedded World 2024 in Nürnberg, Germany and commercialization discussions have since been initiated.

Hahn-Schickard showcase Mixing Flow Sensor System (MFSS) at Embedded World 2024 in Nürnberg, Germany

Sondermaschinenbau Bruckner GmbH, Marktgraitz

Supported the mechanical design and construction of the automated fertigation unit. Assisted in the installation of hydroponic systems at testing sites (HSWT and IARI) and ensured hardware compatibility with sensor systems.

PUBLICATIONS

- Gavhane, K.P., Hasan, M., Singh, D.K., Kumar, S.N., Sahoo, R.N. and Alam, W., 2023. Determination of optimal daily light integral (DLI) for indoor cultivation of iceberg lettuce in an indigenous vertical hydroponic system. Scientific Reports, 13(1), p.10923. https://doi.org/10.1038/s41598-023-36997-2

CONFERENCES

- Abel, M., Wittmann, S., Jüttner, I. and Mempel, H., 2023. Identification of variations in nutrient uptake ratios of Pak Choi (Brassica rapa) as an indicator for the potential of ion-specific nutrient management. In: Acta Horticulturae 2022 XXXI International Horticultural Congress (IHC 2022): International Symposium on Advances in Vertical Farming. International Society for Horticultural Science.

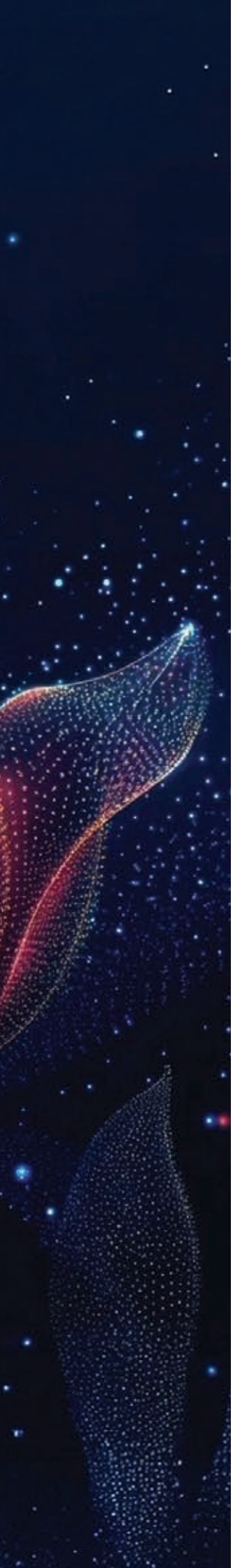
- Mempel, H., Hasan, M., Bourouah, M., Kumar, S., Mani, I., Kumar, L., Paradkar, V., Abel, M., Wittmann, S. and Jüttner, I., 2023. Design and development of automatic nutrient sensors for efficient water and nutrient management in vertical farming. In: Acta Horticulturae 2022 XXXI International Horticultural Congress (IHC 2022): International Symposium on Advances in Vertical Farming. International Society for Horticultural Science.

Plant factory developed inside greenhouse vertical farm

IoT and sensor operated greenhouse vertical farm (1000 square meters)

A frame and flat frame vertical hydroponic facilities in greenhouse vertical farm

Dutch bucket and grow tower facilities inside the greenhouse vertical farm



NOMIS

Non-enzymatic Microfluidic Electrochemical Multiplex Sensor for Cost-Effective Soil Testing

PROJECT BRIEF

Indiscriminate use of fertilizers and pesticides can exhibit moderate to lethal toxicity levels in humans. Although their judicious applications are required in farm fields to boost agricultural productivity, excessive use leads to moving up of these chemicals through the food chain, which leads to biomagnification. Most of the reported methods for detecting fertilizer and pesticides in the soil are expensive, have a short shelf life, and are difficult to implement as a device outside laboratories. By combining the complementary expertise of the Indian and the German partners, the project aims to address this unmet challenge by developing an efficient multiplexed device for the detection of nitrate (a major fertilizer-based soil/groundwater contaminant in India and Germany) and pesticides in soil samples. The proposed device comprises a microfluidic platform integrated with printed electrodes based on analyte-specific nanomaterials and aptamers, which facilitates the regular screening of nitrate (NO_3^-) and organophosphates to monitor the quality of soil samples. Envisioned for commercial marketing, the device will be an important step towards sustainable agriculture, which will significantly improve the livelihood of rural farming communities in the countries and help in safeguarding water resources from pollution. Additionally, through the development of a user-friendly soil testing device in this project, awareness of environmental protection will be enhanced.

CONTACT DETAILS

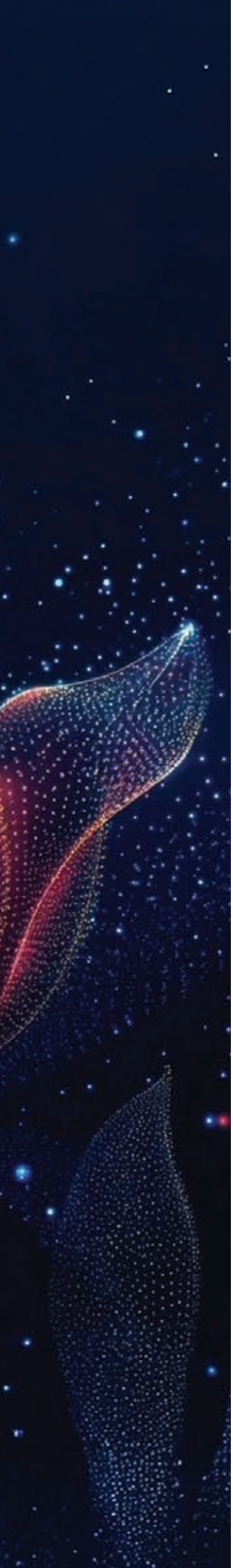
g.dutta@smst.iitkgp.ac.in
Bernhard.wolfrum@tum.de
paridabk@coromandel.murugappa.com

Project Investigators

Gorachand Dutta
IIT Kharagpur

Binaya Kumar Parida
Coromandel International Ltd.
Secunderabad

Bernhard Wolfrum
TU Munich



Progress made/achieved

IIT Kharagpur

Pilot testing for nitrate (NO_3^-) detection initially employed a Glassy Carbon Electrode (GCE), but encountered issues such as instability and high background current, likely due to copper nanoparticle oxidation. IIT Kharagpur synthesized a novel allylamine-capped copper nanoparticle, leading to the development of a more stable and sensitive NO_3^- sensor. This sensor utilized a single-layer homogeneous modification with the allylamine-capped copper nanoparticle-functionalized carbon nanotube (CNT) nanocomposite over a gold-sputtered electrode, eliminating the need for binders and complex layering, thus enhancing stability and reproducibility for onsite applications. For pesticide detection, initial tests used a GCE modified with Poly(3,4-ethylenedioxythiophene): polystyrene sulfonate (PEDOT: PSS) and gold nanoparticles. However, the fabrication process was optimized by adopting gold-sputtered electrodes, reducing complexity and production costs while maintaining comparable performance. This streamlined approach facilitated efficient detection of glyphosate, malathion, acetamiprid, and fipronil. The field testing of the sensors is done with the help of industrial partner Coromandel International Ltd.

TU Munich

The project has developed printed microelectrode arrays using laser ablation, enabling rapid design iterations. Additionally, a fluidic system fabricated from thin polymer adhesive foils has been integrated into the electrode arrays. This approach enhances the scalability of the fabrication process for potential large-scale production. Sciospec, a German company specializing in custom-designed electronics, has delivered the CSX-64 mobile prototype device along with the appropriate adapter to connect the electrode array. The CSX-64 is capable of potential and current measurements, as well as performing impedance spectroscopy, which was the main type of electrochemical measurement used in this project.

Fabricated Sensor arrays linked to a mobile device prototype for soil health monitoring

Coromandel International Ltd

Two field tests of the **NO_3^-** and multiplex pesticide sensors were conducted. The second field test, along with a farmer awareness program, was held in Shiromani village, Midnapore, West Bengal, on 22nd March 2025.

Field testing of NO_3^- and multiplex pesticide sensing device along with awareness program for farmers at Shiromani village, Midnapore, India, with the help of Coromandel International Ltd on 22nd March 2025.

Salient Achievements

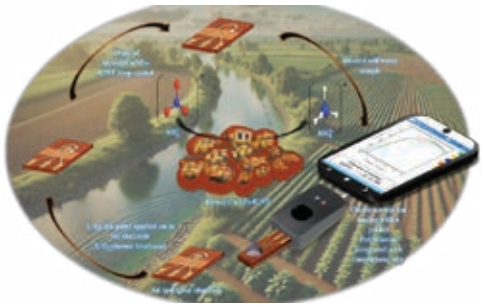
- Developed a stable, smartphone-integrated **NO_3^-** sensor using allylamine-capped copper nanoparticles (Alym@CuNPs) - functionalized carbon nanotube (fCNT) composite on a gold-sputtered electrode, enabling cost-effective, onsite soil monitoring with strong real-sample validation.

- Developed a multiplex pesticide sensor for glyphosate, acetamiprid, malathion, and fipronil using thiolated aptamer-functionalized gold electrodes and microfluidics. It offered low-cost fabrication, picomolar sensitivity, and high selectivity in real samples.

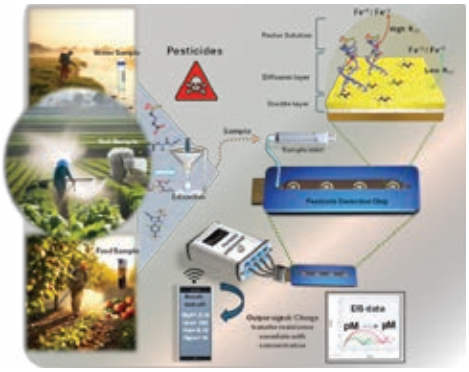
- Both sensors have attained Technology Readiness Level (TRL) 6, reflecting successful demonstration of the prototypes in a relevant operational environment.

- A project website (https://nomisdevice.carrd.co/) has been developed to highlight the research on **NO_3^-** and pesticide detection. It features device schematics and brief write-ups to raise farmer awareness on sustainable farming practices.

Schematic for the operation of the sensor chip integrated with smartphone



Fabrication of Alym@CuNPs-fCNT composite modified Au sputtered electrode for onsite sensing of NO_3^-



Multiplex aptasensor for glyphosate, acetamiprid, malathion and fipronil detection

PATENTS

1. Electrochemical nitrate sensing device for onsite soil and water quality monitoring

   Inventors:
   Bimalendu Mukherjee and Dr. Gorachand Dutta (Application no. 202431105087)

2. Non-enzymatic electrochemical multiplex aptasensor for on-site pesticide detection

   Inventors:
   Mukti Mandal and Dr. Gorachand Dutta (Application no. 202531023744)

PUBLICATIONS

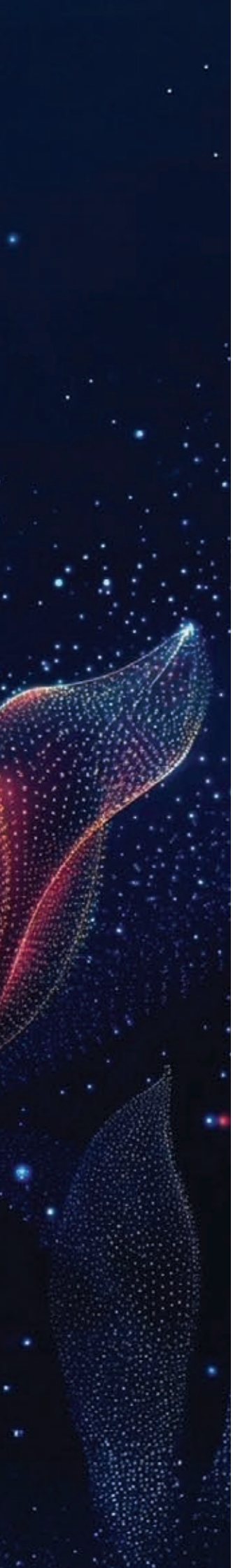
Mukherjee, B., Mandal, M., Suresh, R.R., Kar, S., Parida, B.K., Chakraborty, S. and Dutta, G., 2025. A non-enzymatic highly stable electrochemical sensing platform based on allylamine capped copper nanoparticles for the detection of the soil nitrate content. Analyst. https://doi.org/10.1039/D4AN01345J

Exchange Visits: 04/07/2024-12/07/2024; Gorachand Dutta, and 04/07/2024-28/07/2024; Mukti Mandal visited TU Munich, Germany, from the Indian side to discuss the project progress and exchange knowledge of the project

IGSTC Golden Jubilee celebration at Delhi on 24/10/24, visited by Indian partners: Gorachand Dutta and Mukti Mandal to demonstrate the model of NO_3^- and pesticide sensing device

IGSTC Golden Jubilee celebration at Delhi on 24/10/24, visited by Indian partners: Gorachand Dutta and Mukti Mandal to demonstrate the model of NO_3^- and pesticide sensing device in front of ministers and IGSTC officials

Water Technology



EfectroH2O

Effect-based monitoring demonstrates Efficiency of Electrically-driven Water Treatment Processes to remove Salts and Micropollutants from Process Water

PROJECT BRIEF

The project aims to enhance industrial wastewater treatment in the textile sector by reducing toxicological impacts on the environment. Our goal is to recycle process streams, recover resources, and improve the techno-economic feasibility of Zero Liquid Discharge (ZLD) plants. Current challenges faced by industries in ZLD-implemented regions include salt accumulation, reverse osmosis (RO) membrane fouling, and sludge generation. Smaller units and common effluent treatment plants (CETPs) often use chlorination for color removal, which produces harmful disinfection byproducts. To address these issues, the project introduces a chemical-free, electrochemical-based advanced oxidation process (AOP) combining ozonation and electrolysis. This system, known as electroperoxone, generates powerful oxidants such as hydroxyl and sulfate radicals for complete pollutant degradation. For desalination, capacitive deionization (CDI) is explored as a low-fouling alternative to RO, particularly for treating concentrated brines. Lab-scale studies have been conducted, and pilot-scale trials are underway at Kunnankalpalayam CETP, Tiruppur. Effluents, including dye bath, wash water, and raw wastewater, have been treated using the electroperoxone process. Fixed and flow CDI systems have also been tested at pilot scale with synthetic effluents. Further testing is planned at Shahi Knits and Kunnankalpalayam CETP. A differentiated treatment approach is proposed: high total dissolved salts (TDS) dye bath effluent (10%) will be treated using the electrochemical ozone oxidation (ECOOP) system, followed by CDI/RO, while lower TDS wash water (90%) will undergo biological treatment and CDI/RO. This reduces RO load by 80%, minimizing fouling and sludge. Treatment performance will be evaluated using effect-based methods (EBMs) and a bioassay test battery transferred from Germany under the EfectroH2O project. The initiative aligns with UN Sustainable Development Goals (SDGs) 6, 12, and 13 for sustainable water management.

CONTACT DETAILS

indunambi@civil.iitm.ac.in
hollert@bio.uni-frankfurt.de
sajidhussain@twic.co.in

Project Investigators

Indumathi M Nambi

IIT Madras

Sajid Hussain

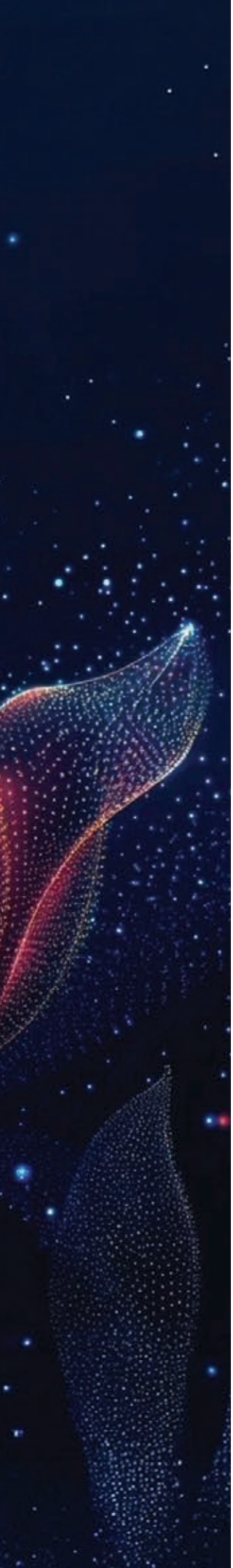
Tamil Nadu Water Investment Company Ltd. (TWIC)
Chennai

Henner Hollert

Goethe-University Frankfurt
RWTH Aachen

Maria Meinerling

ibacon GmbH
Rossdorf



Progress made/achieved

IIT Madras

As part of international collaboration and capacity-building efforts, advanced ecotoxicity assessments were conducted at Goethe University. Laboratory-scale optimization studies were carried out to enhance the treatment efficiency of the (ECOOP) system, during which various parameters and electrode configurations were tested to improve chemical oxygen demand (COD) and color removal while minimizing energy consumption. Additionally, pilot-scale demonstrations were performed using real effluents collected from nearby dyeing units and CETPs. These trials helped assess system robustness under varied influent qualities and supported the development of a differentiated treatment approach for dye bath and wash water.

Tamil Nadu Water Investment Company Limited (TWIC)

Pilot-scale studies were carried out at Kunnankalpalayam CETP, Tiruppur, from 01.12.2023 to 31.08.2024, using multiple effluents (raw effluent, dye bath, secondary clarifier, RO feed, and wash water) collected from CETPs and dyeing units. These trials supported the development of a differentiated treatment approach for dye bath and wash water. However, the operational cost was found to be significantly higher compared to the zero liquid discharge (ZLD) pre-treatment process. Therefore, further optimization studies and trials with advanced electrodes might be considered for further cost-effective treatment. Discussions with academic partners are ongoing for further improvements.

RWTH Aachen and Goethe University

RWTH provided technical guidance for the design and construction of the Fixed CDI pilot plant at the cooperation partner, TWIC. As part of the collaborative knowledge exchange, an Indian project partner from IIT Madras was hosted at RWTH laboratories for a four-week research stay. During this period, expertise and operational insights related to Fixed CDI systems were shared to enhance mutual understanding and support the implementation of the pilot plant. Goethe University supported the establishment and validation of in vivo and in vitro toxicity tests, including the fish embryo toxicity test. It helped evaluate treatment impacts on endocrine activity and mutagenicity, ensuring cross-validation of results between Germany and India. Goethe University participated in international conferences, contributing to joint publications and the

development of policy briefs. The university supported project coordination by assisting with reporting, data management, and quality assurance for effect-based methods (EBM) outcomes.

Salient Research Achievements

A novel ECOOP system was developed and successfully demonstrated for the efficient degradation and mineralization of complex textile wastewater. It showed superior performance in COD, Total Organic Carbon (TOC), and colour removal compared to conventional ozonation and electrolysis techniques. The ECOOP process has shown lab-scale potential for Per- and Polyfluoroalkyl Substances (PFAS) degradation. Pilot-scale evaluation for PFAS treatment is planned as part of the next research phase. In addition, EBM and bioassays have been developed to assess the reduction in ecotoxicity of treated effluents, ensuring environmentally safe water discharge. To safeguard and commercialize the innovation, a patent is under preparation, covering the electrode materials and configurations used in the ECOOP system and their application in textile effluent treatment.

Technology Readiness Level (TRL)

The current TRL of the ECOOP system is 6 to 7, indicating:

- Successful lab-scale validation
- Pilot demonstration in a relevant industrial environment
- Proven treatment efficiency under real textile effluent conditions

The next steps include:

- Long-term performance validation
- Techno-economic feasibility analysis
- Integration into full-scale CETP or industrial treatment systems

This project contributes directly to the following UN Sustainable Development Goals (SDGs):

- SDG 6 – Clean Water and Sanitation
- SDG 12 – Responsible Consumption and Production
- SDG 13 – Climate Action
- SDG 14 – Life Below Water
- SDG 15 – Life on Land
- SDG 17 – Partnerships for the Goals

PUBLICATIONS

John, A. A., Aiswarya, P. B., Govindarajan, D., Karthikeyan, V., Nambi, I. M., and Kannan, A., 2025. Electroperoxone coupled with capacitive deionization for sustainable textile wastewater treatment. All India Research Scholars Summit, IIT MADRAS.

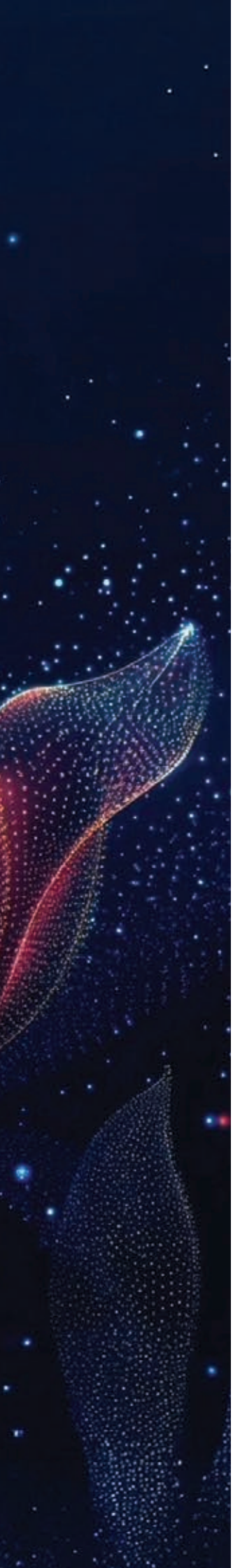
Prof. Indumathi M. Nambi explaining the lab's instrumentation facilities to IGSTC delegates during the lab tour

IGSTC delegates and project team during the project meeting at IIT Madras

Impressions of the Winter School at the IIT Madras

Group photo during the research exchange at the Goethe University, Germany

Advanced Manufacturing/ Materials



SuOCAM

Manufacturing of 3D Printed SiCiC Ceramic Prototypes using Sustainable Raw Materials, as Customized Bio-Carbon Obtained from Microalgal Biomass of Carbon Sequestration Process and Optimized Recycled SiC from Industrial Waste

PROJECT BRIEF

Silicon-infiltrated silicon carbide (SiSiC) ceramics production by additive manufacturing (AM) and Liquid Silicon Infiltration (LSI) offers a cost and design-effective alternative to conventionally sintered silicon carbide ceramics. Their microstructure and properties are mainly determined by the raw materials and the residual silicon gained during LSI. These raw materials are carbon or carbon-precursor and silicon carbide powders, often derived from nonrenewable resources under energy-demanding processes. Therefore, introducing bio-carbon (bio-C) obtained from carbon-sequestered microalgal biomass and recycled silicon carbide (rec-SiC) enhances the environmental sustainability of the synthesized SiSiC. Moreover, precursors coming from natural materials can offer unique hierarchical, micro and nano porosity valuations. The project optimized the bio-C production through hydrothermal carbonization (HTC) to attain the highest C-content at 210 °C and 4 h residence time. Thereafter, the optimized ink rheology for 3D-printed green bodies contained 5, 7.5 and 10 wt.% bio-C, wherein post-sintering and Si-infiltration (at 1500 °C for 1h), incorporation of 7.5 wt.% bio-C exhibited superior mechanical properties. Additionally, the 3D-printed SiSiC prototypes also exhibited promising heat-exchanging properties with remarkable improvements over the green bodies.

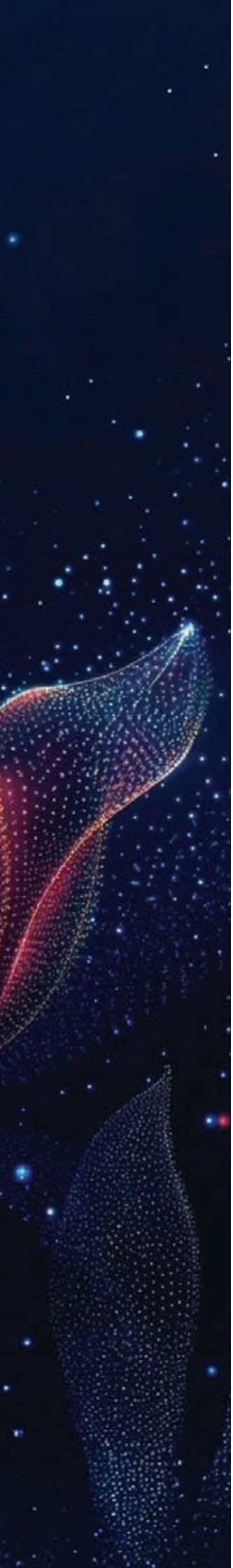
CONTACT DETAILS

bkdubey@civil.iitkgp.ac.in
ranjan.pradhan1@jindalsteel.com

Project Investigators

Brajesh K Dubey
IIT Kharagpur

Ranjan Pradhan
Jindal Steel and Power Ltd.



Progress made/achieved

IIT Kharagpur

Bio-C, produced from Spirulina, was integrated into the ink formulation due to its high carbon content, porous structure, and beneficial surface chemistry. Its inclusion improved the flowability, consistency, and shear-thinning behavior of the ink, enabling smoother extrusion during printing and better shape retention after deposition. Carboxymethyl cellulose (CMC) was identified as the most effective binder, providing good adhesion and rheology without additional humectants. Different proportions of SiC and bio-C were tested, with the optimal formulation. The appropriate combination yielded the best balance of printability, structural integrity, and thermal behavior.
Post-processing through sintering and liquid silicon infiltration (LSI) led to the formation of SiSiC with well-defined microstructures. The presence of bio-C facilitated silicon infiltration and reduced structural voids, resulting in enhanced thermal conductivity and faster heat equilibrium. Mechanical testing and thermal analysis confirmed the material's suitability for high-temperature applications.

Scanning electron microscopy (SEM) and X-ray diffraction (XRD) validated the formation of β-SiC and the successful integration of silicon into the matrix. A life cycle assessment identified the LSI stage as the primary contributor to environmental impacts, driven largely by energy use and silicon consumption. Despite this, the integration of renewable and recycled inputs offers a clear sustainability advantage. The final product is aimed at high-temperature heat exchanger applications, with COMSOL simulations guiding prototype design.

Jindal Steel and Power Ltd.

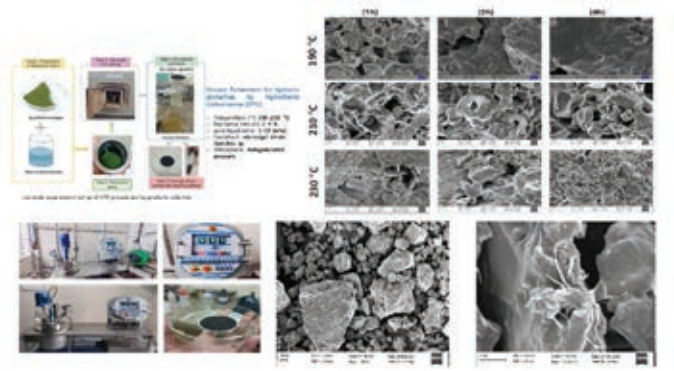
At the Jindal Steel and Power Ltd. CO_2 site, efforts are focused on scaling up microalgal biomass production to 10 kg/day using a combination of closed and open cultivation systems.

Significant outcomes

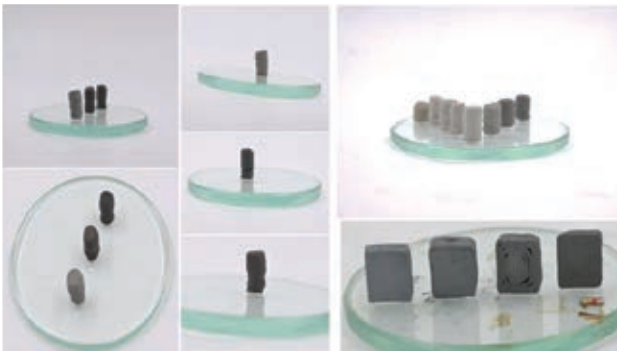
- The addition of bio-C in the ink resulted in better flow characteristics and consistency. The bio-C particles reduced overall viscosity and enabled smooth extrusion through the printing nozzle. It also enhanced the shear-thinning behaviour, allowing the ink to flow comfortably under applied force and retain the shape after printing.

- Functional groups on bio-C surface interact with the ink matrix, optimizing its wetting properties and flow characteristics.
- The moisture adsorption property of bio-C is also one of the major reasons behind the enhanced wettability of ink constituents, thereby increasing the better interaction between all the materials.

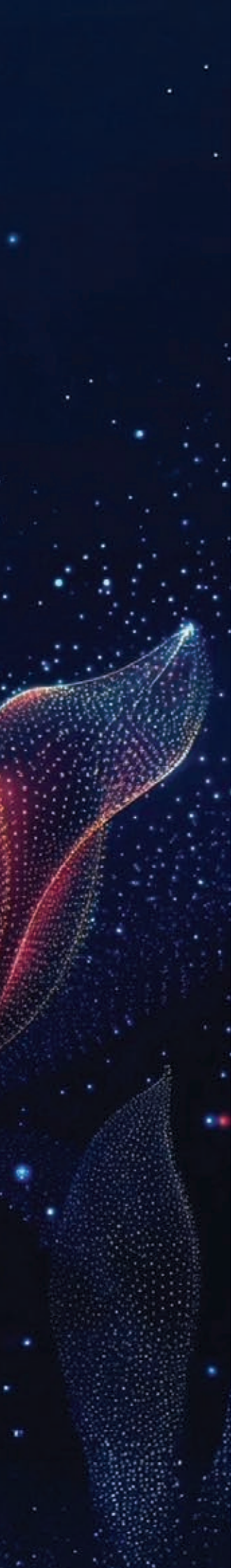
Photobioreactor for microalgal biomass production



Lab and pilot scale bio-C production characterisation



Recycled SiC based 3D printed cylindrical and cuboid structures with varying C content (5-10 wt.%) with carboxymethyl cellulose (CMC) as binder



INGERBDIAM

Development of Biodegradable Alloys and AM Processes for Soft Tissue Anchors

PROJECT BRIEF

Presently used metallic bioimplants are non-degradable and remain permanently inside the body necessitating secondary surgery for removal. To overcome such problems, biodegradable (BD) metallic implants (Fe-Mn, Mg, Zn) are being developed. Mg based alloys are recently being commerciallized for dental, trauma and orthopedic appilcations. However, their usage is not extended to the applications which require longer period due to higher degradation rates and hydrogen evolution. These can be reduced by incorporating fine grain structure and coatings. Fe-Mn based alloys are recently gaining importance due to high specific strength and low cost. The challenge with Fe-Mn based alloys is lower degradation rates which can be addressed by miniaturizing. Presenlty, these BD implants are being developed by conventional techniques. Additive manufacturing (AM) is an advanced manufacturing technique that makes complex and custom-made components with fine grained structure, controlled porosity and degradation rates. In addition, the challenges in fabrication of Mg based implants due to issues with forming and machinability can be overcome by AM. The reported studies on AM are preliminary. The use of soft tissue anchors (STA) as implants is projected to increase due to wider usage for fixing sports injuries as well as repairing wear and tear of tendons, ligaments and cartilage. The proposed study envisages design of STAs, development of Mg and Fe-Mn alloy powders with suitable composition and demonstration of AM process for the manufacture of prototypes. The proposed work also involves characterization (microstructural, mechanical and biological) of AM built and surface modified coupons as well as components.

CONTACT DETAILS

vijay@arci.res.in
suhaib.i69@wipro.com
Franziska.schmidt2@charite.de
jaschinski@kcs-europe.de

Project Investigators

R.Vijay

International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI)

Suhaib Abdurahman

Wipro3D

Franziska Schmidt

Charite Universitätsmedizin Berlin

Peter Jaschinski

KCS Europe GmbH

Progress made/achieved

ARCI

The International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI) has developed two biodegradable alloys, Fe-Mn and Mg-Zn based. Over 15 batches of Fe-Mn alloy powder were synthesized with consistent properties, and approximately 23 kg was supplied to WIPRO 3D for additive manufacturing trials. Additively manufactured (AM) coupons using Fe-Mn alloy exhibited uniform microstructures and were free of defects. Process parameters for Selective Laser Melting (SLM) were optimized, resulting in high-quality builds.

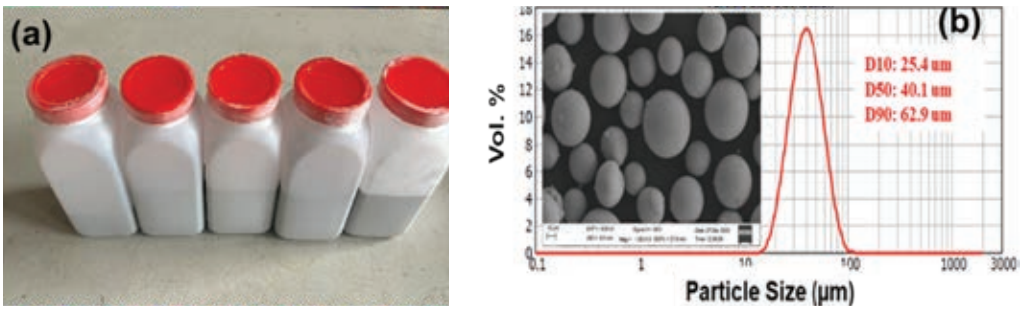


Figure (a) Fe-Mn alloy powder made by IGA and (b) DLS particle size and size distribution and inset is SEM image after sieving

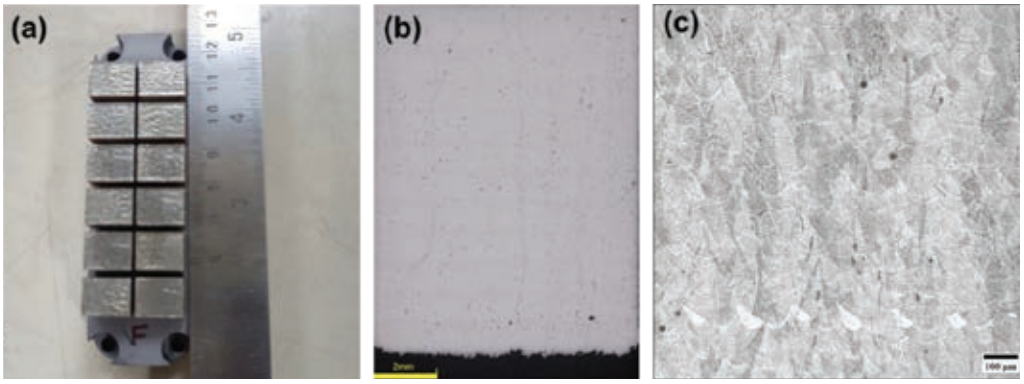


Figure: (a) AM coupons fabricated using in house synthesized Fe-Mn powder and (b) and (c) coupon microstructure (optical)

WIPRO 3D

Approximately 30 different test coupons were successfully fabricated using Fe-Mn alloy powders through the Powder Bed Fusion process, specifically Selective Laser Melting (SLM). These coupons were produced using 15 distinct sets of printing parameters. The resulting samples exhibited desirable microstructures and demonstrated good internal integrity at the coupon level.

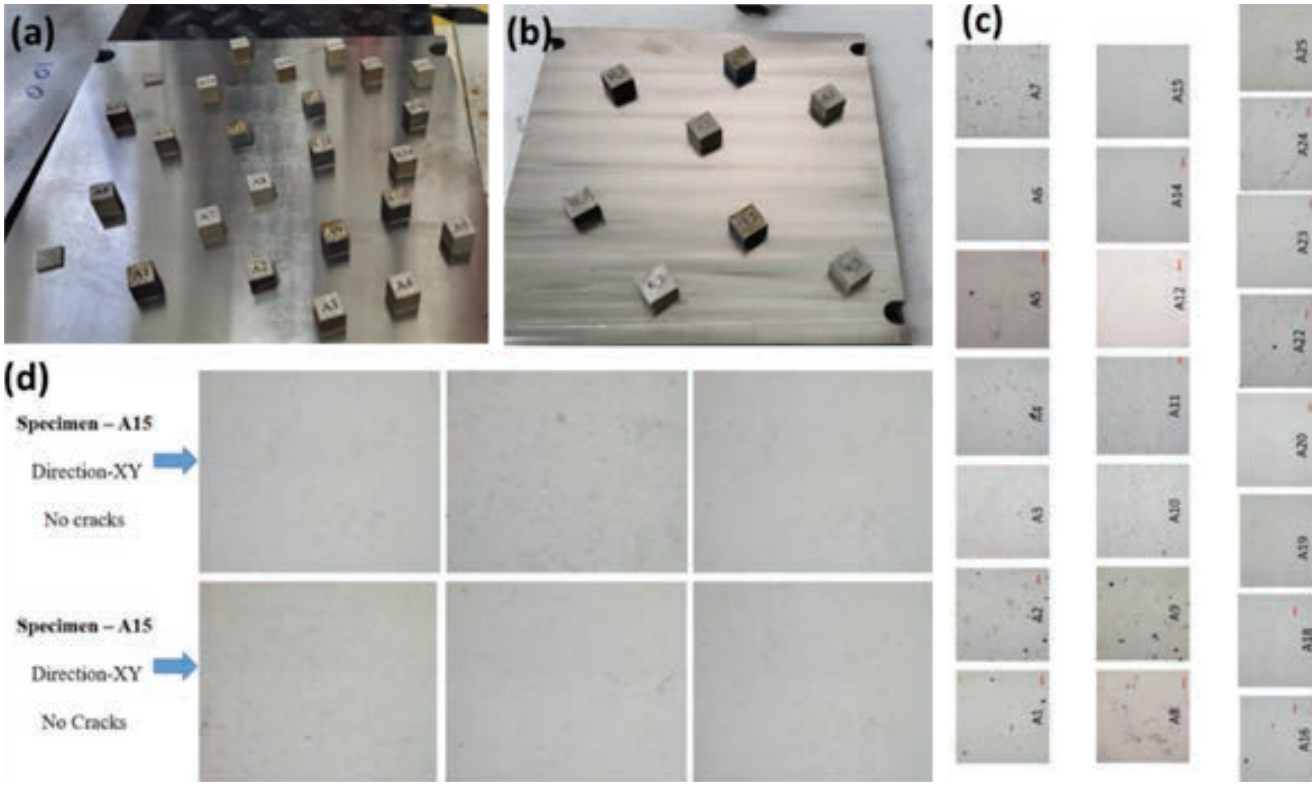
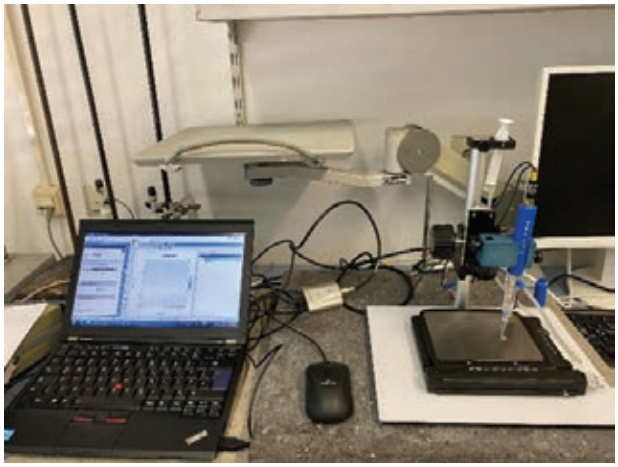


Figure (a) and (b) Fe-Mn alloy coupons printed by powder bed fusion and (c) their respective microstructures, and (d) microstructure of coupon with optimized process parameters showing defect free

Charité, Berlin

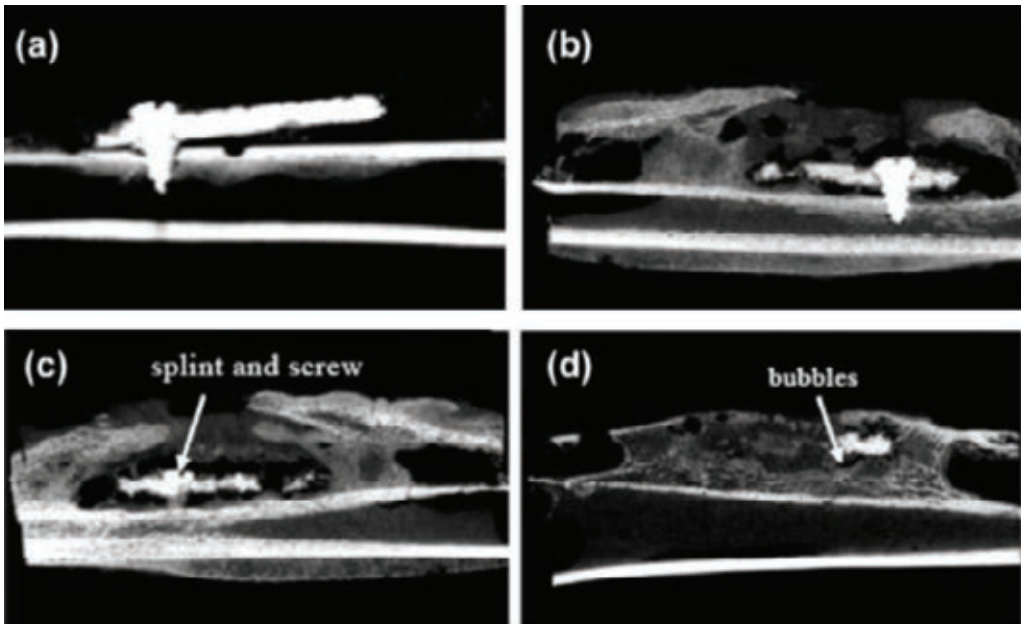
Following an in-depth analysis of commercial soft tissue anchors (STAs) and relevant literature, Charité proposed two distinct STA designs tailored for iron-manganese (Fe-Mn) and magnesium (Mg)-based alloys. The models were created using Autodesk Fusion 360 software. Design 1, intended for Fe-Mn alloys, features sharper threads, while Design 2, developed for Mg-based alloys, includes a tapping-in mechanism. The head tip design is inspired by the most stable screw configuration used in Mg-Zn alloys. The proposed designs have been shared with all project partners and were subsequently updated by the International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI). The designs are now awaiting additive manufacturing for sample production. Mechanical testing, including pull-out strength evaluation of the 3D-printed STAs, as well as degradation studies in a simulated body fluid environment, will be conducted in the next phase.



Electrochemical Working platform

KCS Europe GmbH

To identify an appropriate layer system for coating, KCS Europe GmbH began by conducting a literature review on the corrosion behavior of conventional biodegradable soft tissue anchors. The findings revealed that these anchors typically lose their structural integrity within 8 to 12 weeks, highlighting the need for a corrosion-inhibiting coating. Subsequently, suitable elements for the coating layer system were selected. Given the direct interaction between blood and the implant during implantation, the chosen materials must be both corrosion-resistant and biocompatible—meaning they should be biologically tolerable and capable of interacting beneficially with biological tissue. As some of the selected alloys are not commonly used in Physical Vapor Deposition (PVD) processes, the required target materials had to be sourced and ordered from various suppliers. A series of tests to determine the optimal deposition parameters is planned as the project advances.



CT-images of Mg-Zn implant after (a) 2, (b) 4, (c) 8 and (d) 12 weeks of surgery

RAMFLICS

Robust Additive Manufacturing of Functional Lightweight Integrated Customisable Metallic Structures

PROJECT BRIEF

Light-weight high-performance components such as motor casing and battery enclosures require the assembly of multiple parts with complex geometry for the efficient design of electric vehicles. Design innovation to reduce the part counts without compromising the desired structural, thermal and mechanical performances is needed but limited by the ability of the traditional processes. The recourse is to produce parts with an innovative design by printing additional features on a cast or extruded part using wire-arc additive manufacturing (WAAM) thereby reducing part counts and the need for elaborate assembly processes. WAAM is a novel technique and involves rapid melting, deposition and solidification of materials to build geometric features layer-by-layer on a base. An understanding and precise control of the WAAM process are needed to produce a defect-free, structurally sound and dimensionally consistent component. The present project aims at WAAM based printing of three-dimensional features on cast / extruded aluminium alloy parts to enhance their functionality. The work packages include the development of in-situ monitoring and process control systems, computer-based models to predict the structure, property, residual stress and distortion and defect generation and printing of parts with enhanced features as demonstrators. These demonstrators will be put under standard tests to check their performances for further commercialization and mass production. The tasks will be carried out by all the partners in a systematic manner to ensure the reproducibility of the developed technology and completion of the overall targets.

CONTACT DETAILS

amit@iitb.ac.in
murugaiyan@iitm.ac.in
gautam.wagle@adityabirla.com
max.biegler@ipk.fraunhofer.de
goecke@th-brandenburg.de
aashirwad.parasar@gefertec.de

Project Investigators

Amitava De
IIT Bombay

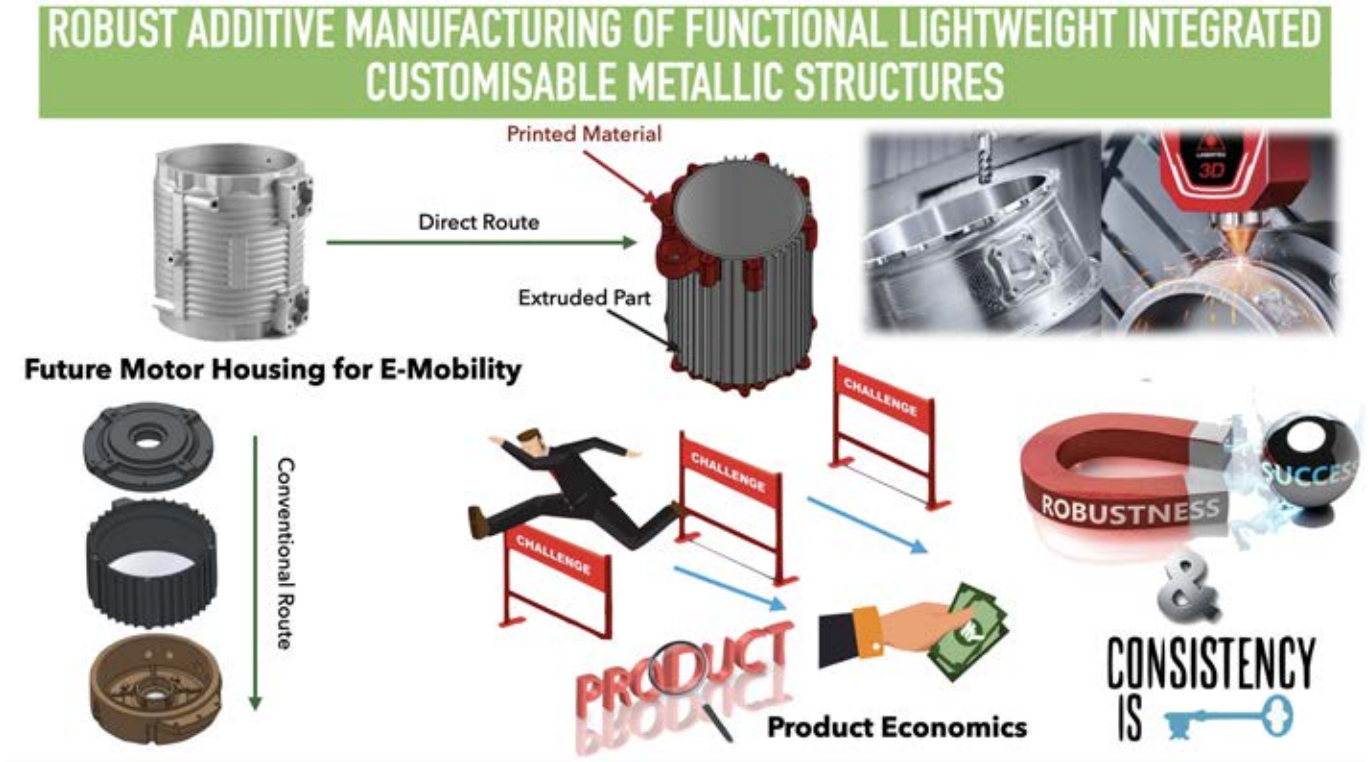
Murugaiyan Amirthalingam
IIT Madras

Gautam Wagle
Hindalco Industries Limited

Max Biegler
Fraunhofer-Institute for Production Systems and Design Engineering (IPK)

Sven-F. Goecke
Technische Hochschule Brandenburg (THB)

Aashirwad Parashar
Gefertec GmbH



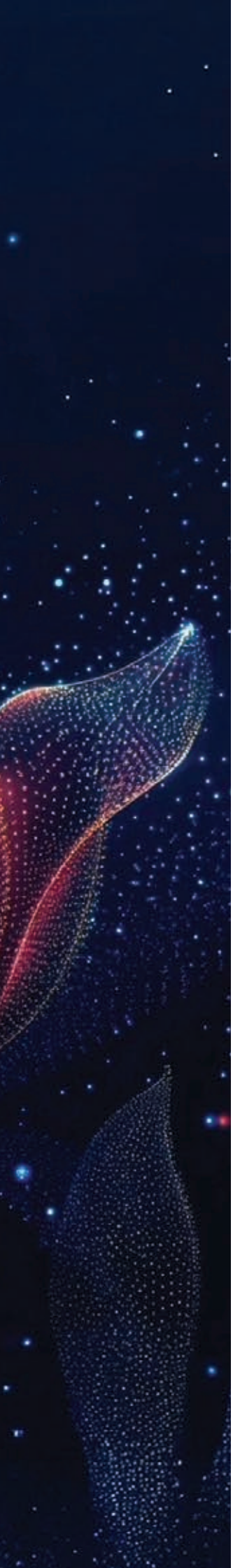
Progress made/achieved

Process Conceptualization and Design (Technology Readiness Level 3)

An inventory was created, detailing the components, manufacturing routes, and overall fabrication procedures for state-of-the-art electric vehicle (EV) motor casings. A design analysis was conducted to explore the integration of three-dimensional (3D) functional features onto extruded parts, aiming to reduce the number of components in the assembly. The procurement of designated Wire Arc Additive Manufacturing (WAAM) facilities at both the IIT Bombay and the IIT Madras has been completed. A meeting was held at IIT Bombay and Hindalco premises, with participation from all six consortium partners and senior representatives from the Indo-German Science and Technology Centre (IGSTC). It was noted that project activities for the German partners began approximately six months after the Indian counterparts. Hindalco has agreed to supply the substrate materials on which 3D feature printing will be carried out at IIT Bombay and IIT Madras.

Process Understanding and Validation (Technology Readiness Level 4)

Efforts have been directed toward developing process parameters for printing 3D features using automotive-grade aluminium alloys on selected EV substrates through WAAM-based 3D printing. Laboratory-scale studies were conducted to assess how process conditions affect dimensional consistency, defect formation (such as porosity and cracking), and overall structural integrity. Additionally, computer-based numerical models are being developed to understand the influence of power and speed on thermal cycles, feature



geometry, microstructure, residual stresses, and distortion during the printing process.

Process Development and Integration (Technology Readiness Level 5)

The printing of the intended 3D features on wrought aluminium substrates using WAAM facilities has been completed. Ongoing evaluations are assessing how key WAAM process variables impact the dimensional accuracy and structural soundness of the printed features. Numerical models are being refined to correlate the effects of WAAM parameters on issues such as lack-of-fusion, warpage, residual stress, and structural performance. An in-situ process monitoring methodology has been developed for laboratory-scale printing, and efforts are underway to adapt it for part-scale applications.

Demonstrator Production and Evaluation (Technology Readiness Level 5)

Hindalco has delivered extruded aluminium substrates for printing sample-level 3D features. The printing of actual, design-accurate features onto extruded motor casings is currently in progress.

Utilization of Results (Technology Readiness Level 6)

A consortium meeting was held at the IIT Madras, with active participation from potential end-users and their Original Equipment Manufacturers (OEMs). Hindalco and Gefertec GmbH presented the advantages of the proposed WAAM-based flexible and rapid manufacturing approach for electric vehicle motor casings.

MAMM-WAAM

Multi-Axis Multi-Material Wire Arc Additive Manufacturing

PROJECT BRIEF

The powder-feed metal Additive Manufacturing (AM) systems can realize the Functionally Graded Materials (FGMs) but remain inefficient and challenging to control the localized material composition. Therefore, this project proposes a novel approach, "Multi-Axis Multi-Material Wire Arc Additive Manufacturing (MAMM WAAM)," to efficiently fabricate large-scale metallic objects of FGMs. The proposed system will be a robot-cell consisting of two multi-wire plasma welding torches attached to two 6-axis Robotic Arms mounted on the curved tracks. This system will produce large-scale FGMs objects of size up to 2m×2m×1m. Also, a Computer-Aided Process Planning (CAPP) software will be developed for efficiently operating the proposed system. New algorithms for (i) representing FGMs CAD models, (ii) build strategies, (iii) volumetric simulation, and (iv) collision detection will be developed for this CAPP software. The system will demonstrate its capabilities through industrial case studies.

CONTACT DETAILS

sajan.kapil@iitg.ac.in
mlaw@iitk.ac.in
vishwaspr@amslindia.co.in
sharma@isf.rwth-aachen.de
denys@moduleworks.com

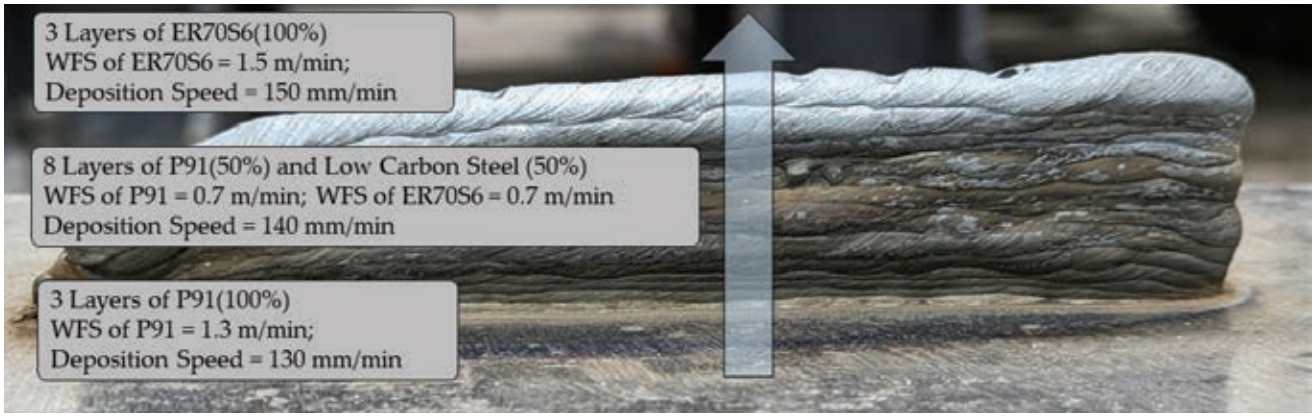
Project Investigators

Progress made/achieved

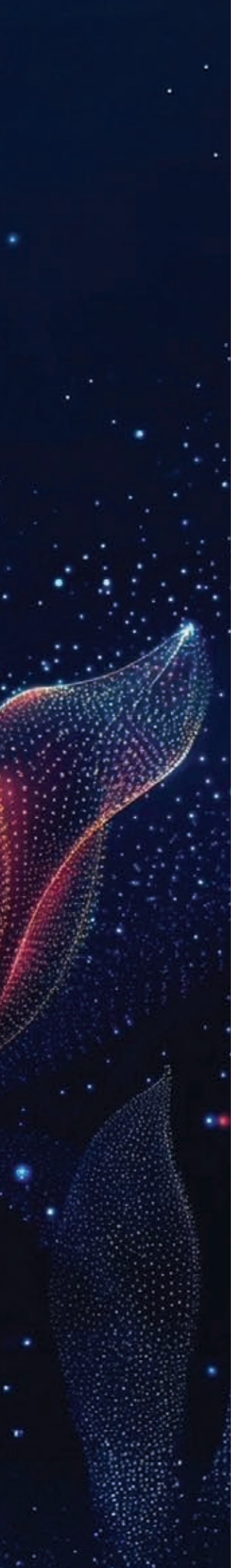
IIT Guwahati

The design of the robotic cell was finalized with the following specifications: two 6-axis robotic arms, each with a payload capacity of 11–12 kg and a reach of 2.2–2.4 meters, mounted on two parallel linear tracks with a stroke length of 3.5 meters. A dual-arm controller will manage a total of 14 axes (6+1 per arm) along with six analog switches for adjusting wire speed and current. The decision to use linear tracks over curved ones was made to avoid complexities in the computer-aided manufacturing (CAM) environment, with no compromise on the deliverables or capabilities of the robotic cell. Additionally, the team developed a novel build strategy termed "drop-on-demand deposition," aimed at locally controlling and engineering the microstructure to fabricate microstructure-based functionally graded materials (FGMs). Using this approach, a thin wall was successfully deposited and provided to the IIT Kanpur for characterization. Preliminary results from Scanning Electron Microscopy (SEM) analysis are highly encouraging.

MAMM WAAM System at IIT Guwahati



Initial Functionally Graded Materials (FGM) Structure deposited by MAMM WAAM



IIT Kanpur

The IIT Kanpur is actively working on both the characterization of materials and the dynamics of robotic systems. IIT Kanpur received a drop-on-demand deposited mild steel wall from the IIT Guwahati, fabricated using Wire Arc Additive Manufacturing (WAAM), for microstructural and mechanical characterization.

Ace Manufacturing Systems Ltd.

A Metal Inert Gas (MIG) welding-based Wire Arc Additive Manufacturing (WAAM) system was developed and studied using an Arc Directed Energy Deposition (DED) setup. Various aspects of the Wire Arc-DED process were investigated, including the interfacing of the MIG welding unit with Computer Numerical Control (CNC) machines to monitor and control key process parameters such as voltage, current, wire feed rate, and axis feed rate, as well as programming through the CNC controller. Additionally, an in-situ interlayer cooling technique was developed to enhance the system's overall productivity.

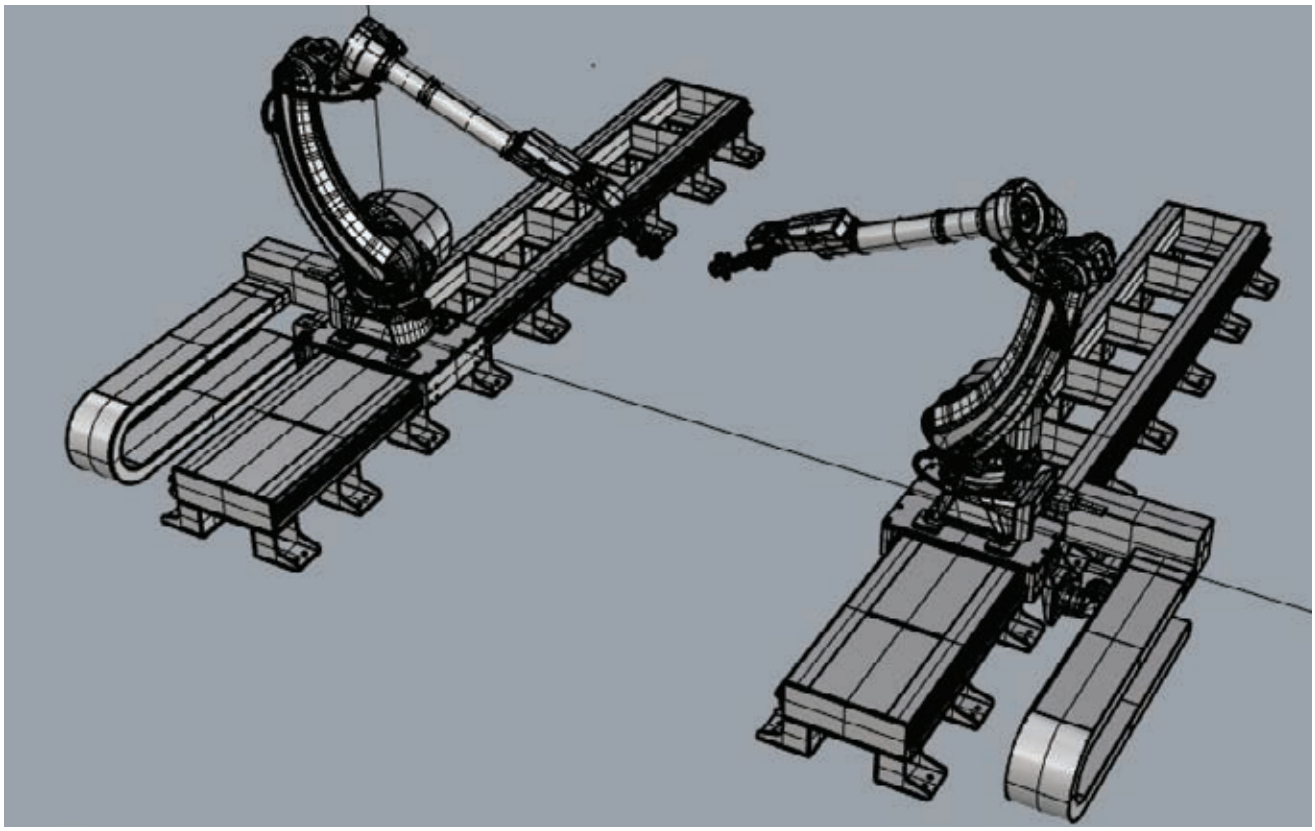
RWTH Aachen

As part of the project, RWTH Aachen is developing a multi-wire plasma torch to enable the additive manufacturing of multi-material components, facilitating the creation of functionally graded materials (FGMs). Two primary use cases have been identified: seawater-resistant, high-strength, low-cost FGM, and another tailored for die and mold applications. Initial samples were produced using Metal Active Gas (MAG) welding, which offers greater flexibility with height variations, and variable wire feed rates were tested. Trochoidal tool paths for in-line multi-material deposition were explored, and hardness testing was conducted. Weld beads produced using a plasma nozzle showed no porosity on straight paths, but trochoidal paths exhibited significant porosity, likely due to inadequate shielding gas. To address this, modified plasma nozzles were evaluated using high-speed imaging and schlieren optics under varying gas flow conditions. Additionally, a path planning tool capable of assigning point-specific material combinations was integrated into the system. Coordination between the robot, welding power supply, and wire feeders has been established, and initial demonstrator parts have been successfully fabricated using the MAG process.

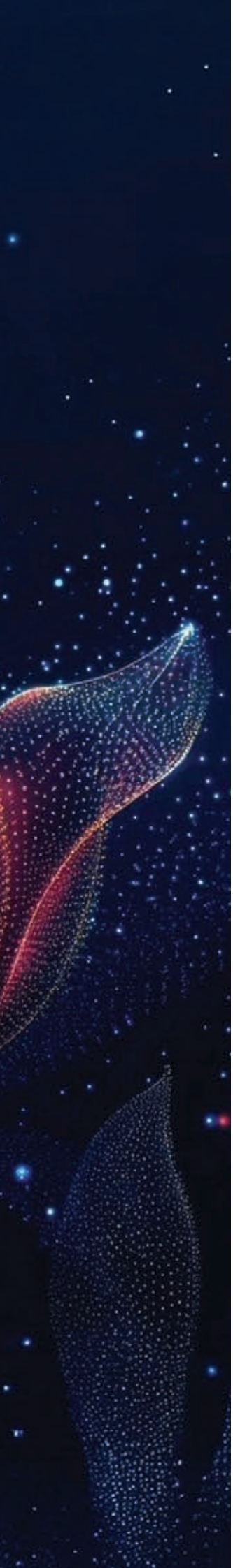
First demonstrator with new path planning setup

ModuleWorks

At the current status of the project, ModuleWorks is working on the integration of the dual robot cell into the ModuleWorks software libraries. The system is now also available for customers. More precisely, it is the first robot cell with several robots in the ModuleWorks software portfolio. Therefore, the dual robot cell of the project is the first demonstration of the software's capabilities.



Dual Robot Cell in ModuleWorks Software



Add-Bite

Development of Patient-Specific Additively Manufactured Mandibular Implants with Biotechnology-Inspired Functional Lattice Structures

PROJECT BRIEF

Commercially available Total Mandibular Joint (TMJ) Replacement implants do not fit properly in Indian patients. Hence, patient specific anatomical TMJ implants seem to be a better alternative than the existing stock implants. Additionally, these commercial implants lack the hierarchical bony architecture. Therefore, it is hypothesized that an anatomical TMJ implant with additively manufactured bio-inspired functional lattice-structures will have improved biomechanical performance. The aims of the manufacturing investigations are to specifically control the process parameters for powder bed fusion with laser beam (PBF-LB) to adjust the morphology and topography of graded lattice structures by achieving a match with the respective bone characteristics. Cryogenic cutting of the final contour, selection and optimization of suitable finishing processes such as stream finishing, centrifugal disc finishing or electropolishing, completes the holistic research approach. This approach also encompasses the manufacturing of the fossa component and the integration of clinical assessments.

CONTACT DETAILS

kmukherjee@mech.iitd.ac.in
ajoyroy@hotmail.com
kingshuk.poddar@tatasteel.com
frederik.zanger@kit.edu
d.stelzer@otec.de

Project Investigators

Kaushik Mukherjee
IIT Delhi

Ajoy Roychoudhury
All India Institute of Medical Sciences (AIIMS)

Kingshuk Poddar
Tata Steel Limited

Frederik Zanger
Karlsruhe Institute of Technology (KIT)

Daniel Stelzer
OTEC
Präzisionsfinish GmbH

Progress made/achieved

All India Institute of Medical Sciences (AIIMS)

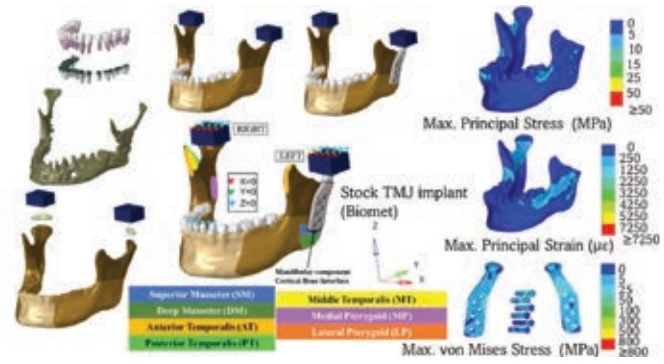
In Work Package 1 - (Analysis of patient data to know the size variation of individual TMJ implants of patients) at AIIMS, suitable patients with terminal Temporomandibular joint disease (TMJ) were identified (n=168) and enrolled in the study. The patients without terminal TMJ disease (n=199) were taken as controls. Their CT scans were acquired, which were used to develop the virtual 3D mandible through biomedical image processing using Materialise MIMICS software. Furthermore, 3D printing of the mandibles via 3D printer was done so that the form factor of the newly designed implant can be evaluated by clinicians.

A review of mandibular borderline movements was conducted in normal individuals (non-TMJ cases). Mouth opening, masticatory muscle function, and dental occlusion were evaluated using a jaw tracker, electromyography (EMG), and T-Scan occlusal analysis. The results were compared between post-operative TMJ disease patients who had undergone total joint replacement and individuals from the normal population. This analysis helped evaluate the role of muscle function and the importance of incorporating muscle reattachment during the design of TMJ implants.

IIT Delhi

IIT Delhi has established a methodology to analyse the CT data for variations in mandibular shape and size between subjects with healthy and ankylosed TMJ to quantify the misfit between a commercially available TMJ replacement implant and a patient with TMJ ankylosis. Detailed in silico (FE-based) biomechanical investigations of novel TMJ replacement implants have been conducted.

Computational frameworks have been developed to predict the homogenized material properties of lattices.



Methodology for detailed FE modelling of mandible and TMJ implant

Tata Steel

The Tata Steel team has established a methodology for fabricating the Ultra-High Molecular Weight Polyethylene (UHMWPE) fossa components and the implant sterilization procedure. Additionally, the process of dip-coating lattice-structured implants with a hydroxyapatite layer has been explored.

wbk Institute of Production Science, Karlsruhe Institute of Technology (wbk-KIT)

A developed novel scan strategy, combined with further parameter optimizations, enabled the manufacturing of advanced TMJ designs. These designs feature intricate, bio-inspired graded lattice structures and meet the size, mechanical strength, and medically defined requirements of both trabecular and cortical bone.

OTEC Präzisionsfinish GmbH

OTEC developed a feasible processing route to smooth all the outer and inner surfaces of the novel TMJ implant. It is achieved by aligning individual finishing processes in a mandatory sequence. This approach enables smooth, homogeneous surface and lattice conditions, based on the extended design freedom introduced through structural grading during the initial manufacturing stage.

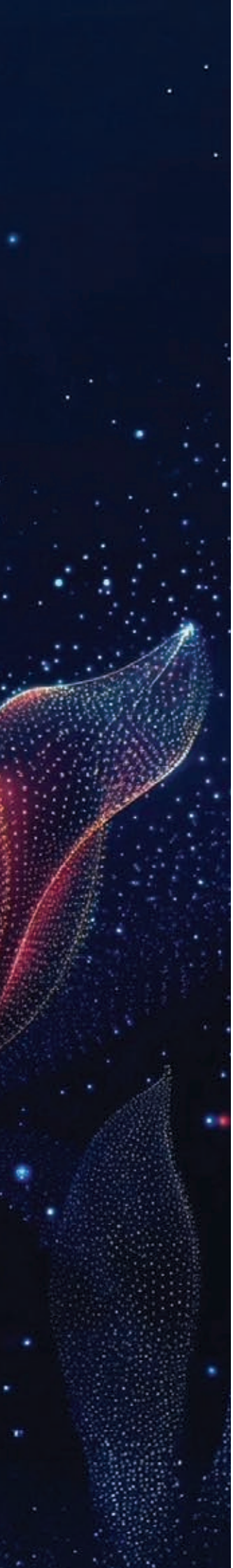
Throughout the period, close coordination was maintained among the three Indian partners (AIIMS, IIT Delhi, and Tata Steel) through meetings between project investigators and researchers from all three institutions. Close coordination was also maintained with the German partners (wbk/KIT and OTEC) through regular meetings and the sharing of updates via a common repository.

PUBLICATIONS

1. Chandra, G., Ghosh, R., Kaur, K., Roychoudhury, A., Mukherjee, S., Chawla, A. and Mukherjee, K., 2024. Morphometric variations of human mandible in Indian population: comparison between subjects having healthy and ankylosed temporomandibular joint. medRxiv, pp.2024-09. https://doi.org/10.1101/2024.09.23.24314231

2. Ghosh, R., Chandra, G., Verma, V., Kaur, K., Roychoudhury, A., Mukherjee, S., Chawla, A. and Mukherjee, K., 2024. Biomechanical Evaluation of Temporomandibular Joint Implants Under Complete Mastication Cycle. bioRxiv, pp.2024-08. https://doi.org/10.1101/2024.08.26.609607

3. Ulff, N., Leingang, E., Schubert, J. and Zanger, F., 2024. Improvement of manufacturing accuracy of graded Ti-6Al-4V BCC lattice structures by local laser power adaption [Procedia CIRP 124 (2024) 118–123]. Procedia CIRP, 124, pp.807. https://doi.org/10.1016/j.procir.2024.10.045



ModAMtool

Material and Process Development for Additive Manufacturing and Post-Processing of Tools Made of Modified Hot Work Tool Steel

PROJECT BRIEF

The Laser Powder Bed Fusion (LPBF) additive manufacturing process is suitable for tool making due to the small batch size and the ability to produce curved cooling channels that are not conventionally possible. When processing standard steel for hot work and plastic moulding tools, steel grade H13 with LPBF, cracking must be prevented by using high preheating temperatures or by significantly limiting part size. To overcome these limitations, a modified hot work tool steel is being developed that can be processed at preheating temperatures of 200 °C or less to enable industrial use. For efficient parameter selection, software for LPBF process development will be adapted and used. For a high surface quality of the functional outer surface and the complex cooling channels, polishing with a polymer rheological abrasive in a semisolid to liquid medium is used. The process chain to produce a tool is demonstrated and the tool is implemented in a plant environment.

CONTACT DETAILS

evmrs@iittp.ac.in
sudarshan.a@intechadditive.com
niklas.praetzsch@ilt.fraunhofer.de
hans-guenter.krull@dew-stahl.com

Project Investigators

Dr Mamilla Ravi Sankar
IIT Tirupati

Anigani Sudarshan Reddy
Intech Additive Solutions Pvt Ltd (Intech)

Niklas Prätzsch
Fraunhofer Institute for Laser Technology (ILT)

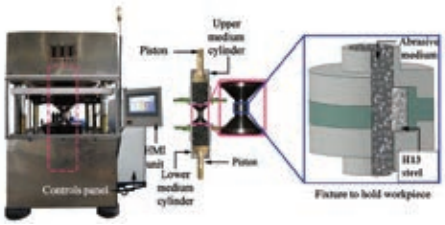
Hans-Günter Krull
Deutsche Edelstahlwerke Specialty Steel GmbH & Co. KG (DEW)

Progress made/achieved

Fraunhofer Institute for Laser Technology (ILT) and Deutsche Edelstahlwerke Specialty Steel GmbH & Co. KG (DEW)

Fraunhofer Institute for Laser Technology (ILT) and Deutsche Edelstahlwerke (DEW) collaborated on several key areas of material and process development. Initially, the miniaturized process module “Petit” was utilized for Laser Powder Bed Fusion (LPBF) manufacturing of samples, enabling Deutsche Edelstahlwerke to expedite the development of new alloys. Following this, various LPBF process parameters were investigated to fabricate samples for the evaluation of relative density, tensile strength, Charpy impact resistance, and microhardness. Contour parameters were also optimized to analyze the surface roughness of both internal and external features. Another area of focus was the LPBF manufacturing of samples with internal cooling channels, which were used for post-processing trials at the Indian Institute of Technology Tirupati (IIT Tirupati), employing a polymer-based rheological abrasive medium. Additionally, Fraunhofer Institute for Laser Technology provided consulting services for transferring optimized parameters to an industrial-scale LPBF machine at Intech Additive Solutions and supported the fabrication of an aluminum die-casting tool demonstrator at Intech. The foundation of this development work was the widely used tool steel H13/1.2344. Thermodynamic and thermokinetic simulations were performed, leading to the identification of three promising new alloy candidates. Laboratory-scale heats of these alloy designs were produced and analyzed, and powder production for the most promising alloy is currently underway.

Build platform with cylinders



Overview of abrasive flow finishing with polymer rheological abrasive medium

IIT Tirupati

IIT Tirupati focused on developing a polymer-based rheological abrasive medium, conducting comprehensive rheological studies, and carrying out finishing experiments on additively manufactured tube structures. Various compositions were evaluated using a trial-and-error approach to finalize the optimal formulation. The abrasive medium was successfully synthesized using a suitable polymer and cross-linker. Dynamic rheological tests were performed to analyze the flow and deformation behaviour of the medium used in abrasive flow finishing. Custom fixtures for the abrasive flow finishing process were also designed and fabricated. Additionally, metallurgical characterization was carried out on as-received H13 steel samples. Finishing experiments on H13 steel were conducted to assess the influence of abrasive particle distribution on material removal rates and surface roughness.

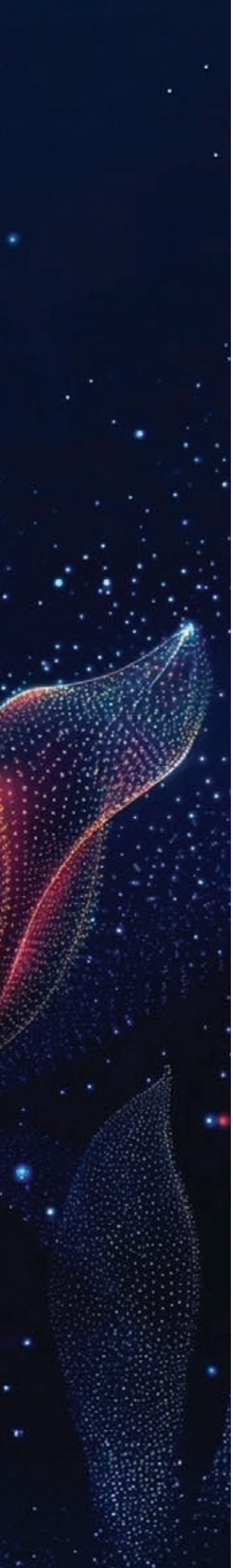
Intech

Intech Additive Solutions Pvt. Ltd. showcased their AMOptoMet software, designed for developing parameters for new materials. They sourced metal powders with modified chemical compositions to assess printability and supplied IIT Tirupati with specimens made from various materials for initial polishing trials. Printing trials were carried out using H13 material, during which Intech successfully optimized the printing parameters and produced test coupons. These coupons were evaluated for density, hardness, and tensile strength, with results aligning closely with nominal standards. Furthermore, Intech provided IIT Tirupati with hollow cylindrical components for post-processing experimentation.

PUBLICATIONS

1. Basha, S.M., N. Venkaiah, T.S. Srivatsan, and M.R. Sankar. "Post-processing Techniques for Metal Additive Manufactured Products: Role and Contribution of Abrasive Media Assisted Finishing." Materials and Manufacturing Processes (2024). https://doi.org/10.1080/10426914.2023.2289678

Waste to Wealth



TRANSFORM

Transforming Industrial Silicon Carbide and Silicon Nitride Ceramics Waste into Products towards Material & Environmental Sustainability (Circular Economy)

PROJECT BRIEF

The project promotes sustainability and circular economy by reprocessing industrial silicon nitride (Si3N4) and silicon carbide (SiC) waste using Polymer Derived Ceramic (PDC) technology. This transformative method aims to address the mass market through conventional forming processes such as uniaxial pressing, isostatic pressing, slurry casting, and cater to special products by the additive manufacturing (3D-printing) technique. It is also envisaged to develop feedstocks using PDC modified wastes for additive manufacturing that can help create an independent ecosystem within the framework of additive manufacturing of materials. State-of-the-art advanced characterization techniques will be used to unveil & evaluate the chemistry and microstructure of the recycled products, coupled with comprehensive thermo-mechanical analysis to assess the product reliability. Project partners will ensure the performance of recycled products through meticulous testing and validation in industries for potential product development, thus promoting waste-to-resource conversion and fostering a greener future. This comprehensive project aligns with circular economy principles, presenting an innovative solution to address industrial waste while paving the way for a more sustainable and efficient industrial landscape.

CONTACT DETAILS

nvrk@iitm.ac.in
mandalsantanu@cumi.murugappa.com
Guenter.Motz@uni-bayreuth.de
ulrich.degenhardt@qsil.com

Project Investigators

Ravi Kumar
IIT Madras

Santanu Mandal
Carborundum Universal Limited

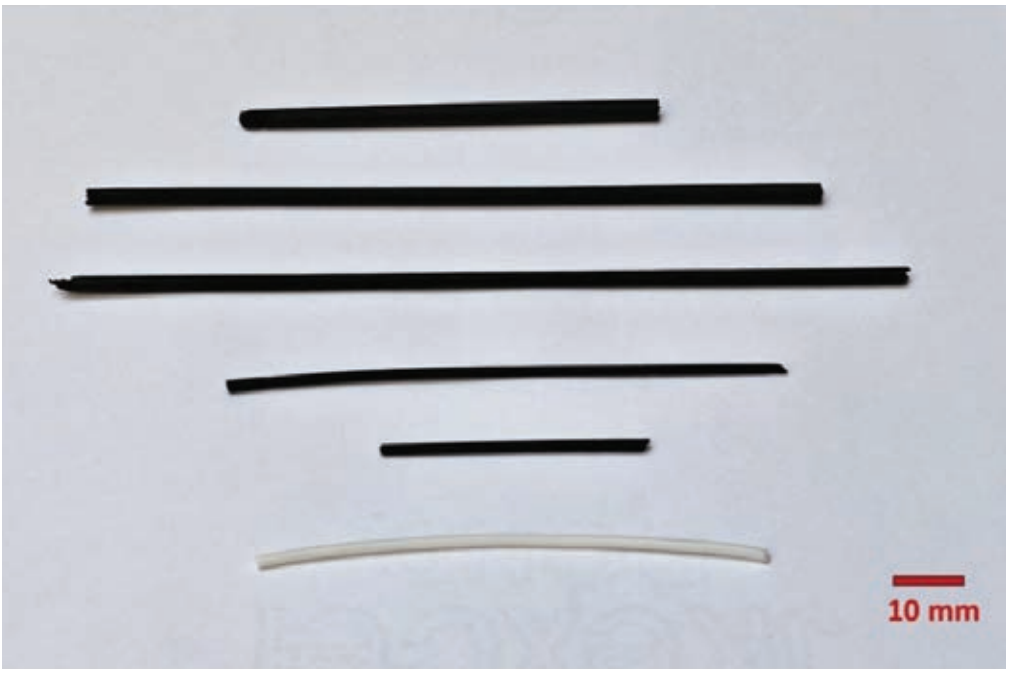
Günter Motz
University of Bayreuth

Ulrich Degenhardt
QSIL Ingenieurkeramik GmbH

Progress made/achieved

IIT Madras

At IIT Madras, initial work focused on creating filaments using waste silicon carbide (SiC) powder supplied by Carborundum Universal Limited (CUMI). A commercial-grade white Polylactic Acid (PLA) was selected as the binder. A heated extrusion process was chosen for fabricating filaments suitable for 3D printing, and IIT Madras designed and began building a lab-scale extrusion setup to support this. Furthermore, IIT Madras received a sample of reclaimed reaction bonded silicon carbide (RbSiC) powder from CUMI and conducted Scanning Electron Microscopy (SEM), Energy Dispersive X-ray Spectroscopy (EDS) and X-ray Diffraction (XRD) analyses, which confirmed the presence of SiC and free carbon in the sample.



Silicon carbide (SiC) filament

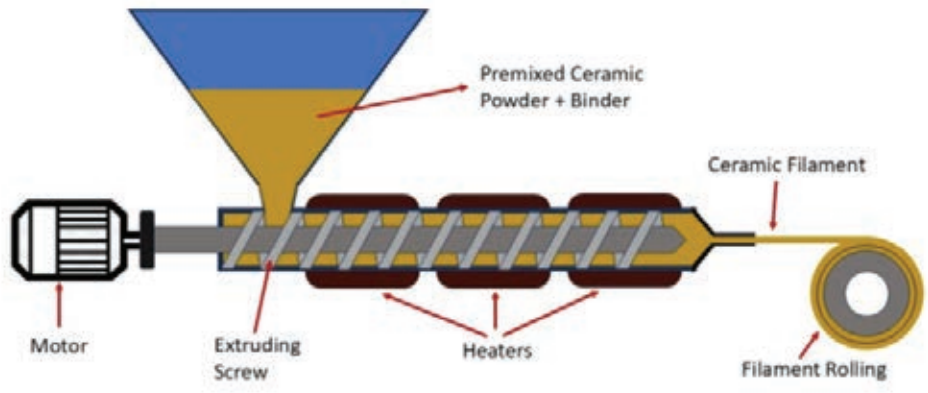


Diagram exemplifying the extrusion setup for making continuous ceramic filaments for 3D printing

Carborundum Universal Limited (CUMI)

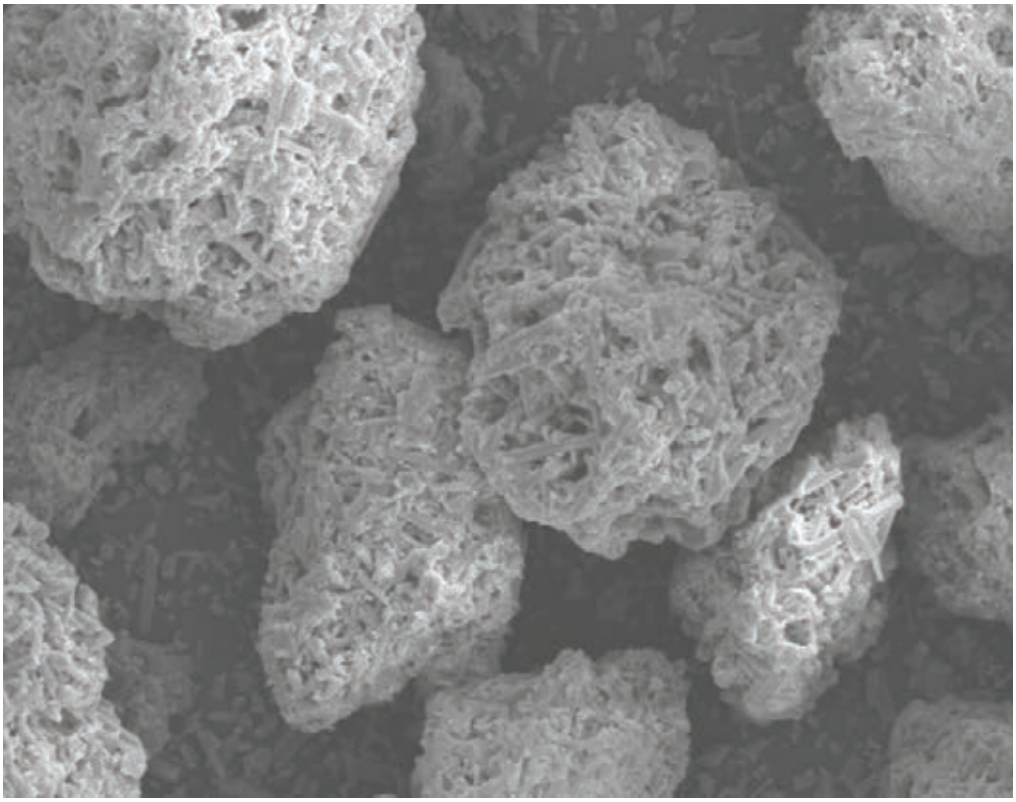
Selected a grade of RbSiC (reaction bonded silicon carbide) used in wear-resistant and engineering ceramics. A sample of powder was sent to IIT Madras for further analysis.

Reaction-bonded silicon carbide (RbSiC) powder from Carborundum Universal Limited (CUMI)

QSIL Ingenieurkeramik GmbH (QSIL-I)

At QSIL-I, various mixed-fraction and heavily cross-contaminated silicon nitride (Si_3N_4) waste materials from current production and existing stock are being collected, inspected, and processed. Samples are sent to project partners, the University of Bayreuth (UBT) and IIT Madras, for initial testing.

QSIL-I has also begun lab-scale processing of the less contaminated batch, including debinding and regranulation. This recycled material has been used for shaping, sintering, and ceramic characterization. Initial results show that the sintered specimens still exhibit high porosity and large pores, limiting their mechanical strength and reliability. These findings indicate that further optimization is needed to improve the quality of recycled Si_3N_4 ceramics.



SEM picture of Si^3N^4 powder from QSIL-1 washed with NaOH solution

University of Bayreuth (UBT)

At the University of Bayreuth (UBT), silicon nitride (Si_3N_4) powder from QSIL-I is being purified to remove surface impurities and reduce the silicon dioxide (SiO_2) layer. The treated powder is then analyzed for surface morphology using Scanning Electron Microscopy (SEM), and its particle size is measured using laser diffraction.

MuScAI

Multiplexing Scanning LIBS for High Throughput AI Scrap Identification

PROJECT BRIEF

High-quality recycling of metals requires sorting into pure alloy fractions. To process the accruing quantity of aluminium scrap, a rapid analysis method is needed. In principle, this can be achieved with laser-induced breakdown spectroscopy (LIBS). In practice, a limiting factor is the throughput of material presented to the LIBS sensor. To overcome this, a novel multiplexing 3D scanning LIBS sensor is being developed. A multiplexing fiber laser source with a high repetition rate will feed an array of laser scanners that cover a large conveyor belt area on which the pieces pass by. The LIBS signal will be observed with a spectrometer at a high rate. This approach requires the adaptation of novel laser sources, scanners and spectrometer technologies to the advanced LIBS requirements. A demonstration system will be set up to show the suitability for a high-throughput application. The system will be tested with aluminium scrap, and its extension to an industrial-scale plant will be examined.

CONTACT DETAILS

jaindeepak@iitd.ac.in
ankur.s@cmr.co.in
cord.fricke-begemann@ilt.fraunhofer.de
j.makowe@lsa-systems.de

Project Investigators

Deepak Jain
IIT Delhi

Ankur Singh
CMR Green Technologies Ltd.
Faridabad

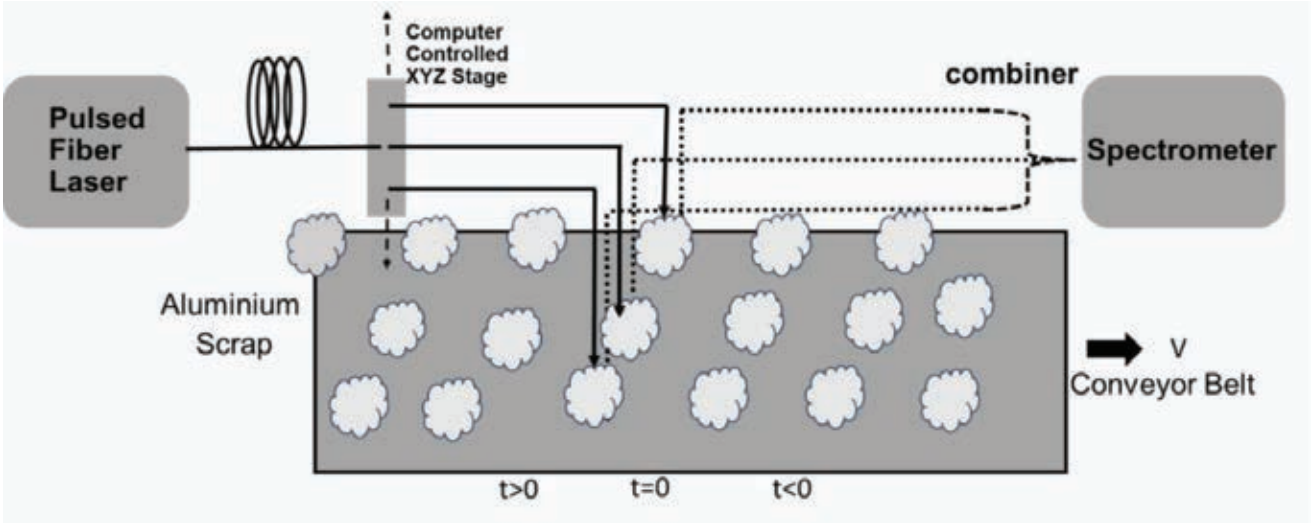
Cord Fricke-Begemann
Fraunhofer Institute
for Laser Technology (ILT) Aachen

Joachim Makowe
Laser Analytical Systems &
Automation (LSA)
GmbH Wolkenstein

Progress made/achieved

IIT Delhi

IIT Delhi is developing a fiber laser-based scanning system for real-time analysis of aluminium scrap using Laser-Induced Breakdown Spectroscopy (LIBS). The setup directs high-energy laser pulses through multiple optical fibers to scan different regions of scrap on a conveyor. Emitted plasma signals are collected and analyzed by a spectrometer to determine material composition. A splitter-combiner configuration is employed to enhance scanning precision and data collection. A high-power fiber laser source is under development for LIBS applications, targeting pulse energies up to a few millijoules, repetition rates of 10–50 kHz, and pulse durations between 0.1–20 ns. Component procurement is in progress, and system integration is underway. To overcome nonlinear limitations at high pulse powers, the team has designed a novel large-mode-area optical fiber. Work is also being carried out on spectral filtering techniques to manage amplified spontaneous emission and suppress Brillouin scattering. The resulting sharp spectral discrimination supports advanced fiber laser applications such as narrow-linewidth sources, gain-shaped lasers, and tandem-pumped systems. These developments will contribute to enhanced precision and power in future LIBS and high-energy laser applications.



Schematic of the multiplexed scanning Laser-Induced Breakdown Spectroscopy (LIBS) system

Lab spectrometer at CMR lab for spark-discharge optical emission spectroscopy (SD-OES)

CMR Green Technologies Ltd.

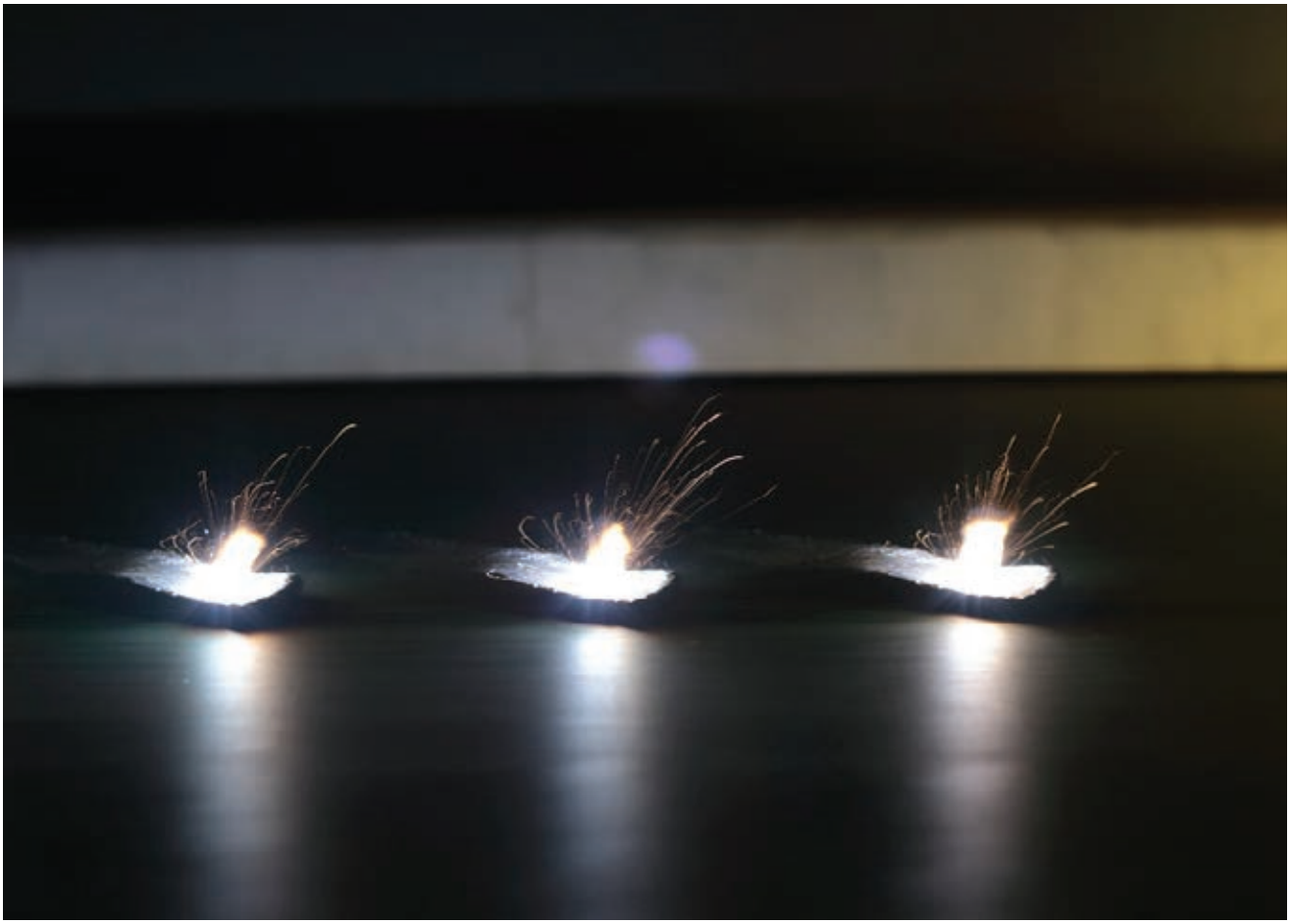
CMR Group analyzed its current aluminium scrap material flow of approximately 30,000 metric tons per month. CMR successfully sorted aluminium sheet scrap with copper content below 0.08%, achieving 91% purity as confirmed by spark Optical Emission Spectroscopy (OES). The sorted scrap can potentially replace costlier raw materials in aluminium alloy production, lowering overall costs.

"Taint Tabor" type scrap delivery

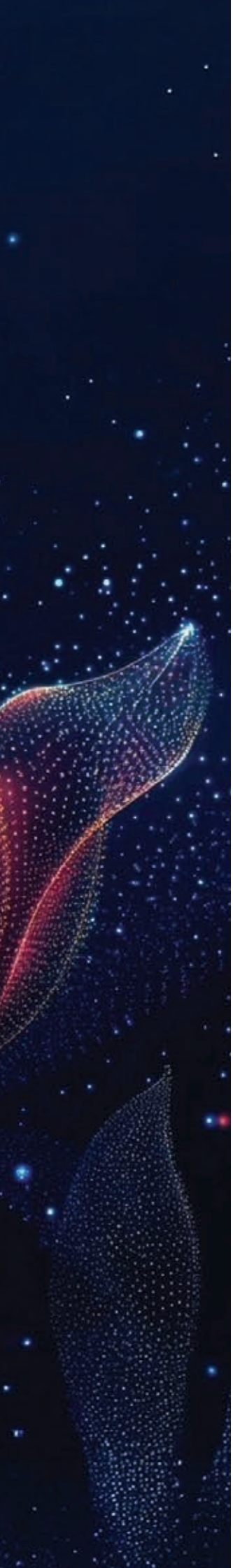
Manual scrap sorting

Fraunhofer Institute for Laser Technology (ILT) and Laser Analytical Systems & Automation (LSA) GmbH

Fraunhofer Institute for Laser Technology (ILT) and Laser Analytical Systems & Automation (LSA) GmbH, in collaboration with the IIT Delhi, are developing a fiber laser-based Laser-Induced Breakdown Spectroscopy (LIBS) system for inline analysis of aluminium scrap. A commercial fiber laser capable of delivering 1 millijoule pulses is used, with programmable pulse control. The setup includes laser focusing optics and plasma emission collection into a single optical fiber connected to a commercial spectrometer. Initial testing involves moving aluminium samples to evaluate scanning and detection. Key emission lines have been identified for aluminium and alloying elements such as copper, magnesium, silicon, iron, and others. These lines support alloy classification, including distinction between wrought and cast aluminium. A preliminary spectrometer setup is designed to support inputs from three scanners, scalable up to ten. Initial experiments confirmed signal detectability, with ongoing optimization of optical design for resolution and signal stability. Regular monthly meetings and document sharing through Microsoft Teams support coordination. A consortium agreement, led by Fraunhofer Institute for Laser Technology (ILT), was signed by all partners in October 2024.



Laser-Induced Breakdown Spectroscopy (LIBS) measurements, repeated three times on a moving scrap piece by 3D-scanning LIBS at Fraunhofer Institute for Laser Technology (ILT)



MAX-RAP

From Waste to Resource: Challenges and Opportunities in Maximising Reclaimed Asphalt Pavement Usage

PROJECT BRIEF

MAX-RAP project seeks to support the transition toward sustainable road infrastructure by optimizing asphalt pavement recyclability. This initiative is grounded in circular economic principles, aiming to reduce the reliance on new raw materials and minimize waste through the adoption of advanced recycling practices. By leveraging the collective expertise of academic researchers and industry partners, the project endeavours to develop innovative, cost-effective, and environmentally responsible solutions for road maintenance. A major focus of the project is understanding the challenges associated with aged asphalt binders. As binders age, their maltene content is reduced due to volatilization and oxidative processes, resulting in changes to their rheological behaviour. This makes the complete reuse of aged binders difficult, necessitating a detailed assessment of binder ageing to determine its recyclability and the appropriate proportion for reuse. Field-obtained Reclaimed Asphalt Pavement (RAP) is often significantly stiff, and while rejuvenators can help restore workability, their use is limited. Therefore, alternative approaches, such as incorporating low-viscosity refinery streams, are being explored, though they introduce new complexities in blend design. The project also addresses the challenge of binder activation, which is critical for aligning binder blend design with mixture blend design. To overcome this, technologies for the large-scale separation of RAP mastic are being considered. A Design of Experiments (DoE) approach will be used to optimize blend proportions based on binder properties, RAP characteristics, as well as rejuvenator type and dosage. Finally, conventional testing methods are being expanded to include advanced rheological testing under various conditions, including high pressure, to better evaluate binder performance. The outcomes of MAX-RAP are expected to deliver a comprehensive framework for binder recycling, supporting maximum RAP utilisation and the integration of alternatives to commercially available rejuvenators.

CONTACT DETAILS

jmk@iitm.ac.in
mrn.civil@psgtech.ac.in
maheshwaris@bharatpetroleum.in
sabine.leischner@tu-dresden.de
joerg.pigorsch@heitkamp-ug.de

Project Investigators

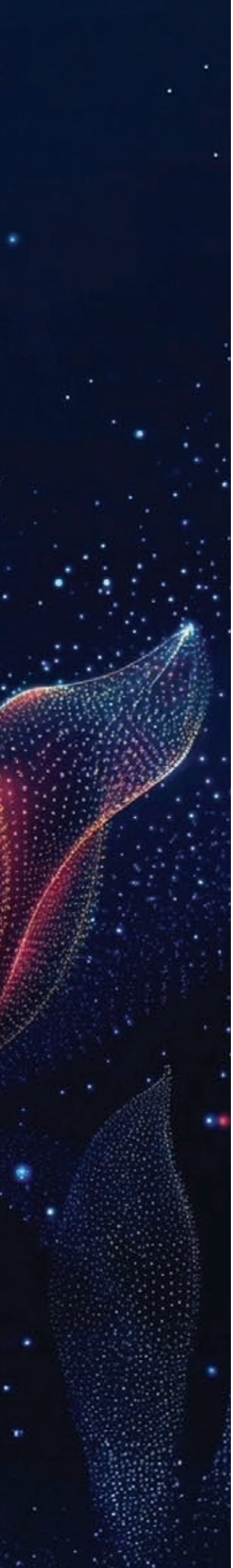
J. Murali Krishnan
IIT Madras

M. R. Nivitha
PSG College of Technology
Coimbatore

Sonal Maheshwari
Bharat Petroleum Corporation Ltd.

Sabine Leischner
TU Dresden

Jörg Kranz
Heitkamp



Progress made/achieved

IIT Madras

Preliminary specification-based testing is underway on the binders sourced from refineries and the field. The testing procedure for bitumen samples using Thin Layer Chromatography (TLC) was finalized. Initial TLC experiments are being carried out to establish repeatability limits. The specification compliance of the procured binders is currently being analyzed. A few rheological test protocols are being formulated, and trials are underway. Tests are also being identified to simulate ageing in the laboratory.

PSG College of Technology

The chemical composition-based tests considered for bitumen are as follows: (i) Fourier Transform Infrared (FTIR) Spectroscopy, (ii) Asphaltene Extraction, and (iii) Column Chromatography. The process is underway to procure materials/accessories required for setting up asphaltene extraction and performing column chromatography. FTIR testing is underway for the unaged binders.

Bharat Petroleum Corporation Ltd

The streams suitable for blending, namely vacuum tower residue and vacuum column slop, have been collected and evaluated for basic compositional characteristics such as (i) Carbon, Hydrogen, Nitrogen, and Sulfur (CHNS) analysis, (ii) Thin Layer Chromatography with Flame Ionization Detection (TLC-FID), and (iii) absolute viscosity. The samples have also been sent to IIT Madras for further evaluation. Trials on asphaltene extraction, column chromatography, and TLC-FID were carried out, and the procedures were finalized.

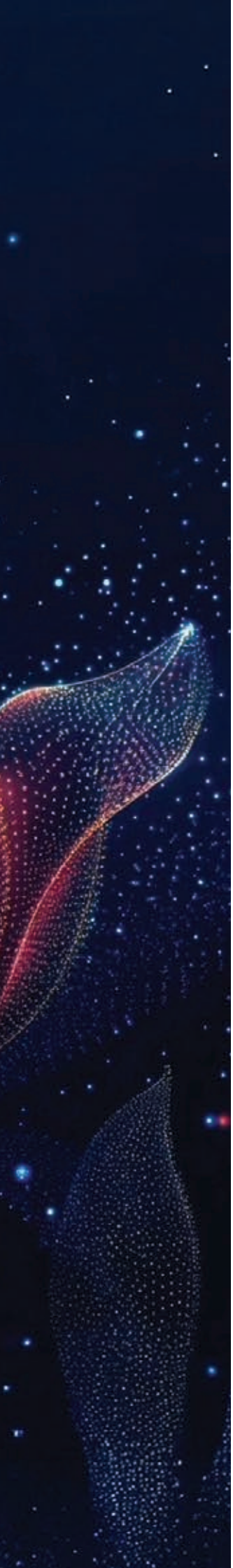
TU Dresden

To evaluate the performance and extent of ageing of the RAP binder, rheological tests were performed on six extracted field RAP binders. In addition, the chemical composition and the chemical ageing state of these RAP binders were analyzed using FTIR Spectroscopy, and fluorescence microscopy was carried out. Based on the results, work is currently underway to formulate a procedure for the laboratory simulation of ageing. This was a contribution to Milestone 1 (Development of a methodology to quantify the

influence of the extent of ageing on the chemical composition and rheological properties of the RAP binder). TU Dresden also contributed to Milestone 7 (Explore the feasibility of separation of mastic from RAP on a large scale for varied RAP and attempt to improvise the same for maximum binder extraction) by assisting Heitkamp in the selection of RAP material for the RAP separation at BHS-Sonthofen, Germany. The tests are scheduled for spring 2025.

Heitkamp

A work plan for handling RAP materials was drawn up during the project. An asphalt mixing plant is included for the RAP produced at the construction site. The trials are due to start in spring 2025. Initially, two RAPs are to be processed (surface + binder course and base course mix). In addition, an exchange took place with the project partners on the practical aspects of reclaiming, preparation and storage of RAP. Experience was exchanged with TU Dresden on the use of the rotor centrifugal crusher.



ECOPAVE

Sustainable Concrete Pavements Using High Volumes of Construction, Demolition, and Industrial Wastes as Constituent Replacements

PROJECT BRIEF

Rigid pavements are durable but unsustainable due to high natural resources use. This project explores utilizing locally sourced construction, demolition, and industrial waste in India and Germany to replace both Portland cement and natural aggregates in concrete. Scientific research will address key challenges like waste processing, activation, dimensional stability (creep, shrinkage, curling), and durability (alkali–silica reaction, freeze-thaw, leaching). Mechanistic models and a machine learning-based mix design framework incorporating life cycle assessment will maximize waste use. A final demonstrator will validate field applicability. Collaborations between academia and industry will drive sustainable construction practices and policy development.

CONTACT DETAILS

manus@zmail.iitm.ac.in
Devendra.Pandey@adityabirla.com
frank.dehn@kit.edu
knoblich@hypercon-solutions.com

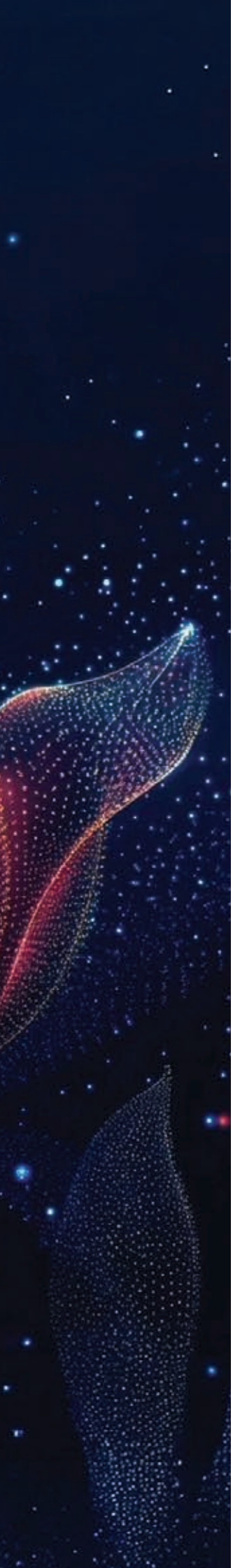
Project Investigators

Manu Santhanam
IIT Madras

Devendra Kumar Pandey
UltraTech Cement Ltd

Frank Dehn
Karlsruhe Institute of Technology (KIT)

Peter Knoblich
Hypercon Solutions GmbH



Progress made/achieved

Karlsruhe Institute of Technology (KIT)

Work Package (WP) 1 (Waste processing and characterization): Data on supplementary cementitious materials (SCM) and blended cement reactivity are being collected to develop a reaction kinetics model based on composition, fineness, and mix parameters. Additional experiments will be conducted at the Institute of Concrete Structures and Building Materials, Karlsruhe Institute of Technology (KIT/IMB-MPA). In Germany, Type 1 and Type 2 recycled concrete fines (RCF) is sourced to study the effect of construction waste impurities. Limestone powder and ground granulated blast furnace slag (GGBFS) are selected as SCMs. The activation of the RCF and R^3 (Rapid, Relevant, Reliable) test of all SCMs are scheduled to be executed. WP2 (Microstructure, strength, and carbon storage): Reactivity tests for blended binders will expand the WP1 database for use in WP3 (Data-driven mix design methodology). KIT/IMB-MPA and IIT Madras are coordinating a shared experimental design.

Hypercon Solutions GmbH

Industrial crushers and classifiers available in Europe and India have been analyzed for their capability to optimize the particle size distribution of recycled concrete fines (RCF). Recycled concrete has been processed and separated into recycled concrete aggregates (RCA) and RCF in multiple stages using Hypercon technology. Different processing methods for RCF have been selected to evaluate the paste content across various particle sizes. This investigation will be carried out at KIT/IMB-MPA. RCF with a high paste content is suitable for mechanical, thermal, or chemical activation and potential use as a binder. In contrast, RCF with a higher sand content is better suited for use as a sand replacement. In collaboration with IIT Madras, a framework is being developed for processing and extracting high-quality aggregates from reclaimed asphalt pavement (RAP) and RCA.

IIT Madras

Work Package (WP) 1 (Waste processing and characterization): Processing of RCA has begun, and the preliminary results indicate that the adhered mortar (AM) around RCA governs the performance of both aggregates. This finding indicates the necessity of the processing

technique to reduce the AM content in RCA. Low-grade limestone is being processed to enhance reactivity, and locally sourced class F fly ash is under physical and chemical analysis. Concrete fines have been collected, and factors affecting their reactivity are being studied. WP2 (Microstructure, strength, and carbon storage): Concrete tests using different mixing methods reveal that the water reduction method (WRM) improves performance with coarse recycled concrete aggregate (CRCA). Chemical characterization of SCMs and blended system reactivity tests are planned to support WP3 (Data-driven mix design methodology). Initial results show ternary SCM blends outperform binary ones in early-age strength, aiding the development of data-driven mix designs.

UltraTech Cement Ltd.

The role of UltraTech Cement Limited will be imminent in the Work Package 6, i.e. construction of the test section and their performance evaluation and monitoring. However, they are helping IIT Madras by supplying the materials (cement, low-grade limestone) needed for conducting laboratory experiments.

PUBLICATIONS

Bhardwaj, B.B., Singh, S. and Swaroop, C.S., 2025. Role of asphalt binder film thickness on the behaviour of RAP-incorporated concrete. Construction and Building Materials, 473, p.141012. https://doi.org/10.1016/j.conbuildmat.2025.141012

Fabricated Sensor arrays linked to a mobile device prototype for soil health monitoring

Jaw Crusher for recycled aggregate processing at IIT Madras

Vertical shaft impact for recycled aggregate processing at IIT Madras

Wide wheel abrasion testing machine at IIT Madras

BIOMOPAC

Biobased Functional Molded Fiber Packaging from Regional Agricultural Residues

PROJECT BRIEF

Molded Fiber Packaging (MFP) made from natural fibers has diverse applications, but for direct food contact, it traditionally relies on virgin fibers. The main challenge is incorporating functional barriers such as grease resistance, typically achieved using additives derived from fossil raw materials, which compromise the recyclability of the packaging. This roject introduces an innovative approach by utilizing vegetable residues from the agricultural industry as both fiber raw material and biogenic additives. Specially treated, highly fibrillated fibers can act as effective barriers against grease and oxygen. However, the dewatering and drying processes for this fiber layer require significant effort and energy, impacting the productivity of the molded fiber process. In addition to optimizing pulping processes, the project focuses on developing a spray application method to apply these fibers onto a preformed porous fiber network. This innovation aims to streamline the application of fiber-based barrier materials derived from various waste streams, ensuring a balance between protective performance, recyclability, and a favourable environmental footprint, as assessed through life cycle analysis (LCA).

CONTACT DETAILS

vibhore.rastogi@pt.iitr.ac.in
msd@parason.com
roland.zelm@tu-dresden.de
f.feuerhahn@bionatic.com

Project Investigators

Vibhore Kumar Rastogi
IIT Roorkee

Madhure Desarda
Parason Machinery India Pvt Ltd

Roland Zelm
TU Dresden

Frederik Feuerhahn
Bionatic GmbH & Co. KG

Progress made/achieved

TU Dresden

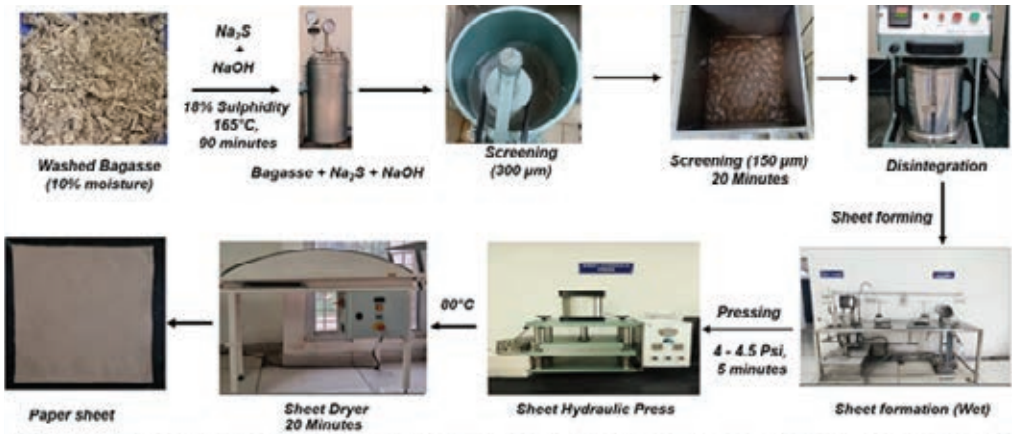
TU Dresden has established key structures to ensure efficient and secure collaboration and data exchange among project partners. In collaboration with Bionatic, a database was developed for LCA datasets, forming the basis for the material catalog and raw material assessment using strengths, weaknesses, opportunities, and threats (SWOT) diagrams. Given its high availability in Germany and India, along with an established database and known applications in pulp production, wheat straw was identified early as a promising agricultural residue. In collaboration with IIT Roorkee, analysis protocols for raw materials were developed to assess their chemical composition. TU Dresden also began benchmarking reference products MFP trays and plates made from bleached bagasse pulp, provided by Bionatic) to guide the development of fiber preparation processes. Extensive trials using Thermo Mechanical Pulp (TMP) and Chemi Thermo Mechanical Pulp (CTMP) refining were conducted to produce high-yield pulps. Mass balance calculations and energy input measurements were performed to be later included in LCA. The pulps produced were comprehensively analyzed in terms of their fiber morphology and dewatering properties. They were used with or without screening for the production of laboratory sheets. Promising fibers have also been used to produce molded fiber plates in analogy to the production conditions in fiber casting. However, these samples are currently under evaluation.

Bionatic GmbH & Co. KG

Bionatic, in collaboration with TU Dresden, has conducted extensive research on biomass potentials in Germany/Europe and compiled relevant LCA datasets on agricultural residues for methodical analysis aligned with project objectives. The LCA method development, which is integrated into the overall potential assessment, follows the steps: Goal and Scope Definition, Data Collection, Life Cycle Inventory (LCI), and Life Cycle Impact Assessment (LCIA). Together with the Institute of Waste Management and Circular Economy, TU Dresden, Bionatic has initiated work on defining system boundaries, the functional unit, and key performance indicators (KPIs) to establish a clear evaluation framework. A material catalog has been developed, profiling fibrous residues based on availability, current usage, mobilizable potential, and suitability for paper industry applications. Process evaluation includes gathering primary and secondary data on inputs such as materials, energy, and auxiliary chemicals. This supports the quantification of relevant flows for the LCI phase. In the LCIA, impact categories including global warming potential, human toxicity, eco-toxicity, water demand, and land use are assessed. Preliminary assessments show significant availability of cereal straw, mainly wheat straw, in both Europe and India. While straw is known in pulp production, its use in molded fiber packaging remains limited and will be explored further in this project.

IIT Roorkee

IIT Roorkee has contributed significantly to the evaluation and valorization of agro-residues in India, focusing on sugarcane bagasse/pith and wheat straw. Their research includes material characterization, pulping processes, and product development, supporting sustainability goals in the fiber-based packaging sector. In collaboration with TU Dresden, IIT Roorkee established standardized protocols for the chemical and physical characterization of agricultural residues. This involved proximate analysis, solubility testing, lignin and cellulose quantification, and extractive content analysis, all conducted in accordance with Technical Association of the Pulp and Paper Industry (TAPPI) standards. They also evaluated pulping methodologies for wheat straw and sugarcane bagasse (with and without pith) using kraft pulping with varying sulphidity and active alkali levels. The resulting data supports comparative life cycle assessment (LCA) and material performance evaluations.



Process flowsheet for the production of paper sheets from bagasse

IIT Roorkee performed in-depth studies on the availability and utilization of bagasse and wheat straw in Northern India. Their experimental comparison of untreated, dry-depithed, and wet-depithed bagasse highlighted process-chemical efficiencies and mechanical performance gains, supporting an environmentally and economically favourable material selection. IIT Roorkee has also started to develop raw material profiles for wheat straw and bagasse, which includes profiles such as yield of the pulping process, fiber potential, and material evaluation data.

Parason Machinery India Pvt. Ltd.

Parason has started various constructive works for the realization of an edge trimming machine as well as

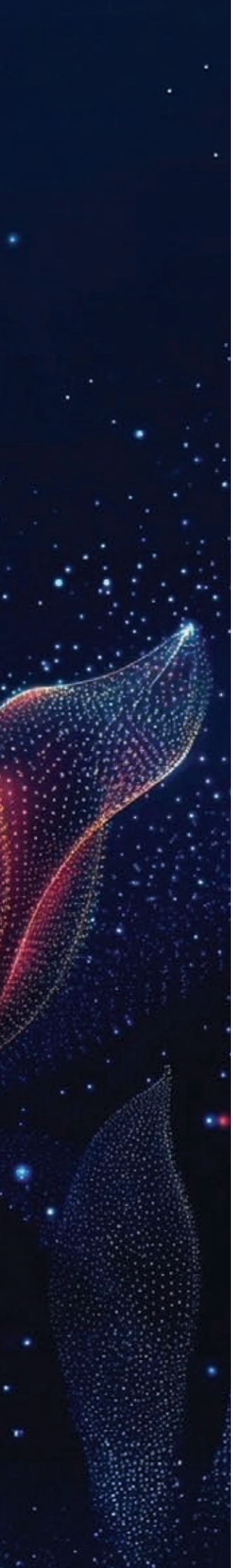
the laboratory fiber molding machine, which is necessary for the tests of the project partners (especially IIT Roorkee). For both machines, a list of requirements was prepared in consultation with project partners, forming the basis for the design development, which is already underway.

The design of the edge trimming machine has been completed, while the fiber molding machine is at an advanced stage of development. Throughout the ongoing project, Parason has conducted tests to optimize processes and incorporate improvements into the design phase of the laboratory fiber molding system. To support optimization and define the final form of the demonstrator, Parason has designed and produced various shapes, tested using its in-house pilot plants. In coordination with the other partners, a structured procedure was developed to set up the trials and development efforts at Parason, serving as a work plan for achieving key project goals.

Illustration of the Lab Scale Fiber Molding Machine

Thermo Mechanical Pulp (TMP)/Chemi Thermo Mechanical Pulp (CTMP) Pilot Plant at TU Dresden

Parason Molded Fiber Prototype Machine



BetteRyRec

Integrated Bio and Hydro Metallurgical Techniques for the Recovery of Metals from Spent Battery Waste and Recycling Wastewater

PROJECT BRIEF

BETTERyRec aims to develop an innovative and environmentally friendly process that integrates biotechnology with hydrometallurgy for the recovery of critical and base metals from spent batteries and battery recycling wastewater. Valuable metals in streams, if not recovered, may be permanently lost and contribute to environmental pollution. The project is expected to provide novel insights into the development of a sustainable bioionflotation process for metal recovery from wastewater. The main goals of the project are to optimize and scale up a novel bioleaching process for metal recovery from solid fractions of battery waste; develop a key bioionflotation process for metal recovery from dilute battery recycling water; and their integration into traditional flotation and leaching methods, followed by metal recovery in pure forms and production of battery grade materials. Such a recycling technology will not only help bridge the gap between the supply and demand of key metals like Li, Co, Ni, and Mn, but also support natural resource conservation and promote the circular economy in battery value chains. The benefits are multi-faceted—economic, environmental, and regulatory—while also enhancing raw material security. The project aligns well with India's Waste to Wealth campaign and Germany's strategic focus on critical metal recovery, circular economy, and research and innovation in battery raw materials.

CONTACT DETAILS

npradhan@immt.res.in
ddas@himadri.com
m.rudolph@hzdr.de
carsten@meab-mx.com

Project Investigators

Nilotpala Pradhan

CSIR-Institute of Minerals & Materials Technology (CSIR-IMMT)

Debasish Das

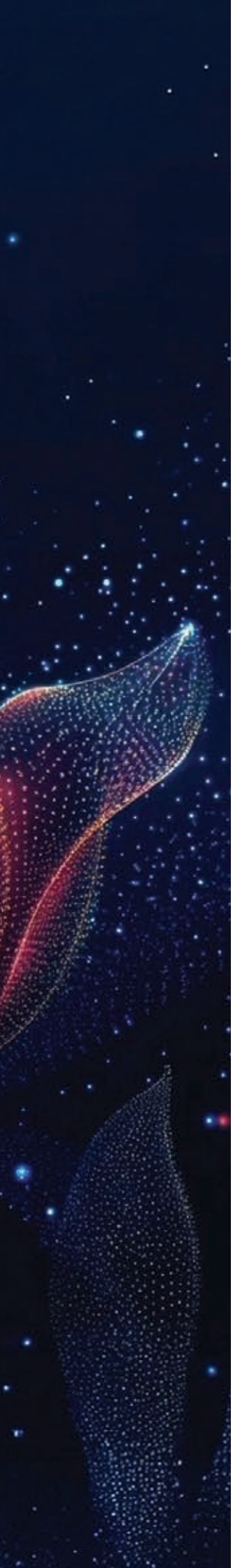
Himadri Speciality Chemical Ltd. (HSCL)

Martin Rudolph

Helmholtz-Zentrum Dresden-Rossendorf (HZDR)

Carsten Dittrich

MEAB Chemie Technik GmbH



Progress made/achieved

CSIR-Institute of Minerals & Materials Technology (CSIR-IMMT)

To start the preliminary testing of chemical leaching and bioleaching of black mass material, CSIR-IMMT is conducting characterization of battery waste materials to determine their elemental composition. Chemical leaching is being carried out using Sulfuric Acid (H_2SO_4), Hydrochloric Acid (HCl), and Ammonium Chloride (NH_4Cl) as lixiviants, with ongoing evaluation of their effectiveness. To enhance leaching efficiency, bioreductants such as fruit-peel biomass are being investigated. The process is being optimized with respect to reagent consumption, reaction time, and temperature.

Bioleaching is being carried out using bacteria and fungi isolated from mineral and metal contaminated sites. 15 fungi and 9 bacteria were isolated using the dilution method on potato dextrose agar and nutrient agar plates, respectively. They are screened for their bioleaching potential and metabolite production. Identification is underway through phylogenetic analysis using 16S ribosomal DNA (rDNA) and internal transcribed spacer (ITS) region sequencing. Upon receiving the black mass from Himadri Speciality Chemical Ltd., CSIR-IMMT will proceed with further experiments.

Himadri Speciality Chemical Ltd. (HSCL)

The staff have undergone comprehensive training in the characterization of lithium-ion battery cathode and anode materials. This includes the analysis of physicochemical properties (powder and microstructural characteristics) as well as the evaluation of electrochemical performance (electrode and cell fabrication and testing). HSCL has also initiated benchmarking studies on commercial Lithium Iron Phosphate – $LiFePO_4$ and Nickel Manganese Cobalt Oxide – $LiNiMnCoO_2$ cathode materials.

Helmholtz-Zentrum Dresden-Rossendorf (HZDR)

HZDR aims to investigate the complexation of target metal ions with various biosurfactants. Three types of biosurfactants have been received and are currently being studied for their complexation with metal ions (Al, Mn, Ni, Co, and Li). Additionally, two types of battery process water were collected from ongoing projects at HIF, HZDR. Characterization of these process waters revealed high concentrations of both Al and Li. Building on the

outcomes of previous projects, initial bioionflotation experiments have been conducted on battery process waters. These tests focus on evaluating the influence of pH on metal recovery using rhamnolipid as a biosurfactant. Further process optimization is underway to enhance the recovery of target metals, particularly aluminium, which has shown 60% recovery in preliminary bioionflotation tests.

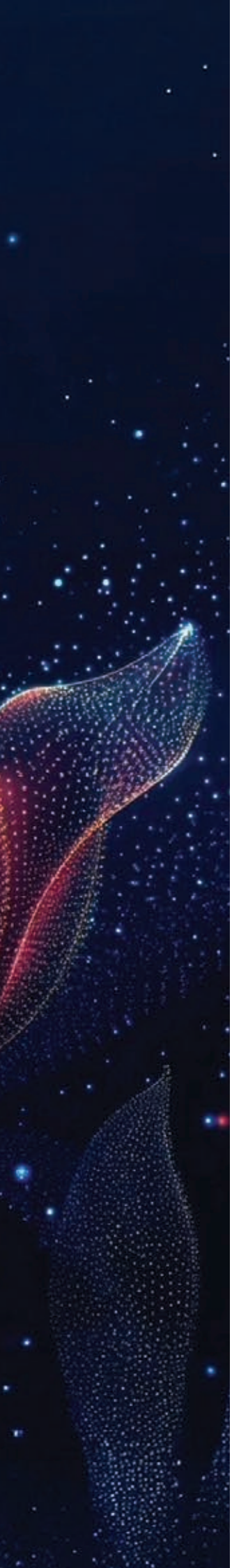
MEAB Chemie Technik, GmbH

The milestones have not yet been achieved, as the project is still in its initial stages. Work related to MEAB is scheduled to commence in the later phases of the project.

BETTERyRec German partners visit Indian academic partner, CSIR-Institute of Minerals and Materials Technology, Bhubaneswar

BETTERyRec German partners visit to Indian industrial partner Himadri Speciality Chemical Ltd.

IGSTC Bilateral Workshops



IGSTC Bilateral Workshops

Platform for substantive interactions between researchers, academicians and industry

The Indo-German Science & Technology Centre (IGSTC), a joint initiative by the Department of Science and Technology (DST), Government of India and the Federal Ministry of Education and Research (BMBF), Government of Germany supports proposals for organising Indo-German workshops (in India or Germany) on areas designed around a specific research topic out of thematic areas relevant to both DST and BMBF.

- Create platform for cross fertilization of ideas
- Establish joint knowledge pools to address global challenges
- Develop knowledge networks for industrial sectors to enhance competitiveness
- Advance industrial research partnership with mutuality of interest and respect

Fellowship Details

Who can apply?

- The proposal should have coordinators from India and Germany
- Coordinator should hold a regular position in public or private non-profit research organisation, institution of higher education or university
- The application can be submitted by any one of the coordinators
- Training workshops do not fall under the scope of this call

Funding: Approximately € 30000 / ₹ 25 lakhs

Support:

- Event cost for up to 30 participants
- International and domestic air fare for participants
- Accommodation costs
- Organisational and logistics expenses

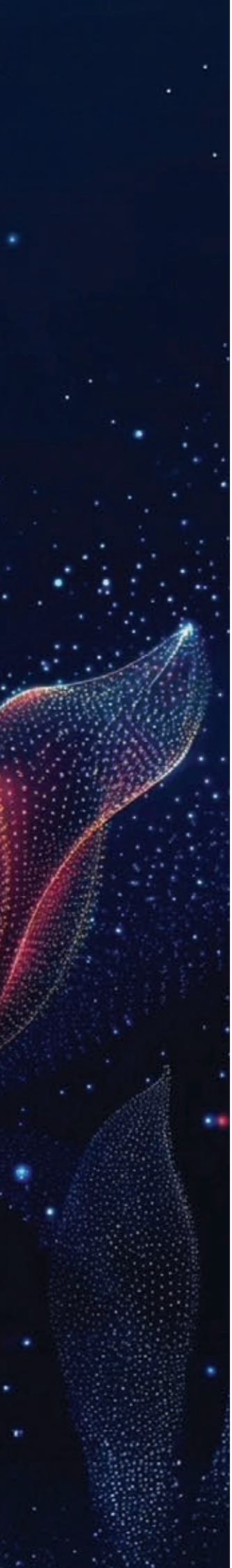
Catalytic Chemical Processes for Tomorrow (CatChemPro-2024)

21-23 AUGUST 2024 | GOA, INDIA

WORKSHOP COORDINATORS

Dr. Rishikesh Narayan
School of Chemical & Materials Sciences/Chemistry
IIT Goa

Dr. Michelle Browne
Department of Chemical Energy
Helmholtz Zentrum for Materials Research, Berlin



The workshop "Catalytic Chemical Processes for Tomorrow (CatChemPro-2024)" brought together around 30 participants from over 20 premier institutions and universities from India and Germany, including IISc Bangalore, IIT Delhi, JNCASR, IISER Kolkata, Max Planck Institute, and TU Berlin. The event aimed to advance the global dialogue on sustainability in catalytic processes and seed Indo-German collaborations across cutting-edge chemical sciences. The workshop covered diverse themes through plenary talks, invited lectures, breakout sessions, and podium discussions, with a strong focus on sustainable catalytic systems, carbon dioxide conversion, biomass utilization, green hydrogen production, and the integration of green chemistry into education.

Notably, keynote lectures were delivered by world-renowned chemists—Prof. Markus Antonietti from the Max Planck Institute, who introduced the concept of functional carbocatalysts as alternatives to precious metals in catalytic processes, and Prof. John Warner, known as the "Father of Green Chemistry," who emphasized biomimicry and advocated for deeper integration of green chemistry education in curricula to reshape future generations of chemists. Catalytic conversion of CO_2 was a central theme.

Prof. Sebastian Peter, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) and Dr. Raja Mitra, IIT Goa presented their developments on novel catalysts, including intermetallics, chalcogenides, and rhenium-based systems, for transforming CO_2 into value-added fuels and chemicals. In the field of green hydrogen, several researchers, including Prof. Prashanth Menezes, TU & HZB Berlin, Venkataramanan Mahalingam, IISER Kolkata, and Michelle Browne, HZB, showcased work on advanced electrocatalysts and hybrid water electrolysis. They highlighted innovations like bimetallic and MXene-based materials, with others, such as Sasanka Deka, Delhi University, introducing non-precious metal-based catalysts for seawater splitting. Tim Huelser, Institute of Energy and Environmental Technology e.V. (IUTA) discussed pilot-scale nanomaterials synthesis for scalable catalytic applications, while Pravin Ingole, IIT Delhi and Pablo Jimenez-Calvo, Interdisciplinary Center for Nanostructured Films (IZNF) focused on optimizing the electrochemical interface and photoelectrocatalytic systems using carbon nitride.

Water electrolysis systems such as Proton Exchange Membrane (PEM) and Anion Exchange Membrane (AEM) were examined by Eva Jodat and Kiran, FZ Jülich, who investigated degradation and operational parameters using

advanced electrochemical and spectroscopic techniques. The use of biomass-derived feedstocks for producing furanic and aromatic compounds was discussed by researchers Sudarsanam Putla (IIT Hyderabad) and Navneet Gupta (IISc), while Ujjal K. Gautam (IISER Mohali) presented an innovative method to upcycle plastic waste into carbon quantum dots for environmental applications.

Catalysis in organic synthesis was also explored. Researchers Rodney Fernandes (IIT Bombay), K. Geetharani (IISc), and Rajarshi Samanta (IIT Kharagpur) focused on novel transformations involving transition metal catalysts for oxidative coupling, boronic ester synthesis, and the formation of extended conjugated systems. Industrial applications were represented by Souvik Rakshit and Piyush Ingale, BASF SE who discussed process optimization and value chain development using sustainable methods.

The workshop also prioritized education, hosting a unique session on "Green Chemistry Education and Practices" which included participation from host of teachers and lecturers from different local colleges affiliated with Goa University and discussions on integrating sustainability into undergraduate and postgraduate curricula. Nikki Man (HU Berlin) shared initiatives linking education, research, startups, and industry to promote a green chemistry ecosystem.

Major recommendations of the event:

a. Green hydrogen production should be viewed as a major technology development challenge to meet the energy needs of the future in a sustainable way.
b. Need for development of alternative sources of catalysts, possibly from natural sources, such as carbonaceous materials as an alternative to precious metal catalysts for high value applications
c. Incorporation of system's level understanding of the sustainability in the development of processes and products especially chemical production
d. Incorporation of green and sustainable chemistry education in the curriculum to bring about a generational shift in the chemistry thinking

Interactive breakout sessions encouraged small-group discussions on the future of catalytic sustainability, and a final podium discussion consolidated the key outcomes and collaborative opportunities.


IGSTC
HZB
ChemPr
2014

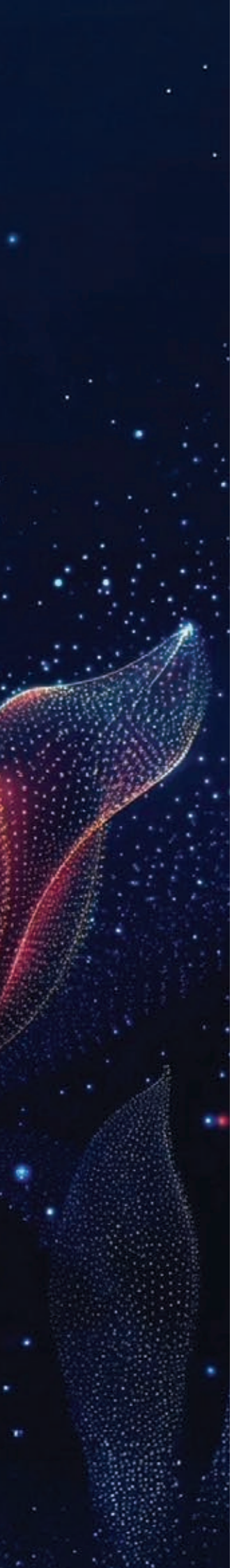
Supramolecular Systems Emerging Applications in Catalysis, Materials and Biomedicine (SUPRASYS)

18-20 SEPTEMBER 2024 | GOA, INDIA

WORKSHOP COORDINATORS

Dr. Raja Mitra
School of Chemical & Materials Sciences/Chemistry
IIT Goa

Prof. Jochen Niemyer
Faculty of Chemistry, Organic Chemistry
University of Duisburg-Essen



Supramolecular Chemistry is a discipline of modern chemistry. Supramolecular Chemistry was termed as "the chemistry beyond the molecule," meaning that it deals with interactions between molecules. As such, supramolecular chemistry requires an interdisciplinary approach to advance both fundamental understanding and application-oriented aspects. Due to the complexity of supramolecular interactions, experts from synthetic chemistry, physical chemistry, materials science, catalysis, and biological sciences are needed. Keeping that in mind, an Indo-German workshop supported by IGSTC, SupraSys 2024, consisting of thirty speakers in three days working on different aspects of supramolecular chemistry, was organized jointly by Prof Raja Mitra (IIT Goa) and Prof Jochen Niemeyer (UDE) in Goa. This enabled the discussion of future collaborations and research directions. The workshop “Supramolecular Systems – Emerging Applications in Catalysis, Materials and Biomedicine (SUPRASYS)” focused on advancing the field of supramolecular chemistry, which explores molecular interactions beyond the individual molecule, requiring an interdisciplinary approach. The event gathered 30 expert speakers over three days, each presenting on a wide variety of topics within the field of supramolecular chemistry.

On day 1, Prof. Dhirendra S. Katti showed the application of supramolecular chemistry for repairing the tissue cartilage between the knee joints using non-invasive procedures. Prof. Pol Besenius presented the use of glycopeptide-decorated scaffolds for designing synthetic vaccines, showing that supramolecular materials are key in future biomedicines. Prof. Partha S. Mukherjee, Prof. Guido Clever, Prof. Arne Luetzen, Prof. Anna McConnell, and Prof. David Van Craen showed the importance of self-assembly in forming metallo-cages, which enable catalysis, host-guest chemistry, drug delivery, anion sensing, and spin–crossover properties.

Prof. Dibyendu Das presented adaptive materials for biological applications. Small peptides can be synthesized to generate supramolecular nanotubes controlled by the functionalization of the peptides. Prof. Evgeny Kataev showed that the cAMP protein binding site can serve as an inspiration for developing potassium ion sensors. Prof. Debasish Manna, continuing the topic of chemical sensing, introduced the importance of copper in our daily lives and the importance of early detecting whether there is deficiency or excess in our body. Prof. Debabrata Maity showed how supramolecular modulation helped grow amyloid protein fibrils that can hold the key to understanding Alzheimer's disease.

Prof. Rahul Banerjee introduced the fields of COF chemistry and reticular synthesis, starting from applications of COFs in materials science and then shifting to Porous Covalent Organic Nanotubes. Prof. Michael Giese focused on how dynamic covalent chemistry can be used to design innovative liquid crystalline materials. Prof. Kana M. Sureshan highlighted recent advancements in topochemical reactions from his research group, presenting some fascinating results on polymer polymorphs. Prof. Bernd M. Schmidt presented a new aspect of dynamic covalent chemistry to construct cage compounds, introducing various strategies for building and modifying these discrete architectures. In summary, the speakers showed that control of structures in 1D/2D/3D enables the fabrication of intelligent materials.

Prof. Pinaki Talukdar presented artificial ion carriers and channels showing anticancer activity. Two strategies (photoisomerization and photocleavage) were exploited to modulate the ion transport in response to light. Prof. Shikha Dhiman presented bioinspired supramolecular systems where supramolecular polymers are broken down into droplets that regrow fibers. Prof. Subhabrata Maiti presented colloidal systems that display phoresies and catalysis in response to enzymatic cleavage, as studied by spectroscopy in microfluidic channels.

Prof. Bart Jan Ravoo shared the changes in morphology using light switches in biomedical applications. Water-soluble aminoazopyrazoles (AAPs) can be used to constrct photoresponsive foams and to enable sol/gel transitions in response to UV light. Prof. Supratim Banerjee presented amphiphilic molecules, which can assemble into higher-ordered structures yielding luminescent supra structures that monitor and recognize heparin. Prof. Robert Hein showed surface-attached redox-active ferrocenes, which can be used for real-time sensing of anions. Prof. Jake Greenfield introduced the field of switchable imines and highlighted the key features of suitable switches. Ortho-functionalized imines yielded excellent imine switches, which were investigated in detail regarding their photophysical and switching properties.

Prof. Subi J. George showed methodology for precision synthesis of supramolecular polymers with heterostructure that can be utilized in electronic devices. Prof. Raj Kumar Roy showed the bulk assembly of sequential polymer chains, which is an inspiration from nature herself. Through space charge transfer, different aromatic amides give different secondary structures, and it was shown that pyrene systems are best for b-pleated secondary structures. Prof. Shanmugaraju Sankarasekaran emphasized nucleophilic displacement as the critical reaction for synthesis. He showed the synthesis of Ru(II)-based organometallic cages that form ultrasound-sensitive spheres by solvent-induced morphogenesis. Prof. Bappaditya Gole used metal-directed self-assembly to form foldamers and applied these for catalysis. Further, he showed a method to grow single-crystal foldamers from the single-crystal monomer.

Prof. Jens Voskuhl discussed the design, synthesis, and application of novel luminescent materials. Aromatic thioether-based materials show aggregation-induced emission (AIE) properties, while further modifications can even give dual-state emitters. Prof. Rishikesh Narayan began by emphasizing

the versatility of furan as a heterocycle in nature. He developed cross-dehydrogenative coupling of furans with indoles using inexpensive ferric chloride as a catalyst. The resulting tetraarylfurans show unexpected aggregation caused by quenching (ACQ). Prof. Jochen Niemeyer and Prof Raja Mitra showed the importance of mechanically interlocked molecules (rotaxanes, catenanes) and macrocycles in homogeneous catalysis.

The event emphasized the importance of sharing research facilities and available funding opportunities, with an emphasis on the role of IGSTC programs in supporting budding researchers.

A significant outcome of the event was the identification of common challenges faced by researchers in both India and Germany, along with suggestions for overcoming them. The event concluded with speakers expressing their enthusiasm for more opportunities to collaborate and share their work at similar future events organized by IGSTC. The Indo-German collaboration proved to be academically enriching and set the stage for future interdisciplinary research in supramolecular chemistry and its applications in catalysis, materials science, and biomedicine.


German Workshop
on
stems - Emerging applications
in
terials, and Biomedicine
Goa, India
Supramolecular

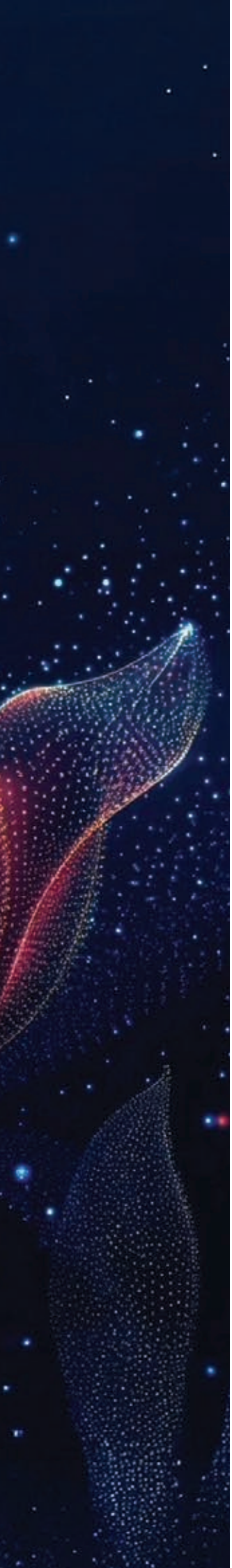
Vibroacoustic Characterization and Mitigation Using Metamaterials (ViMeta)

23-27 SEPTEMBER 2024 | NEW DELHI, INDIA

WORKSHOP COORDINATORS

Dr. Arnab Banerjee
Department of Civil Engineering
IIT Delhi

Prof. Steffen Marburg
School of Engineering and Design
Technical University of Munich



The workshop on Vibroacoustic Characterization and Mitigation Using Metamaterials (ViMeta) aimed to foster bilateral collaboration in tackling vibration and noise challenges through advanced metamaterial technologies. Spearheaded by Dr. Arnab Banerjee (IIT Delhi) and Prof. Steffen Marburg (Technical University of Munich), the event brought together 28 leading researchers from both countries to exchange knowledge and explore innovative solutions in vibroacoustic engineering. The event was the result of months of meticulous planning and focused on current trends in vibroacoustic characterization, metamaterial design, and computational modelling. It served as a dynamic platform for researchers to share cutting-edge insights and develop interdisciplinary partnerships with practical applications across aerospace, automotive, and construction sectors.

The workshop was inaugurated in a ceremonial session graced by eminent dignitaries such as Prof. Rangan Banerjee (Director, IIT Delhi), Mr. R. Madhan (Director, IGSTC), and the lead investigators. The technical program featured a series of keynote lectures by experts from both countries. Indian speakers included Prof. Chandramouli P (IIT Madras), who presented on low-frequency bandgaps in metamaterial plates; Prof. Kamal K. Bera (NIT Trichy), who discussed vibration control in wind turbines; and Prof. Rajesh Chaunsali (IISc Bangalore), who explored topological metamaterials for wave manipulation. Additional talks covered topics such as structural resilience (Prof. Sandip Saha, IIT Mandi), blast-resilient materials (Prof. Manmohan Dass Goel), auxetic mechanisms (Prof. Sahil Kalra, IIT Jammu), geotechnical uncertainty (Dr. Anindya Pain, CSIR-CBRI), energy harvesting (Prof. Pradeep Malaji), and active vibration control (Prof. Vasant Matsagar, IIT Delhi). Dr. Arnab Banerjee discussed metamaterial applications for vibration suppression. German contributors provided complementary perspectives. Dr.-Ing. Tobias Paul Ring (TU Braunschweig) delivered insights on vibroacoustic characterization and control using metamaterials. Mr. Jonas Schmid (TUM) introduced fungal mycelium-based sound absorbers as sustainable acoustic materials. Mr. Johannes Schmid discussed AI-based neural operators for acoustic metamaterial design. Further talks included Dr.-Ing. Matthias Klärner (damping modeling in composites), Dr.-Ing. Hendrik Holzmann (energy harvesting using vibroacoustic materials), and Prof. Michaël Scheffler (mechanical behavior of wood-based materials for stage acoustics). Hands-on sessions allowed participants to engage in experimental testing and computational modelling, with emphasis on aerospace and automotive use cases.

Collaborative brainstorming encouraged the formation of cross-disciplinary research teams and set the stage for future innovation. Cutting-edge advancements were discussed, including Acoustic Black Holes for vibration control, lightweight metamaterials for aerospace noise reduction, and AI-integrated tools for real-time system optimization. Sustainable materials, such as fungal mycelium-based sound absorbers, showcased the growing emphasis on environmentally friendly engineering solutions.

The workshop concluded with a strong consensus on initiating joint research projects, student exchange programs, shared experimental infrastructure, and co-authored publications. One notable outcome was the agreement to write a joint book chapter summarizing the workshop's innovations. The event laid the foundation for long-term Indo-German collaboration to advance energy efficiency, structural resilience, and sustainable noise reduction through metamaterial technologies.

Terahertz Technology for Industrial Application (TTIA)

03-05 OCTOBER 2024 | PILANI, INDIA

WORKSHOP COORDINATORS

Dr. Niraj Kumar
Central Electronics Engineering Research Institute (CSIR-CEERI)
Pilani

Prof. Hartmut Roskos
Physikalisches Institut
Goethe University Frankfurt

The workshop “Terahertz Technology for Industrial Application (TTIA)” provided an in-depth exploration of the current state of Terahertz (THz) science and technology, emphasizing both the challenges and opportunities that lie ahead. The primary objective of the workshop was to serve as a crucial resource for individuals newly entering the field, as well as for seasoned professionals, offering a comprehensive introduction to the capabilities of THz radiation.

The workshop was strategically designed to cater diverse audience, including government bodies, funding agencies, and industrial stakeholders, with the aim of guiding future investments and fostering collaborative efforts. A key achievement of the workshop was its success in promoting a strong collaborative framework between India and Germany, thereby strengthening the bilateral relationship in the field of THz technology. The workshop’s two major themes— “Advances in Terahertz Technology” and “Application Areas of Terahertz Technology” were well-aligned with ongoing global initiatives in this rapidly advancing field. During the workshop, a total of 29 lectures were delivered in three technical sessions including a keynote lecture by the special guest and German coordinator Professor Hartmut Roskos, and by other German and Indian scientists and learned experts on topics such as terahertz imaging and medical applications of terahertz, its utility and importance in communications, spectroscopy, environmental monitoring, etc.

Esteemed experts from premier research institutions in both countries, including the IITs, IISER, DRDO, IISc, and TIFR, participated and contributed their expertise, enhancing the workshop's value as a knowledge-sharing platform.

In addition to the academic presentations, the workshop served as a valuable platform for showcasing THz-related products from various industries, further strengthening India’s technological capabilities in this domain.

Despite the growing importance of THz technologies, publications from both Germany and India in this field have shown remarkable similarity, with 2003 publications from Germany and 1684 from India over the five-year period from 2019-2024. The overlap in research topics, especially in the areas of physics, materials science, and telecommunications, underscored the alignment between the two nations' efforts in advancing THz science.

At the conclusion of the workshop, several notable outcomes were achieved. A key highlight was the exchange of Memorandums of Understanding (MoUs) with companies such as M/S TOPTICA and M/S ACST GmbH, Germany, aimed at fostering joint research and development in THz technology. The event brought together leading scientists, academicians, and researchers from prestigious institutions in both countries, providing a platform for future collaborative efforts. Dr P.C. Panchariya, the Director of CSIR-CEERI, emphasized the significance of this workshop in promoting joint research initiatives, particularly in emerging fields such as THz-based non-destructive systems and imaging systems. These areas were identified as crucial topics for future proposal submissions, with a strong focus on fostering international collaboration in these technologies. The workshop thus set the stage for continued advancements in THz technology and its industrial applications, ensuring the continuation of a strong and productive partnership between India and Germany.


IGSTC
Indo-German Joint Scientific Workshop
on
Terahertz Technology for Industrial Applications
(IGSTC-TTIA)


GOETHE UNIVERSITÄT


CSIR - CEERI

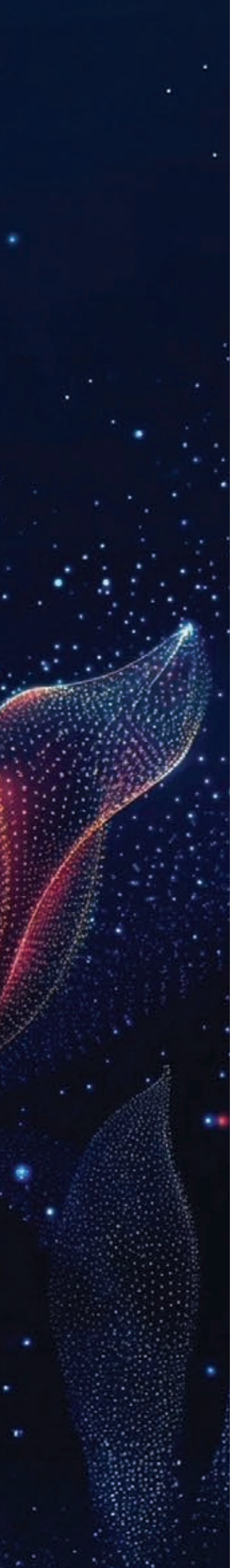
Indo-German Workshop Path to Sustainable Future: Innovations in Bio Manufacturing

14-15 OCTOBER 2024 | PUNE, INDIA

WORKSHOP COORDINATORS

Dr. Avinash Sharma
Microbial Ecology Research Group
DBT-National Centre for Cell Science (NCCS)

Prof. Jörg Overmann
Department of Biology
Leibniz Institute DSMZ-German Collection of Microorganisms and Cell Cultures



The workshop “Path to Sustainable Future: Innovations in Bio-Manufacturing” served as a platform to explore the current landscape, challenges, and innovations in bio-manufacturing, with a strong focus on fostering collaborations between India and Germany. The workshop envisioned the future of biomanufacturing, emphasizing sustainable production and a resilient bioeconomy. It focused on emerging biological technologies, particularly microbial metabolism, highlighting a global shift towards natural processes. With Germany's expertise in biomanufacturing and India's BioEconomy target of $300 billion by 2030, the workshop aimed to promote collaborative research, technology transfer, and capacity building. Sessions during the workshop covered topics such as metabolic engineering, synthetic biology, and novel expression systems, fostering partnerships among academia, industry, and government stakeholders. The event addressed mutual interests in areas like waste-to-energy, organic farming, and CO_2 sequestration, contributing to the advancement of sustainable biomanufacturing and shaping the global BioEconomy landscape.

The agenda included a series of plenary talks, invited lectures, technical sessions, and thematic discussions centered around microbial process development, genomics, bioresource utilization, and sustainable agriculture.

The workshop began with a welcome address by Dr. Sharmila Bapat, who emphasized the role of international partnerships in advancing sustainable bio-manufacturing. This was followed by a keynote presentation by Dr. Alka Sharma from the Department of Biotechnology (DBT), India, who introduced the BioE3 policy, designed to drive bio-innovation, support entrepreneurship, and expand the bioeconomy in India. She highlighted key sectors such as bio-based chemicals, smart proteins, carbon capture, and marine research as focal points for future growth. Dr. P. V. Lalitha from IGSTC elaborated on bilateral Indo-German programs, including 2+2 collaborative projects, fellowships, and capacity-building initiatives that align with the workshop's mission. The academic sessions featured a range of cutting-edge research topics. Dr. Avinash Sharma presented genome-based studies on extremophiles for producing

secondary metabolites, supporting India's BioE3 goals. Prof. Jörg Overmann emphasized culturomics and microbial data digitization, highlighting the importance of microbial diversity databases like BacDrive. Dr. Abhishek Jha discussed the potential of bio-manufacturing in space, focusing on bioreactor design and microgravity experiments. Dr. Daniel Schindler presented synthetic biology tools like Golden Gate Cloning and automated DNA synthesis using the fast-growing bacterium Vibrio natriegens. Talks by Dr. Sanjukta Subudhi and Dr. Yogesh Shouche explored biohydrogen production and gut microbiome engineering respectively, with implications for the energy and health sectors. Other notable presentations included those by Prof. Torsten Waldminghaus on plasmid gene therapy, Prof. Shilpi Sharma on plant-microbiome interactions for sustainable agriculture, and Dr. Sarangthem Indira Devi on bio-prospecting traditional medicinal plants. Dr. Pierre Stallforth showcased the potential of ancient microbiomes, while Prof. Heiko Briesen focused on fungal pellet modelling to optimize bio-manufacturing processes. Additional talks covered thermophilic enzymes, microbial pigments, biotechnological plant production, and bioinoculants for acidic soils, underscoring the breadth of microbial innovations.

New developments presented during the workshop emphasized the transformative impact of synthetic biology, culture collections, genome editing, and microbiome science in advancing sustainable biomanufacturing. Key themes included leveraging microbial interactions for novel compound discovery, utilizing extremophiles for metabolite production, and developing hybrid platforms for efficient biomolecule synthesis. The potential of gut and plant microbiomes in health and agriculture further highlighted the multidisciplinary nature of bio-manufacturing research.

The workshop concluded with major recommendations, including enhancing Indo-German institutional collaboration, identifying accessible solutions in microbial bio-manufacturing, and establishing a sustained framework for ongoing research engagement. A key outcome was the consensus to prepare a concept note involving DBT and IGSTC, with a thematic focus on climate resilience. NCCS was proposed as the lead institution for future collaborative projects, and the title “Microbiome-based manufacturing focusing on novel compounds and food-based microbiome” was supported for its relevance to both human health and sustainable manufacturing. Future directions involve drafting a memorandum of understanding (MoU) under the BioE3 policy, addressing regulatory challenges with India’s National Biodiversity Authority, and establishing a national microbial database to support research and strain sharing.

In summary, this workshop not only advanced scientific dialogue but also laid the groundwork for long-term Indo-German cooperation in microbiome science, bio-manufacturing, and regulatory harmonization, contributing to global efforts for climate resilience and health innovation.

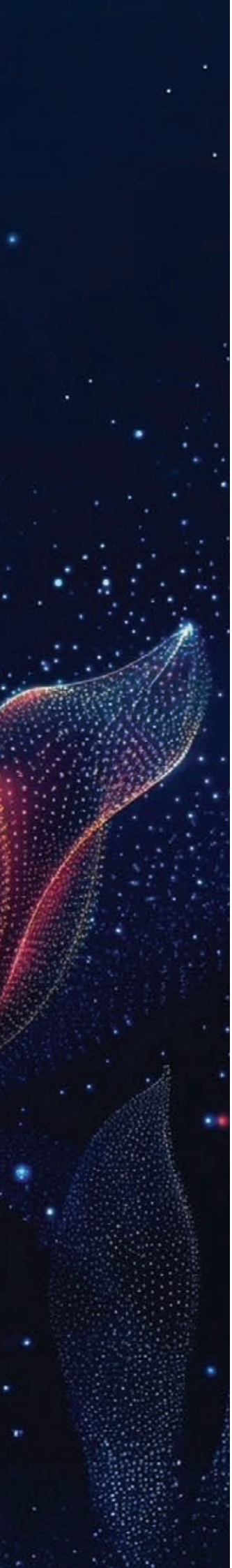
Scoping Out Net Zero with Next Generation Electrical Power Drive Systems– A step towards SDG-2030

7-8 NOVEMBER 2024 | HANNOVER, GERMANY

WORKSHOP COORDINATORS

Dr. Lenin N C
School of Electrical Engineering
Vellore Institute of Technology

Prof. Bernd Ponick
Institute of Drive Systems and Power Electronics
Leibniz University Hannover



The workshop successfully addressed the pivotal role of electric drive systems in global energy consumption, focusing on their usage across four major applications: compressors (32%), mechanical movement (30%), pumps (19%), and fans (19%). These systems, which account for 45% of global electricity consumption, were identified as critical areas for improving energy efficiency and promoting circularity.

During the event, participants explored policy options to enhance efficiency, discussed new technologies, and examined improvements across the entire power drive system. The workshop provided an innovative analysis of the impact of increasing the adoption of high-efficiency motors and drive systems. With the electric vehicle (EV) market emphasizing energy-efficient electrified powertrains, the discussions highlighted how effective technologies can significantly reduce carbon emissions during the manufacture and use of electric drive systems. The event fostered collaboration between industry and business, establishing partnerships to drive sustainable advancements.

The workshop "Scoping Out Net Zero with Next Generation Electrical Power Drive Systems – A Step Towards SDG-2030" convened a total of 21 experts, including 10 from India and 11 from Germany comprising scientists, academic professionals, and industry leaders, to collaboratively address key technological advancements and strategies for achieving net-zero carbon emissions through innovative electric drive systems. The workshop was a platform to explore high-efficiency electric motor technologies that play a critical role in decarbonizing the industrial and transportation sectors, considering that electric motors account for approximately 45% of global electricity usage.

Presentations focused on the promotion of ultra-premium efficiency motors (IE5 and above) and the adoption of variable speed drives (VSDs) to improve energy efficiency and reduce carbon footprints. Significant emphasis was placed on integrating circular economy principles in motor design by using recyclable materials like copper and steel, which help minimize Scope 3 emissions and support end-of-life sustainability. Participants also highlighted the importance of advanced materials, such as graphene-coated copper, lightweight composites, and novel magnetic substances, which offer improved thermal performance and reduced energy losses in high-power-density motors, particularly for electric vehicles and heavy industrial machinery. In addition, the use of wide-bandgap semiconductors like silicon carbide (SiC) and gallium nitride (GaN) in motor

drives was presented as a breakthrough in reducing heat loss and enhancing energy efficiency in compact, high-power applications. Discussions included the integration of thermal energy storage (TES) with electric motors to capture and reuse waste heat in industrial settings, thereby improving energy utilization and supporting grid flexibility. The event also showcased digital solutions, including IoT-enabled systems, AI-based predictive maintenance tools, and big data analytics, which allow for real-time monitoring and optimization of energy consumption, ensuring motors operate at peak efficiency.

Case studies, such as ABB's implementation of highly efficient motors in geothermal power plants achieving 98.76% operational efficiency, were shared as real-world examples of scalable and sustainable industrial solutions. The workshop recommended prioritizing the development of motors compatible with renewable energy systems, such as those used in wind and solar applications, and encouraged investment in collaborative Indo-German R&D programs. Key outcomes included proposals for international testbed facilities to evaluate next-gen motor technologies, the establishment of a global standard for recyclable motor components, and policies supporting subsidies and incentives for industries adopting efficient motor systems. Capacity-building initiatives were also emphasized, including skill development programs for engineers and technicians working with advanced motor technologies and awareness campaigns for stakeholders to promote the economic and environmental benefits of sustainable systems.

The workshop identified several key outcomes, such as the prioritization of ultra-efficient motors for various applications, advancements in material science for enhanced recyclability and performance, and the integration of wide-bandgap semiconductors. It highlighted the urgent need for international policy frameworks to support circular motor economy standards and retrofitting incentives. A roadmap for smart, IoT-enabled systems was outlined, along with strategies for motors compatible with hybrid renewable energy systems. Strengthened Indo-German partnerships, the proposal for international testbeds, and capacity-building initiatives—including skill development and public outreach—were endorsed to drive implementation and innovation.


OPEN SPACE SESSION
ROOM H210
ROOM H121
ROOM H021


Celebrating 50 years of successful
Indo-German Science & Technology Cooperation
1974 - 2024

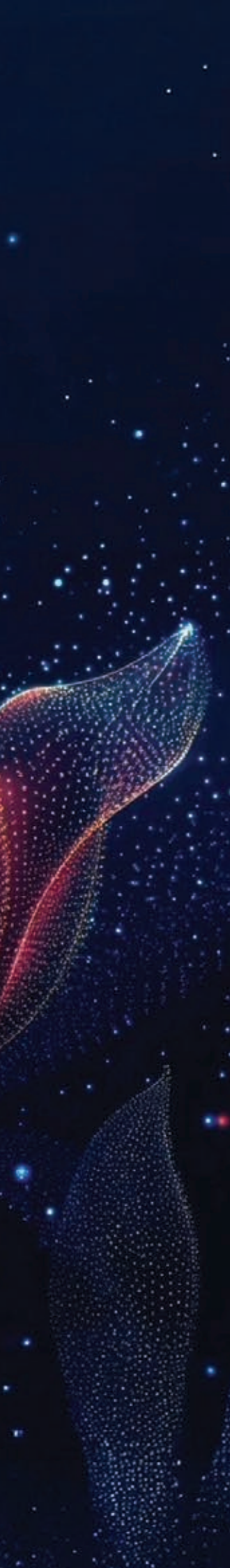
Indo-German Workshop on "Challenges and New Opportunities in Vaccine Development for Aquaculture" (IMAQUAVAC)

27-29 NOVEMBER 2024 | KERALA, INDIA

WORKSHOP COORDINATORS

Dr. Punnadath Preetham
School of Marine Sciences
Cochin University of Science and Technology (CUSAT)

Dr. Mikolaj Adamek
Department of Fish Diseases and Fish Farming
University of Veterinary Medicine Hannover (TiHO)



The workshop "Challenges and New Opportunities in Vaccine Development for Aquaculture (IMAQUAVAC)" core objective was to address the growing importance of fish vaccination in ensuring sustainable aquaculture practices. With bacterial and viral diseases posing serious threats to aquatic ecosystems, vaccine development was recognized as a critical strategy for promoting fish health, enhancing productivity, and reducing reliance on antibiotics. The workshop brought together a diverse group of 23 international participants and industrial experts from countries including Germany. The event facilitated interdisciplinary networking among leading scientists, academic institutions, and industrial partners, aiming to strengthen collaborative initiatives through laboratory exchange programs, joint PhD opportunities, and international research alliances.

The workshop officially commenced with addresses by senior representatives from academic, governmental, and scientific institutions, and included the ceremonial launch of workshop abstract book along with books on Fish Vaccines and Immunomodulators for Aquaculture and Fish Health. Keynote sessions set the tone for deep scientific dialogue, exploring the use of advanced vaccine development techniques such as low-frequency sonophoresis, transcriptomic analysis, and immunoinformatics. Presentations highlighted immune responses triggered by C-type lectin-based vaccines, the impact of feeding stress on immunity, and the role of neuroimmunity in aquaculture species.

Special attention was given to the challenges faced in Asia regarding fish vaccine accessibility and adoption. Industrial partners showcased real-world applications of vaccine formulations, discussing their integration into commercial aquaculture systems. Sessions delved into novel approaches like reverse vaccinology, adjuvant-enhanced mucosal immunity, and in vivo expression technologies. Notably, there was a strong emphasis on epitope mapping and immunoproteomics to identify protective antigens for recombinant and DNA-based vaccines. One of the key features of the workshop was the "speed networking" session, which encouraged attendees to engage in meaningful discussions, exchange ideas, and initiate future collaborations. This platform proved especially beneficial for early-career researchers, offering them exposure to global trends, potential mentorship, and pathways to international training and research programs.

The establishment of Special Aquaculture Zones and the expansion of training programs, such as the proposed International Fish Immunology Training Program, were among the major proposals aimed at capacity building. Further recommendations included exploring support from global funding bodies like the DAAD, DFG, and other German research networks for infrastructure development and bilateral exchange initiatives.

The Centre of Excellence for Aquatic Vaccine Development, which hosted the event, showcased its achievements in vaccine research, highlighting its strong research infrastructure and funding support from Indian and international agencies. The Centre's commitment to sustainable aquaculture, biosecurity, and farmer-focused outreach was evident throughout the proceedings.

A highlight of the workshop was a pre-event awareness program targeting school students. Designed to promote awareness about fish health management through vaccination, this outreach initiative drew participation from over 300 students and fostered early engagement with the science of aquaculture. International delegates interacted with students, offering guidance on academic and research opportunities in the field. This was followed by field visits to local fish farms, where researchers engaged directly with farmers to understand the practical challenges they face in disease management.

In conclusion, IMAQUAVAC 2024 was successful in fostering an ecosystem of cooperation, innovation, and capacity building. It reinforced the importance of interdisciplinary approaches in vaccine development, laid the groundwork for impactful Indo-German collaborations, and provided a strategic vision for future advancements in aquaculture health management.

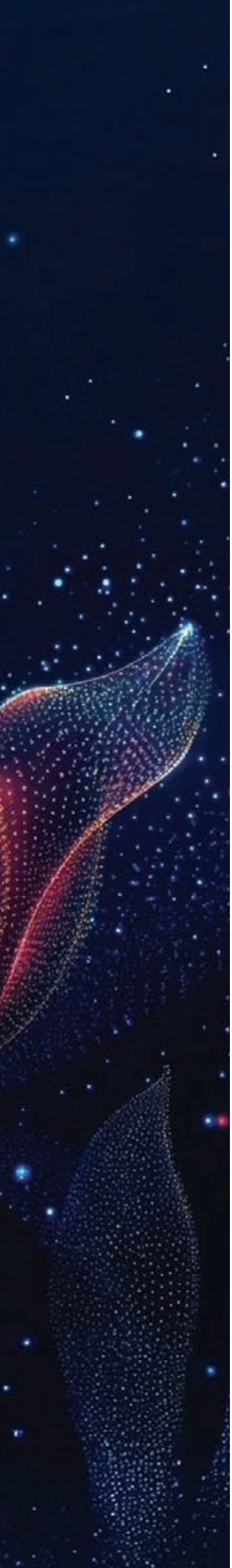
Inter-Disciplinary Approach to Sustainable Habitats using AI-ML Tools: Water & Wastewater Management, Air Quality, Energy Systems, Material Selection, Agricultural Practices with Law and Policy

24-26 FEBRUARY 2025 | BENGALURU, INDIA

WORKSHOP COORDINATORS

Prof. Lakshminarayana Rao
Centre for Sustainable Technologies
IISc Bengaluru

Prof. Christina Bogner
Institute of Geography
University of Cologne



The workshop "Inter-Disciplinary Approach to Sustainable Habitats using AI-ML Tools: Water & Wastewater Management, Air Quality, Energy Systems, Material Selection, Agricultural Practices with Law and Policy" served as a dynamic platform for interdisciplinary collaboration between Indian and German experts in environmental science, engineering, law, and policy. The three-day workshop brought together researchers, industry professionals, and policymakers to address pressing challenges in sustainable urban and rural development. The core themes included water security, wastewater management, sustainable agriculture, energy and material innovation, AI-ML integration in habitat planning, and legal frameworks for sustainability.

The workshop began with inaugural speeches emphasizing international collaboration to tackle water and air quality issues, sustainable energy use, and climate-resilient agriculture. Prof. Rao (Indian coordinator) highlighted India's water stress and wastewater reuse efforts, while Prof. Bogner (German Coordinator) focused on the emerging problem of microplastic pollution in terrestrial and aquatic ecosystems. The opening day featured key presentations on water security, including large-scale recycling of treated wastewater for groundwater recharge, microplastics' impact on soil and water, and integrated water resource management strategies using sensors and satellite data. Discussions also explored sustainable stormwater management, circular economy in wastewater treatment, and innovative policies to reuse wastewater in urban areas. The workshop also featured sustainable agriculture, with sessions focusing on the use of treated wastewater in farming, climate-resilient agriculture, and circular farming models. Noteworthy talks addressed integrating wastewater for nutrient recycling, soil conservation, and AI-based solutions to support farmers. Additionally, presentations on sustainable materials, such as green halide chemistry for solar cells and biodegradable farming inputs, showcased cutting-edge research to reduce environmental impact. Initial sessions concluded with a roundtable discussion on the need for low-carbon strategies, biodiversity protection, and AI-optimized systems for sustainability.

Workshop centred on sustainable energy and advanced materials. Presentations spanned multiscale modelling of Na-ion batteries, material innovations for water electrolysis, plasma pyrolysis for energy recovery, and AI-enhanced recycling systems. Dr. Payam Kaghazchi's work on sodium-ion batteries presented an eco-friendly

alternative to lithium, while Fraunhofer IWKS researchers discussed circular economy applications in resource recovery. The AI-focused session explored AI's role in industrial resource optimization, predictive maintenance, and urban sustainability through digital twins and city information models. Additional talks examined the legal dimensions of sustainability, such as water rights governance, e-waste regulation, and environmental justice, with experts advocating for stronger legal frameworks to support environmental ethics.

Workshop featured a dedicated session on sustainable cities and communities. Discussions ranged from climate adaptation policies, heat stress mitigation, and the use of AI/ML in managing smart cities to the role of shallow aquifer management and public policy in sustainable development. Participants from government and industry shared insights on sustainable startups, space technologies, and the integration of AI into water and energy management systems. Legal experts stressed the need for environmental education, policy integration, and public awareness to support long-term environmental stewardship. The final roundtable summarized the key takeaways, highlighting the need for resource-efficient AI integration, water reuse strategies, advanced waste treatment technologies, and inclusive sustainability policies. The workshop concluded with a field visit to Bengaluru International Airport, showcasing real-world sustainability practices such as renewable energy systems, rainwater harvesting, and advanced waste management aligned with circular economy principles

The Indo-German Workshop held at the Indian Institute of Science (IISc), Bengaluru, successfully fostered bilateral scientific and technological collaboration by bringing together leading researchers, industry professionals, and policymakers from both countries. Key outcomes include:

1. **Strengthened Research Collaboration:** The workshop identified potential joint research themes in sustainable energy, water purification, AI for environmental monitoring, and circular economy. German and Indian institutions expressed mutual interest in co-developing scalable technologies addressing climate-resilient infrastructure and green mobility.

2. **Project Conceptualization and Joint Proposals:** Multiple Indo-German research teams were formed to co-develop proposals for DST-DFG and IGSTC funding calls. Focus areas include decentralized renewable energy systems, solar-driven nitrogen fertilizer technologies, and data-driven smart city solutions.

3. **Student and Researcher Exchange:** Discussions led to a preliminary agreement between participating universities (including IISc and select German universities like TU Berlin and RWTH Aachen) for initiating short-term exchange programs, PhD cotutelle models, and summer internships.

4. **Industry-Academia Linkages:** German industry representatives, including SMEs and clean-tech startups, showed interest in piloting their technologies in India in collaboration with Indian research institutions, opening avenues for technology localization and co-commercialization.

5. **Capacity Building and Training:** Plans for organizing Indo-German training schools and joint workshops were proposed, especially focused on emerging technologies such as AI-ML for sustainability, energy-efficient building materials, and water-energy nexus.

Overall, the workshop successfully bridged scientific innovation with policy frameworks, fostering Indo-German collaborations to address sustainability challenges through an interdisciplinary lens. Key outcomes included identifying research gaps, promoting AI-enabled solutions, encouraging circular economy practices, and strengthening bilateral partnerships to support a climate-resilient and sustainable future.

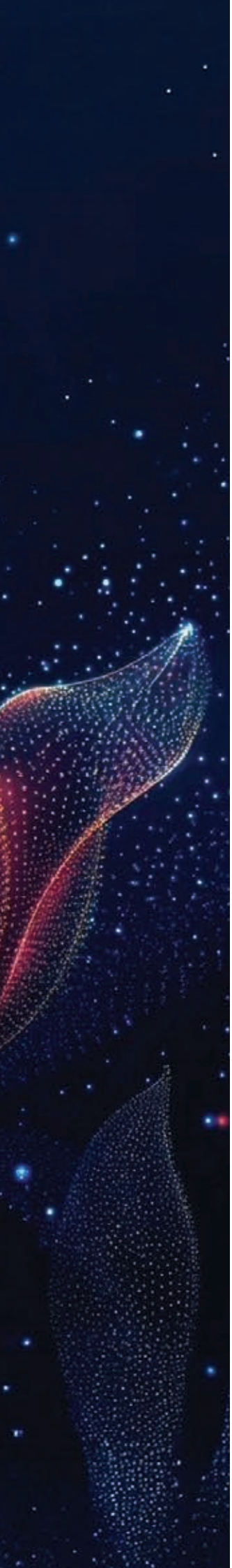
Indo-German Workshop on Translational Research in Andrology

28 FEBRUARY – 1 MARCH 2025 | MANIPAL, INDIA

WORKSHOP COORDINATORS

Prof. Satish Kumar Adiga
Centre of Excellence in Clinical Embryology
Kasturba Medical College, Manipal Academy of Higher Education

Prof. Stefan Schlatt
Centre for Reproductive Medicine and Andrology
University of Münster



The Indo-German workshop on Translational Research in Andrology, held on February 28 and March 1, 2025, at Kasturba Medical College (KMC), Manipal, Manipal Academy of Higher Education, was a collaborative initiative between the Centre of Excellence in Clinical Embryology, Kasturba Medical College, Manipal, and the Centre for Reproductive Medicine and Andrology, University of Münster, Germany. Prof Satish Adiga and Prof Stefan Schlatt jointly hosted the event which integrated cutting-edge male reproductive research into clinical practice, focusing on the diagnosis and treatment of male infertility. Participants presented significant Centers of Excellence of both countries which created a unique scenario for exchange on basic and clinical aspects in Andrology.

The brainstorming sessions discussed the innovative, clinical, translational, and collaborative research in reproductive health, strongly emphasizing idiopathic male infertility, non-invasive methods for sperm selection, stem cell-based fertility preservation, in vitro spermatogenesis, and their genetic, epigenetic, and immunological implications.

The key outcomes and achievements of the workshop include scientific presentations where the experts discussed mechanisms of sperm motility, idiopathic male infertility, and clinical challenges in diagnosing and treating male infertility. Several new ideas erupted during the brainstorming sessions, which have the potential to become major projects. German professionals gained insights into the diverse medical challenges faced by the Indian fertility centres and research institutes, while Indian professionals benefited from Germany's cutting-edge facilities and research approaches in translational andrology. The developments from this meeting enhanced expertise and skill sets in both countries, strengthening global efforts in male reproductive health. The Indo-German collaborative meeting provided a platform for young scientists to present their research work and receive constructive feedback. Industry collaborations led the path for new start-ups in andrology clinics, and networking among young scientists led to discussions on joint collaborative projects between India and Germany.

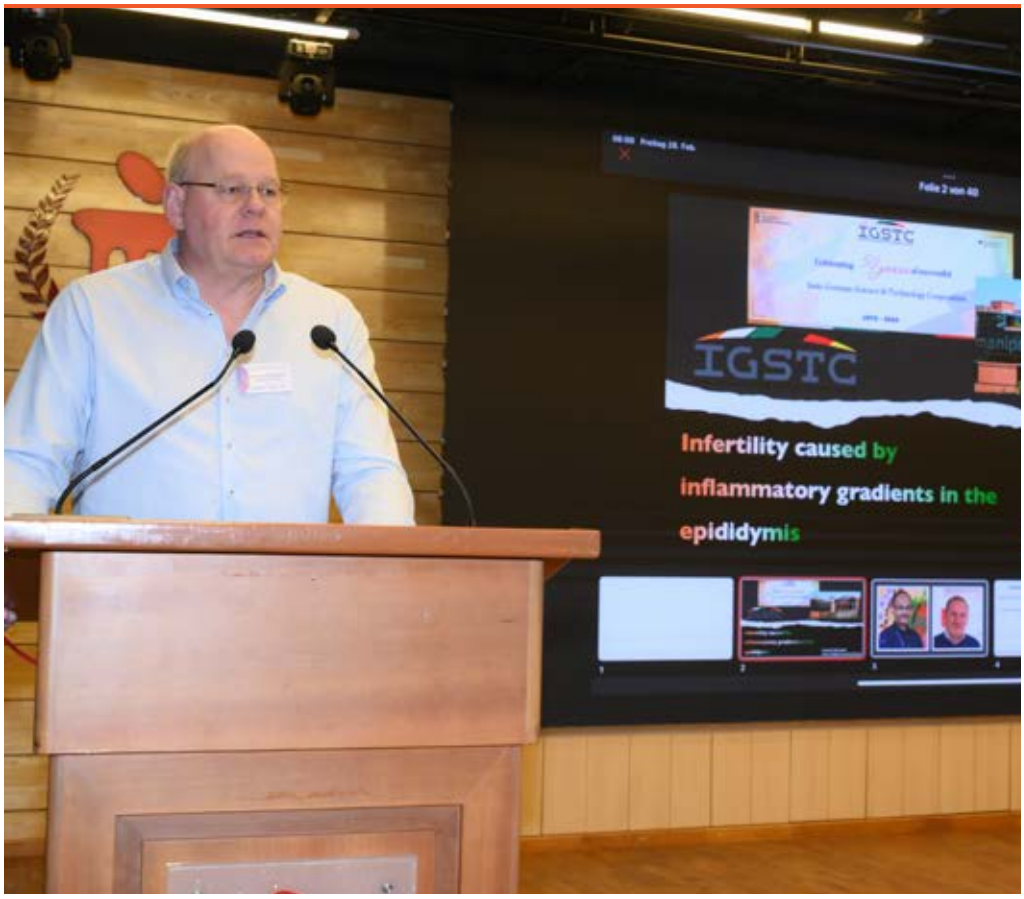
Scientific sessions began by delving into the fundamental biology of spermatozoa, focusing on the mechanisms of cilia and sperm motility. Discussions extended to the genetic and epigenetic factors affecting male fertility, highlighting key markers and the potential for personalized

diagnostics. Experts addressed clinical challenges in diagnosing and treating male infertility, emphasizing the critical role of the CatSper ion channel in sperm motility. Presentations also explored non-invasive sperm selection techniques to improve embryo quality and fertility outcomes, as well as stem cell-based strategies for fertility preservation, particularly in young cancer patients. An important focus of the workshop was the link between environmental factors and male infertility. Sessions discussed the influence of infections, lifestyle, diet, gut microbiota, and traditional practices such as Ayurveda and yoga. Innovative solutions such as glycoproteins to enhance sperm motility and increased application of genetic testing for diagnostic precision were also emphasized.

Beyond the scientific agenda, the workshop offered rich cultural exposure that further deepened the spirit of collaboration. German participants experienced a vibrant showcase of Indian cultural traditions through a captivating evening of performances. In turn, Indian participants had the rare opportunity to experience a lively street-style German carnival, filled with colourful costumes, festive music, and cheerful songs offering a taste of German celebration and community life. These cultural exchanges fostered comradeship, respect, and appreciation for each other's heritage.

Overall, the workshop emphasized translational research, fostering industry-academia collaboration and opening paths for start-ups in andrology. Specific outcomes include strategic plans to use non- invasive tools to diagnose idiopathic male infertility, develop region-specific semen normograms for fertility evaluation, and bilateral research on gene panels to understand failure in assisted reproduction. The event has laid a strong foundation towards bridging the gap between experimental research and clinical practice in male fertility. Supported by the IGSTC, the workshop not only catalysed new scientific initiatives but also showcased cross-cultural engagement in strengthening global partnerships and advancing male reproductive health.


MANIPAL
IGSTC
Indo-German Workshop on
Translational Research in Andrology
28th February & 1st March 2025


IGSTC
IGSTC
Infertility caused by
inflammatory gradients in the
epididymis

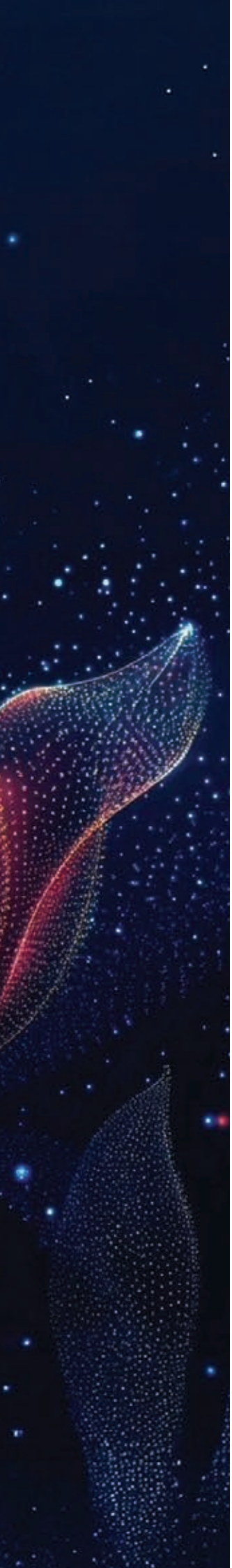
Germany–India Brain & Oncology Personalized Medicine (GIND-BOPM)

9-10 March 2025 | Hyderabad, India

WORKSHOP COORDINATORS

Dr Sasidhar Manda
Cell and Molecular Biology Research Centre
Apollo Hospitals Educational and
Research Foundation (AHERF)

Dr. Basant Kumar Thakur
Department of Pediatrics Hematology and
Oncology University Hospital Essen



The Germany–India Brain & Oncology Personalized Medicine (GIND-BOPM) Workshop 2025 marked a pivotal advancement in Indo-German biomedical collaboration, bringing together over 25 experts from more than 20 premier institutions across both countries. The workshop provided a vibrant platform for scientific exchange and strategic partnership in precision medicine, oncology, and neurology.

The event was enriched by ceremonial and panel sessions. The lamp-lighting ceremony, attended by key academic leaders, marked the formal inauguration and set a collaborative tone. A high-level panel discussion on bridging gaps in oncology research brought together thought leaders to examine translational challenges, collaborative models, and innovative research pathways.

The workshop focused on the frontiers of cancer diagnostics and therapeutics. Discussions revolved around groundbreaking technologies such as liquid biopsy, extracellular vesicles (EVs), and circulating tumour DNA (ctDNA). Emphasis was placed on AI-integrated multi-analyte biomarker platforms, droplet digital Polymerase Chain Reaction (PCR) for clinical diagnostics, and functional tumour models that enable precise therapeutic screening. The role of single-cell multi-omics in unravelling tumour evolution was also featured in the workshop. One of the standout moments was a session proposing an AI-driven liquid biopsy platform for early cancer detection. Experts debated the practical and regulatory challenges involved in transitioning innovative diagnostics from laboratory research to clinical settings. The need for harmonized regulatory frameworks, robust standardization protocols, and scalable validation mechanisms was highlighted as essential to bridging translational bottlenecks.

On the second day, the spotlight shifted to neurology, delving into the diagnostic and therapeutic potential of exosomes, miRNAs, and other vesicle-mediated strategies. The agenda covered neurodegenerative disorders such as Alzheimer's and Parkinson's disease, as well as epilepsy, paediatric brain tumours, and high-grade gliomas. A compelling session on neuronal exosome biomarker validation drew strong interest, particularly in relation to Alzheimer's and dementia research. Researchers shared insights into micro ribonucleic acid (miRNA) signatures that could enable earlier and more precise diagnosis of neurological diseases. Vesicle-mediated drug delivery mechanisms and their application to central nervous system disorders were explored as emerging frontiers.

The concluding panel discussion addressed the critical need for biobank access, longitudinal cohorts, and cross-border collaboration in biomarker research. This session emphasized the value of international data sharing and resource pooling to accelerate therapeutic translation in neurology.

The workshop culminated in several actionable outcomes. Key among them was the formation of interdisciplinary working groups focused on biomarker science and personalized medicine. Another significant initiative was the launch of a collaboration mapping and resource-sharing platform designed to connect researchers and institutions in both countries. In a major strategic move, Apollo Hospitals Educational and Research Foundation and the University of Duisburg-Essen announced plans to jointly apply for an Indo-German Centre dedicated to oncology and neurology. Additionally, a Confidential Disclosure Agreement (CDA) was signed between Apollo Hospitals Educational and Research Foundation and the University of Freiburg to facilitate collaborative research on prostate cancer biomarkers. Feedback from attendees reflected the strong impact of the event, with 92% of participants rating the sessions as highly relevant to their work. Dr. Saroj Kumar, AIIMS Delhi, highlighted the transformative potential of AI-driven diagnostics in oncology, describing them as a paradigm shift in early cancer detection. Dr. Dirk Kuhlmeier, Fraunhofer IZI, underscored the promise of exosome-based platforms in the early identification of neurological diseases.

Overall, the GIND-BOPM Workshop served as a catalyst for high-impact biomedical collaboration between Germany and India. It not only advanced the scientific dialogue in oncology and neurology but also laid a strong foundation for sustained partnership, joint research, and innovation in personalized medicine.

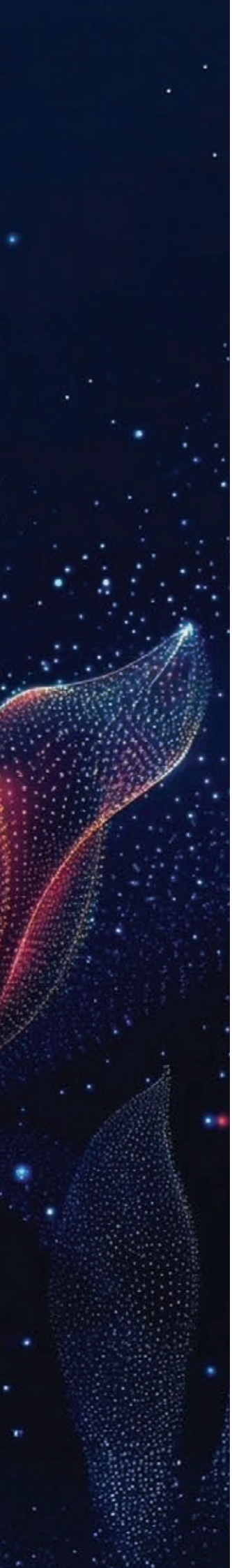

AHERF
GIND-BOPM


IGSTC
AHERF
GIND-BOPM


UKD Universitätsklinikum Düsseldorf
hhu
A High Blood Volume Approach to Improve Sensitivity of CTC-Based Liquid Biopsies
Nikolas Stoecklein
Experimental Surgical Oncology (EGO)
Dept. for General, Visceral and Pediatric Surgery
Medical Faculty of the Heinrich-Heine-University
Düsseldorf, Germany


Prof. Dr. Irina Naza
IGSTS Workshop, Circulating Biomarkers in
9-10 March, 2025, Hyderab

IGSTC Industrial Fellowships



IGSTC Industrial Fellowships

Industrial Exposure in Germany for Young Indian Researchers

- Motivate and facilitate young researchers towards applied research
- Expose researchers to German industrial ecosystem
- Capacity Building
- Encourage innovation & technology development

The Indo-German Science & Technology Centre (IGSTC), a joint initiative by the Department of Science and Technology (DST), Government of India, and the Federal Ministry of Education and Research (BMBF), Government of Germany offers Industrial Fellowships to encourage young Indian researchers towards applied research at an industrial setup in Germany.

Fellowship Details

PhD Industrial Exposure Fellowship (PIEF)

Eligibility Criteria:

- Pursuing and completed one year of PhD in Science/Engineering
- **Age limit:** 28 years

Duration: 3 to 6 months

Funding: Stipend of € 1500 per month + travel, visa and medical insurance

Post Doctoral Industrial Fellowship (PDIF)

Eligibility Criteria:

- PhD awarded within the last 2 years in Science/ Engineering
- **Age limit:** 35 years

Duration: 6 to 12 months

Funding: Stipend of € 2500 per month + travel, visa and medical insurance

PDIF Industrial Fellows 2024

PRASHANT KUMAR CHAURASIA

IIT Bombay

HOST

Bundesanstalt für Materialforschung und-prüfung (BAM)

AREA OF WORK

Multi-sensor based in-situ monitoring and control of robotic wire arc additive manufacturing for fabricating defect-free functional part.

SANJEET KUMAR SINGH

IIT Kanpur

HOST

Airbus Central R&T

AREA OF WORK

Design and development of fractal acoustic ventilated programmable/ intelligent metamaterials utilizing shape memory polymers for advanced engineering applications.

SACHIN RAHI

IIT Jodhpur

HOST

Airbus Munich

AREA OF WORK

Exploration of printable organic/oxide semiconductor based flexible transistors for aeronautic applications.

HIMANSHU GAUTTAM

Atal Bihari Vajpayee-Indian Institute of Information Technology and Management (ABV-IIITM), Gwalior

HOST

Airbus Munich

AREA OF WORK

Deterministic networking and edge computing for mobile extended reality services.

SATYA KUMAR DEWANGAN

NIT Raipur

HOST

Testia GmbH

AREA OF WORK

AI safety and reliability research, along with the qualification of assisted defect detection software for CT evaluations in aviation applications.

PRADNYA KAMBLE

ICMR - National Institute for Research in Reproductive and Child Health

HOST

LIONEX GmbH

AREA OF WORK

Development of whole blood based IL2-ELISA assay for distinguishing patients with active and latent tuberculosis.

ARYA DAS

CSIR-Institute of Minerals and Materials Technology (IMMT)

HOST

Skeleton Technologies GmbH

AREA OF WORK

Optimization of form factors for development of advanced superbatteries.

SIDDHI KESHARWANI

IISc Bangalore

HOST

Wama Widder

AREA OF WORK

Optimizing ram pumps and o-pumps with internal design and external system variables using theory, simulations, and field studies.

VINAY HEGDE

Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola

HOST

Bayer Crop Science

AREA OF WORK

Integrated pest management using insect-pathogenic microorganisms for sustainable agriculture.

PRINCE KUMAR RAI

IIT Jodhpur

HOST

Airbus Munich

AREA OF WORK

Surface treatment for complex metallic additive manufactured product for aerospace applications.

PIEF Industrial Fellows 2024

RAVI RAJ

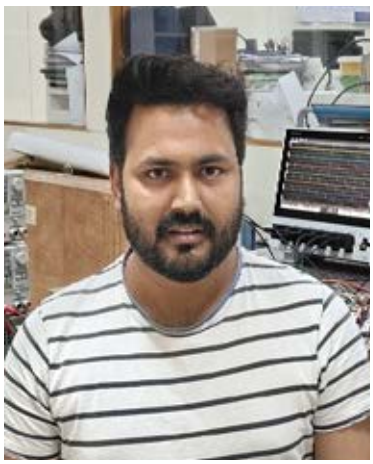
CSIR-IHBT

HOST

LIONEX GmbH

AREA OF WORK

Isolation of specific monoclonal antibodies and development of a multiantigen based urine test for fast diagnosis of tuberculosis.



MD ASIF KHAN

IISER Bhopal

HOST

Fraunhofer Institute for Integrated Systems and Device Technology IISB

AREA OF WORK

Advancing IC design through comprehensive understanding of 4H-SiC CMOS technology characterization.

SHEFALI TRIPATHI

IIT Roorkee

HOST

Dr. August Oetker Nahrungsmittel KG

AREA OF WORK

Replacement of pizza primary packaging with a sustainable alternative.

PRASHIL BADWAIK

IIT Bombay

HOST

BASF SE

AREA OF WORK

Application of interface force field model of metal oxides for the surface pretreatment technology.

STUTI SRIVASTAVA

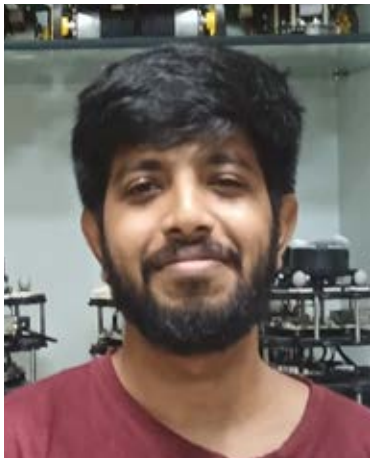
Amrita Vishwa Vidyapeetham

HOST

DHI WASY GmbH

AREA OF WORK

Dynamic hydro-modelling: Integrating land surface phenology (LSP) and climate projections for groundwater resilience.



VEEJAY KARTHIK JEGAN KUMAR

IIT Bombay

HOST

Fraunhofer Institute for Manufacturing Engineering and Automation IPA

AREA OF WORK

Safe localization with multiple sensor sources for autonomous navigation.

SUKRITI SHARMA

IIT Ropar

HOST

Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT

AREA OF WORK

BeWISER project: Green steel production: from potential analysis to implementation at the Salzgitter Steel Works.

KOLLI VENKATA SUPRAJA

IIT Delhi

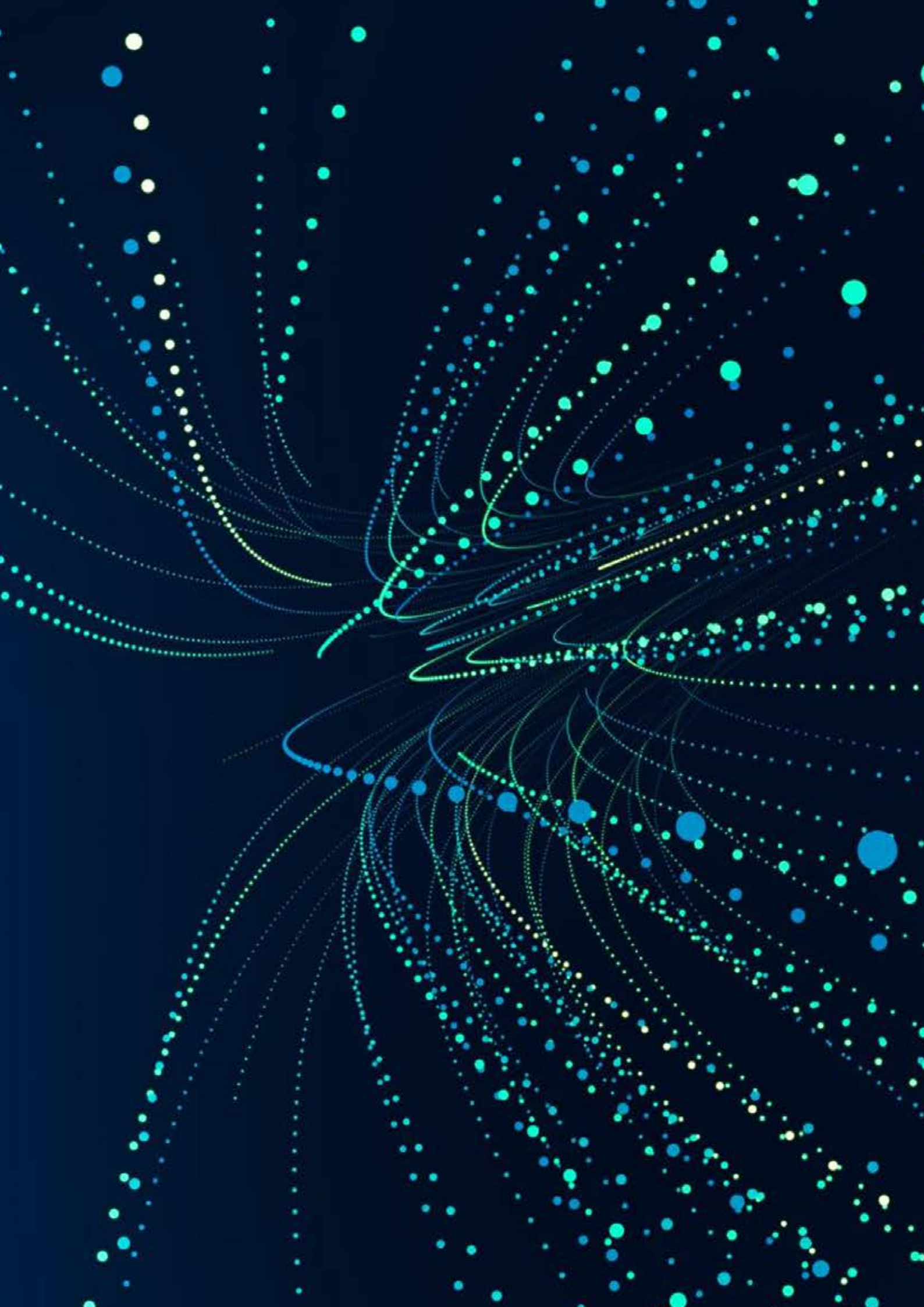
HOST

HZDR Innovation GmbH

AREA OF WORK

RePhoAs: Recovery of arsenic and phosphate from wafer production wastewater.

Women Involvement in Science and Engineering Research (WISER)



Women Involvement in Science and Engineering Research (WISER)

The Indo-German Science & Technology Centre (IGSTC), a joint initiative by the Department of Science and Technology (DST), Government of India and the Federal Ministry of Education and Research (BMBF), Government of Germany supports proposals in paired mode from women researchers in India and Germany to foster innovation in the field of STEM.

- Facilitating bilateral exchange among women researchers
- Create avenues for long-term Indo-German research collaboration
- Capacity building and networking
- Open to all areas of STEM

Salient Features

- **Eligibility:** Women holding a regular/long term research position in academia or research institutes/industry
- **Tenure:** 3 years
- **No age limit**
- **Research stays:** 1-month/year fellowship in the host country
- Mode: In paired mode (Proposals from Indian and German women researchers)

Financial Assistance:

Indian Awardee

- Up to ₹ 39 lakhs
- Grant includes support for research staff, consumables, contingency, travel and per diem (€ 2300) in Germany

German Awardee

- Up to € 48000
- Grant includes support for research staff, consumables, contingency, travel and per diem (€ 2300) in India

INDIAN AWARDEES

ALOKA SINHA

IIT Delhi

HOST

Oana Cojocaru-Mirédin, University of Freiburg

AREA OF WORK

Unlocking synergies between liquid crystal-polymer composites: study and design of advanced thermoelectric generators for real-world applications

ARCHANA SINGH

CSIR-AMPRI, Bhopal

HOST

Anjana Devi, Leibniz Institute of Solid State and Materials Research

AREA OF WORK

Design and development of high-performance electrocatalysts for urea assisted hydrogen generation (Ecat-UH2)

ATHIRA GOPINATH

IIT Palakkad

HOST

Prof. Karl Christian Thienel, University of the Bundeswehr Munich

AREA OF WORK

Durable and sustainable low-carbon cements using local clays and biomass ashes - A local approach to future cements

DR. DEEPSHIKHA JAISWAL NAGAR

IISER Thiruvananthapuram

HOST

Philipp Gegenwart, University of Augsburg

AREA OF WORK

Delving into metamagnetic quantum criticality in magnetic insulators: Thermal expansion and magnetocaloric effect studies

KANTI KIRAN

Gujarat Biotechnology University, Gandhinagar

HOST

Friedrich Kragler, Max Planck Institute of Molecular Plant Physiology

AREA OF WORK

Transgene-free edited wheat through grafting for enhanced agricultural benefits.

PYDI BAHUBALINDRUNI

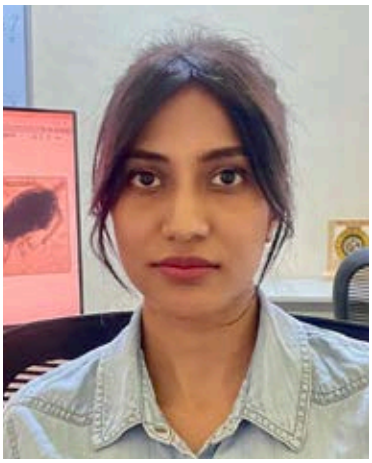
IISER Bhopal

HOST

Mathias Rommel, Fraunhofer Institute for Integrated Systems and Device Technology IISB

AREA OF WORK

SiC based multi-sensing system for UV, magnetic field, temperature, and pressure monitoring in real world applications



SADAF ANSARI

CSIR-NIO, Goa

HOST

Rainer Kiko, GEOMAR Helmholtz Centre for Ocean Research Kiel

AREA OF WORK

AI-driven advanced plankton image analysis for ocean monitoring

SHARMISTHA ANWAR

CSIR-IMMT

HOST

Mandy Holn, Fraunhofer Institute Ceramic Technologies and Systems IKTS

AREA OF WORK

Development of optically-transparent anti-scratch coatings based on Al-Ge-N

SHILPI VERMA

Thapar Institute of Engineering and Technology

HOST

Harald Horn, Karlsruhe Institute of Technology (KIT)

AREA OF WORK

Development of upconversion photocatalytic materials for efficient degradation of poly- and perfluoroalkyl substances (PFAS) from water using solar activation

SHOBHANA SINGH

IIT Jodhpur

HOST

Klarissa Niedermeier, Karlsruhe Institute of Technology

AREA OF WORK

Integration of macro-encapsulated phase change material in packed-bed thermal energy storage for high-temperature applications

GERMAN AWARDEES

JUAN LI

Fraunhofer Institute for Wood Research Wilhelm-Klauditz WKI

HOST

Vasant Matsagar, IIT Delhi

AREA OF WORK

Aging of hybrid fiber reinforced polymer composites meausred by AFM and DMTA

UTE DISTLER

Institute for Immunology, University Medical Center Mainz

HOST

Nishith Gupta, BITS Pilani, Hyderabad Campus

AREA OF WORK

Proteomics-based identification of host determinants and diagnostic biomarkers of Toxoplasma infection in human skeletal muscle cells

ANN-CHRISTIN HAU

University Hospital Frankfurt am Main

HOST

Kavi Devraj, Birla Institute of Technology & Science, Pilani

AREA OF WORK

Personalized Immunotherapy evaluation using a blood-brain-barrier (BBB) integrating microfluidics model

JUTTA PAPENBROCK

Leibniz University Hannover

HOST

Deepak Swami IIT Mandi

AREA OF WORK

Phytoremediation of industrial wastewaters by glyco- and halophytes cultivated in hydroponic systems and constructed wetlands (RemCW)

SYLKE BLUMSTENGEL

Humboldt-Universität zu Berlin

HOST

Parinda Vasa, IIT Bombay

AREA OF WORK

Quantum scale photonics using plasmonic platforms

ALOKA SINHA

SHILPI VERMA

SHARMISTHA ANWAR

SADAF ANSARI

PYDI BAHUBALINDRUNI

KANTI KIRAN

DEEPSHIKHA JAISWAL NAGAR

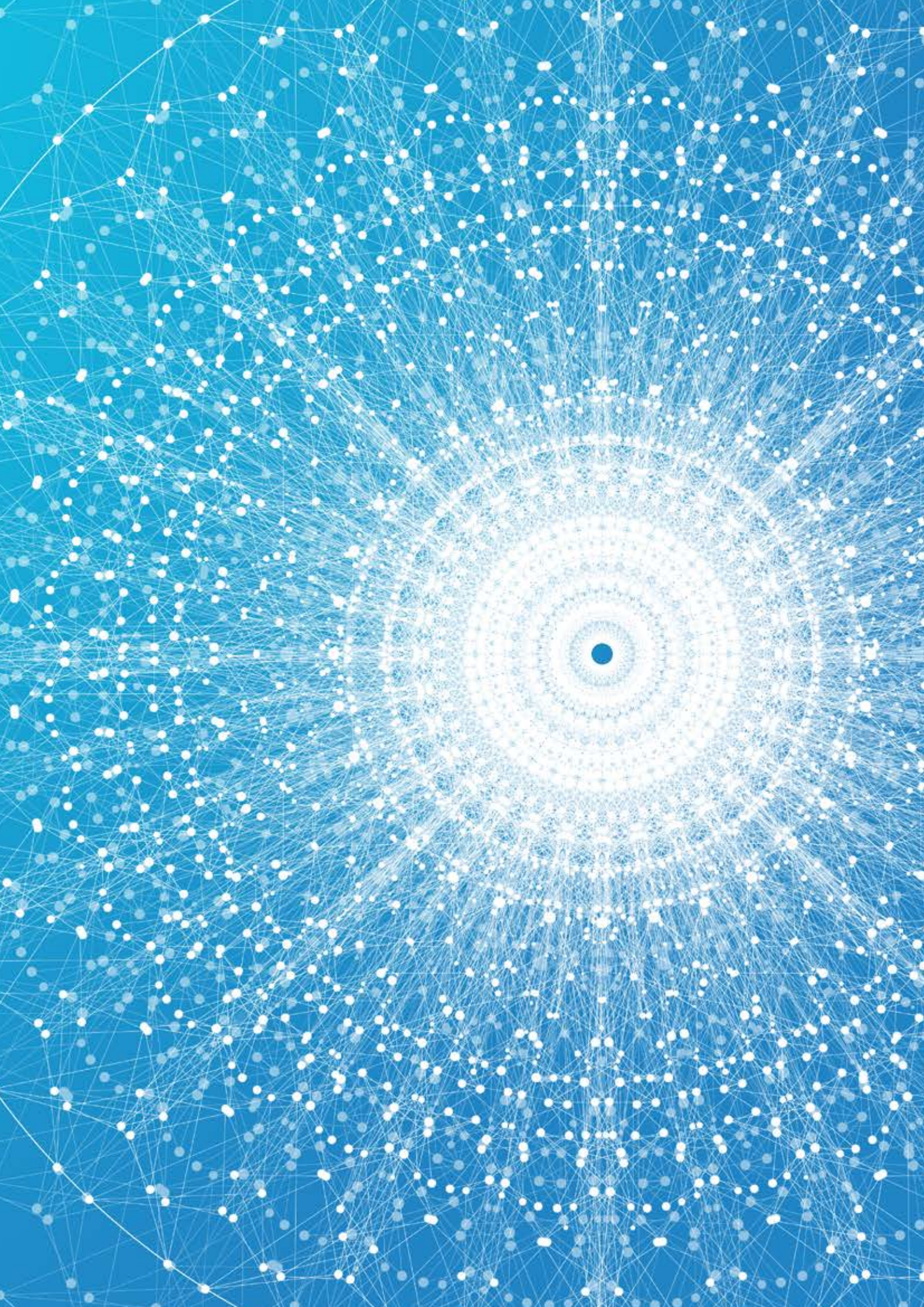
ARCHANA SINGH

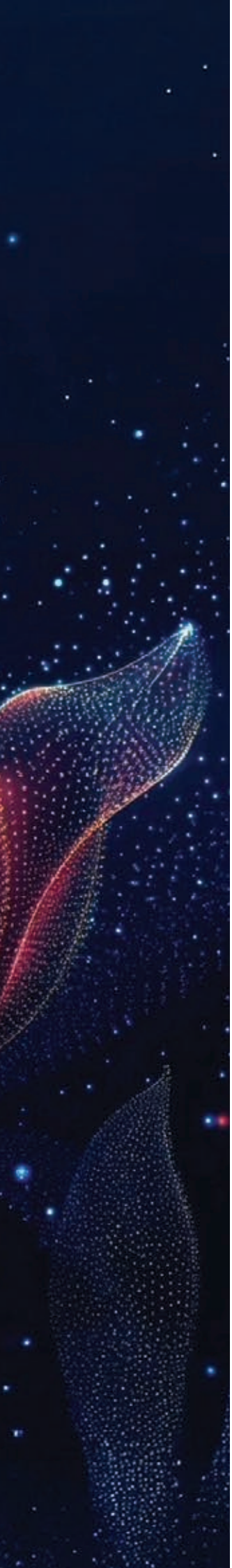
SHOBHANA SINGH

ANN-CHRISTIN HAU

SYLKE BLUMSTENGEL

Paired Early Career Fellowship in Applied Research (PECFAR)





Paired Early Career Fellowship in Applied Research (PECFAR)

The Indo-German Science & Technology Centre (IGSTC), a joint initiative by the Department of Science and Technology (DST), Government of India and the Federal Ministry of Education and Research (BMBF), Government of Germany offers Paired Early Career Fellowship in Applied Research (PECFAR) to facilitate exchange of early career Indian and German researchers. The Programme supports short duration visit to explore, connect and network for research collaboration in Science, Technology, Engineering and Mathematics (STEM).

- Create avenues for two-way exchange of young researchers in pairs
- Support for research stay in India/Germany
- Explore the Indo-German research landscape on entrepreneurship, joint research and innovation
- Build future partnerships with complementary expertise

Salient Features

Eligibility:

- Early career researchers holding regular positions in academic/ research institutions/industries or long-term nationally recognized fellowship
- Minimum Qualification: Master's in Science/Bachelor's in Engineering
- Applications are to be submitted jointly by the pair of Indian and German researchers

Age Limit: 40 years

Tenure: Minimum -1 month, Maximum -2 months

Financial Assistance:

- **Fellowship:** € 2300 per month/awardee
- Single round trip economy class airfare including visa fees and medical/travel insurance up to € 1500

PECFAR AWARDEES 2024

SATISH NAIK BANAVATH

IIT Dharwad

AREA OF WORK

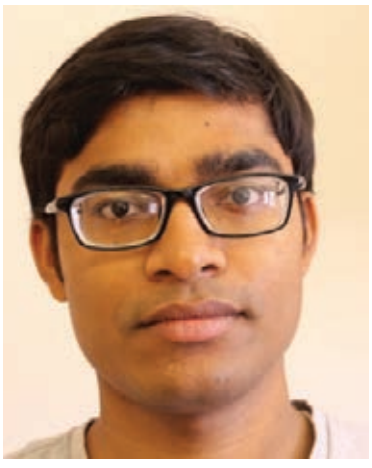
Development of adaptive, protective and modular circuit breaker design for residential low-voltage DC (LVDC) grids.

GIOVANNI DE CARNE

Karlsruhe Institute of Technology

AREA OF WORK

Development of adaptive, protective and modular circuit breaker design for residential low-voltage DC (LVDC) grids.

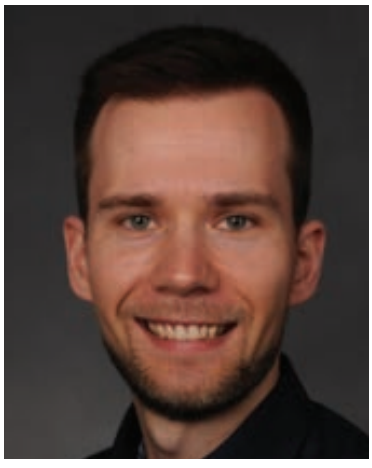


RITWIK MONDAL

IIT (ISM) Dhanbad

AREA OF WORK

Band topology of inertial magnons in magnetic heterostructures.



ALEXANDER MOOK

Johannes Gutenberg-Universität Mainz

AREA OF WORK

Band topology of inertial magnons in magnetic heterostructures.

SNEHASIS BHAKTA

Cooch Behar College

AREA OF WORK

Concurrent selective depletion of albumin and antibodies from human serum using surface-imprinted nanocomposites.

MEHMET DINC

Hahn-Schickard-Gesellschaft für angewandte Forschung e.V.

AREA OF WORK

Concurrent selective depletion of Albumin and Antibodies from Human Serum using surface-imprinted nanocomposites.

ABHIJITH GOPINATHAN NAIR REMA DEVI

IIT Kanpur

AREA OF WORK

Urban water quality control for urban water management using a Hybrid Modelling (HM) framework.

NADJA VEIGEL

TU Berlin

AREA OF WORK

Urban water quality control for urban water management using a Hybrid Modelling (HM) framework.

SAMALA RATHAN

Indian Institute of Petroleum and Energy, Visakhapatnam

AREA OF WORK

Numerical analysis of nonlocal conservation laws in multi-dimensions to study their convergence properties.

JAN JOSEF FRIEDRICH

RWTH Aachen University

AREA OF WORK

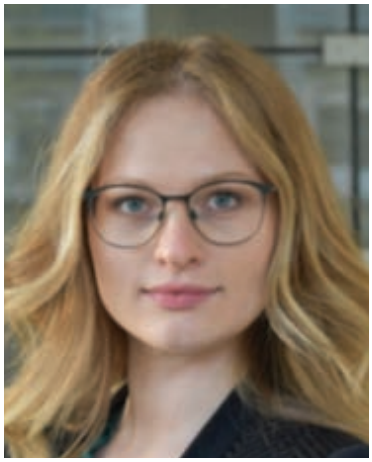
Numerical analysis of nonlocal conservation laws in multi-dimensions to study their convergence properties.

VINEET ANIYA

CSIR - Indian Institute of Chemical Techology

AREA OF WORK

Synthesis of bio-based nanocellulose reinforced Polyurethanes.



PAULINE SHAMRAIENKO

Leibniz Institute for Polymer Research Dresden e.V. (IPF)

AREA OF WORK

Synthesis of bio-based nanocellulose reinforced Polyurethanes.

SOUMYA RANJAN MOHAPATRA

Kalinga Institute of Industrial Technology (KIIT) Deemed University

AREA OF WORK

Liquid biopsy biomarkers for early detection of head and neck squamous cell carcinoma.

AOIFE GAHLAWAT

German Cancer Research Center (DKFZ) and National Center for Tumor Diseases (NCT)

AREA OF WORK

Liquid biopsy biomarkers for early detection of head and neck squamous cell carcinoma.

NIKHIL DHAWAN

IIT Roorkee

AREA OF WORK

Precious metals recovery from waste printed circuit boards (PCBs) through thermal and chemical treatment processes.

VOLKER RECKSIEK

Helmholtz-Zentrum Dresden-Rossendorf Helmholtz Institute Freiberg for Resource Technology

AREA OF WORK

Precious metals recovery from waste printed circuit boards (PCBs) through thermal and chemical treatment processes.

PROSENJIT DAS

IISc Bangalore

AREA OF WORK

Process models to manufacture Novel Corrosion protected Rheo gravity die cast AZ91D Mg alloy for two-wheeler (electric vehicles) wheel hub applications.

VALERYIA KASNERYK

Helmholtz-Zentrum Hereon

AREA OF WORK

Process models to manufacture Novel Corrosion protected Rheo gravity die cast AZ91D Mg alloy for two-wheeler (electric vehicles) wheel hub applications.

VIVEKANANDA BHAT

Kasturba Medical College,
Manipal Academy of Higher Education

AREA OF WORK

Genomic insights and capacity building in Rare Monogenic Disorders.

TESS HOLLING

University Medical Center Hamburg-Eppendorf

AREA OF WORK

Genomic insights and capacity building in rare monogenic disorders.

JAICHANDER SWAMINATHAN

IISc Bangalore

AREA OF WORK

High-pressure membrane technologies for industrial zero liquid discharge (ZLD) in the textile dyeing industry.

CHRISTINE KLEFFNER

TH Köln

AREA OF WORK

High-pressure membrane technologies for industrial zero liquid discharge (ZLD) in the textile dyeing industry.

SUJEET KUMAR SINGH

Indian Statistical Institute, Hyderabad Unit

AREA OF WORK

Multi-objective optimization of trade-off development for sustainable and efficient urban logistics.

PIRMIN FONTAINE

Catholic University of Eichstätt-Ingolstadt

AREA OF WORK

Multi-objective optimization of trade-off development for sustainable and efficient urban logistics.

DHAKSHINAMOORTHY SUNDARAMURTHI

SASTRA Deemed University

AREA OF WORK

Development of diverse bioinks for 3D bioprinting of complex tissues such as nerve, cardiac, muscle, bone, and skin.

ANDREAS BLAESER

TU Darmstadt

AREA OF WORK

Development of diverse bioinks for 3D bioprinting of complex tissues such as nerve, cardiac, muscle, bone, and skin.

SUDARSANAM PUTLA

IIT Hyderabad

AREA OF WORK

Valorization of lignocellulosic biomass for lignin-derived catalysts and biofuels.

MAJD AL-NAJI

TU Berlin

AREA OF WORK

Valorization of lignocellulosic biomass for lignin-derived catalysts and biofuels.

SHIVENDRA KUMAR PANDEY

NIT Silchar

AREA OF WORK

Ultrafast electrical switching characteristics of phase-change memory devices for non-volatile data storage applications.

STEFAN WIEFELS

Forschungszentrum Jülich GmbH

AREA OF WORK

Ultrafast electrical switching characteristics of phase-change memory devices for non-volatile data storage applications.

KALAIVANAN NAGARAJAN

Tata Institute of Fundamental Research

AREA OF WORK

Molecular-level effects of vibrational strong coupling via hollow-core fiber setup.

MARCUS SEIDEL

Deutsches Elektronen-Synchrotron DESY

AREA OF WORK

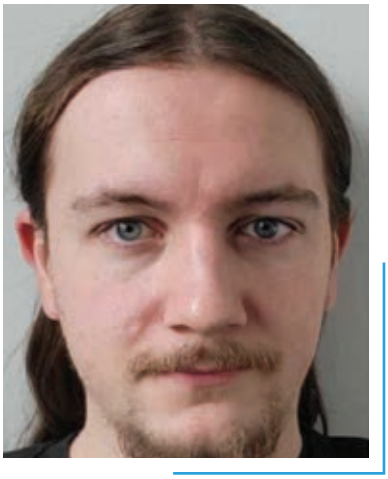
Molecular-level effects of vibrational strong coupling via hollow-core fiber setup.

ASHISH GAURAV

CSIR - Central Scientific Instruments Organisation

AREA OF WORK

Privacy-preserving radar-based fall detection using machine learning and iot integration.



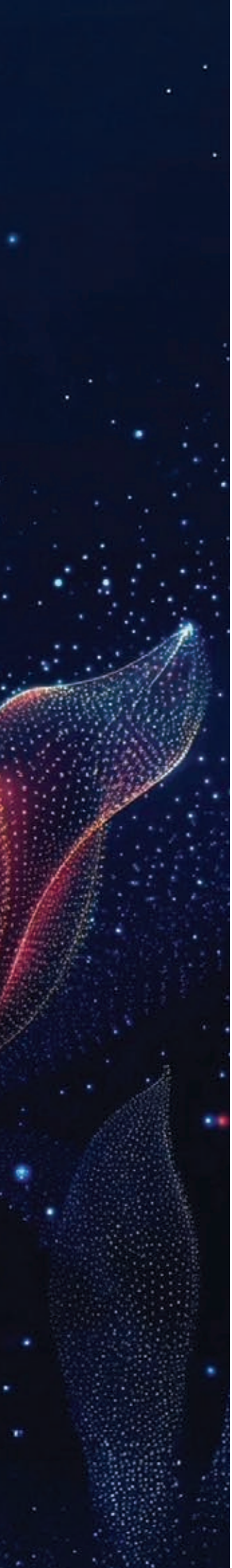
KONRAD WARTKE

Goethe University

AREA OF WORK

Privacy-preserving radar-based fall detection using machine learning and iot integration.

Small Immediate Need Grants (SING)



Small Immediate Need Grants (SING)

The Indo-German Science & Technology Centre (IGSTC), a joint initiative by the Department of Science and Technology (DST), Government of India and the Federal Ministry of Education and Research (BMBF), Government of Germany offers Small Immediate Need Grants towards joint initiatives that require modest funding and has the potential to embark on Indo-German collaboration.

- Quick assistance to kick off ad-hoc opportunities
- Single window approach with fast-track processing and low turnaround time
- Funding support up to € 10000
- Facilitates new ideas and propositions

Sing Supports

- Joint initiatives/ideas that have a scope to ignite and open avenues for long-term connect/technology development/new areas of collaboration.
- Joint activity towards innovation, rapid prototyping, technology demonstration or industrial R&D.
- Individual proposals that have a high potential of involving industrial sectors.
- Utilizing scientific events to share intellectual thoughts/ideas that can explore avenues for bilateral cooperation.

Who Can Apply?

- Individuals or groups from industry, academic and research institutions.
- Members/participants in any of the IGSTC programs including workshops.
- Engineering, Academic & Research community from ongoing inter-institutional MoUs between India and Germany.
- Personnel from industry with specific requirements in applied research, technology development and entrepreneurship.
- Age below 55 years.

SING AWARDEES 2024

SANCHITA BANDYOPADHYA GHOSH

Manipal University Jaipur

HOST

Andreas Blaeser,
Technical University of Darmstadt

AREA OF WORK

Nano-enabled bioink for 3D bioprinting of personalized bone graft.

PUNIT KUMAR

University of Lucknow

HOST

Michael Bonitz, Kiel University

AREA OF WORK

Novel simulation methodology for studying shock waves in quantum plasmas with potential applications in inertial confinement fusion (ICF).

HRIDAYESH PRAKASH

Amity Centre for Translational Research

HOST

Weigert Andreas, Goethe-University Frankfurt

AREA OF WORK

Tweaking sphingolipids for restoring gut immune homeostasis in inflammatory bowl diseases.

INBARASAN MUNIRAJ

Alliance University

HOST

Claas Falldorf, BIAS - Bremer Institut für angewandte Strahltechnik GmbH

AREA OF WORK

CATCH-3D Cancer prognosis via tissue-safe combined digital holographic microscopy and hyperspectral 3D imaging.

MILIND THOMAS THEMALIL

IIIT Kottayam

HOST

Johannes Schumacher, Celestial Space Technologies GmbH

AREA OF WORK

Design and development of solar panel integrated transparent microstrip patch antennas with isoflux coverage for small satellite applications in S and X bands.

PREETHAM ELUMALAI

Cochin University of Science and Technology

HOST

Bernd Lepines, Ludwig Maxmillian University

AREA OF WORK

Targeting C-type lectins in fish to increase the immunogenicity of vaccines.

TUMMALA ANUSHA

Koneru Lakshmaiah Education Foundation

HOST

Parvaneh Rahimi, TU Bergakademie Freiberg

AREA OF WORK

Development of an electrochemical biosensing platform for multiplexed simultaneous quantification of sepsis biomarkers.

IGSTC-Connect Plus Fellow

IGSTC-Connect Plus Fellow

Alexander Von Humboldt (AvH) foundation and the Department of Science & Technology (DST) organizes Indo-German Frontiers of Engineering Symposia (INDOGFOE) which are a series of interdisciplinary, binational conferences. Funding support on the Indian side is provided by the Department of Science & Technology, Government of India and on the German side by the Federal Ministry of Education and Research (BMBF).

The activity brings together outstanding, early-career German and Indian engineers and natural scientists from industries, universities, and other research institutions to introduce their areas of research and technical work, thereby, facilitating an interdisciplinary transfer of knowledge and methodology that aims to lead to the development of cooperative networks of young scientists from both countries.

To encourage long-term collaboration among participants of INDOGFOE, the AvH Follow-up Programme CONNECT allocates residence allowances for working visits of participants in INDOGFOE partner countries for up to a total of 30 days per conference. To further support working visits for successful CONNECT applicants from India and Germany, this Letter of Intent (LOI) designates and appoints IGSTC to implement, administer and manage the IGSTC-CONNECT Plus Programme. Under this programme, IGSTC will support international travel expenses for successful Indian and German CONNECT participants, thus promoting the scientific exchange and networking.

IGSTC-CONNECT Plus Fellows

SURJYA GHOSH

BITS Pilani K K Birla Goa Campus

HOST

Natalie Packham, Berlin School of Economics and Law

AREA OF WORK

Investor Behavior Modelling in Financial Market using Affective and Physiological Signatures: A Quantitative Approach

SIDDHARTHA SANTRA

Indian Institute of Technology Bombay

HOST

David Florysiak, IU Internationale Hochschule

AREA OF WORK

Quantum Computing and Financial Services Transformation

KANTESH BALANI

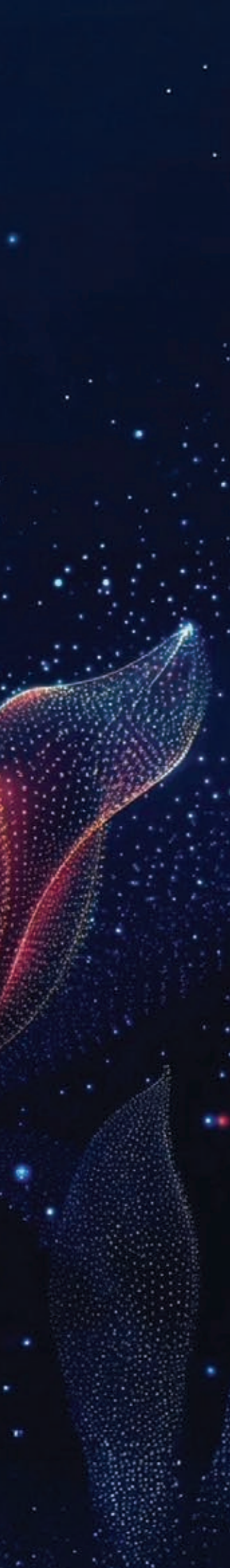
Indian Institute of Technology Kanpur

HOST

- Cecile Bidan & Clemens Schmitt, Max Planck Institute of Colloids and Interfaces Potsdam
- Franziska Schmidt, Charité –Universitätsmedizin, Berlin
- Tobias Fey, Friedrich-Alexander University, Erlangen-Nürnberg
- Katharina Herkendall, TU Berlin
- Christoph Kirchlechner & Marcel Weil, Karlsruhe Institute of Technology (KIT)

AREA OF WORK

Dental Biomaterials



IGSTC Outreach

In the financial year 2024–25, the Indo-German Science and Technology Centre (IGSTC) significantly enhanced its outreach and visibility through a series of strategic engagements and events. These efforts aimed to deepen Indo-German collaboration and raise awareness about IGSTC's mission, programs, and funding opportunities.

IGSTC organized four successful one-day outreach events across India in Bhopal, Tirupati, Jammu, and Silchar. Each event saw enthusiastic participation from stakeholders across academia, research institutions, and industry. The program featured comprehensive sessions on IGSTC's activities, detailed guidance on application processes, and the presentation of success stories from Indo-German collaborative projects.

A central element of each event was the panel discussion, which brought together distinguished panelists from academia, industry, research organizations, and the German consulate. The discussions focused on the importance of international cooperation in science and technology and explored innovative ways to bridge academia, research, and industry. These sessions elicited strong engagement from attendees and contributed to vibrant knowledge exchange and networking.

IGSTC participated in the BAU Fair 2025 held in Munich, Germany—the world's leading trade fair for architecture, materials, and systems. This participation underscored IGSTC's commitment to fostering Indo-German scientific and industrial collaboration.

At the fair, the IGSTC booth garnered considerable attention from a broad spectrum of visitors, including CEOs, Vice Presidents, R&D heads, and representatives from Fraunhofer institutes, universities, and research laboratories. A major highlight was IGSTC's featured presentation on "Opportunities for Cooperation with India," hosted by the Founders Club at BAU Fair. The session was met with an overwhelmingly positive response and sparked numerous inquiries and discussions on future collaborations.

These outreach initiatives were widely appreciated by participants and stakeholders. They served as vital platforms for promoting IGSTC's programs, showcasing successful Indo-German partnerships, and building new connections. The events reinforced IGSTC's role as a dynamic facilitator of scientific and technological cooperation between India and Germany.

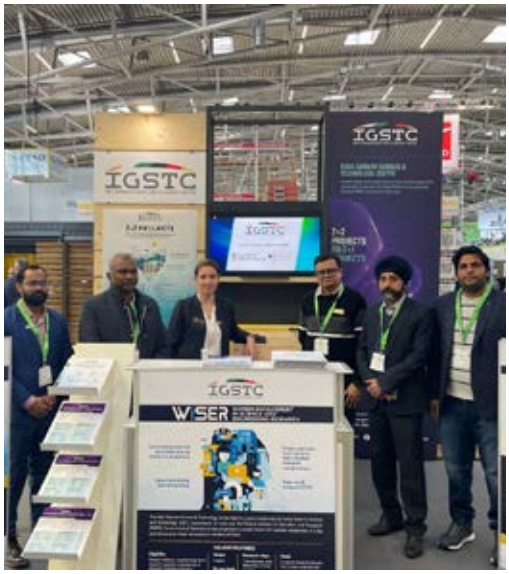
Participants at the Bhopal event (multi-institutional) on 04th April 2024

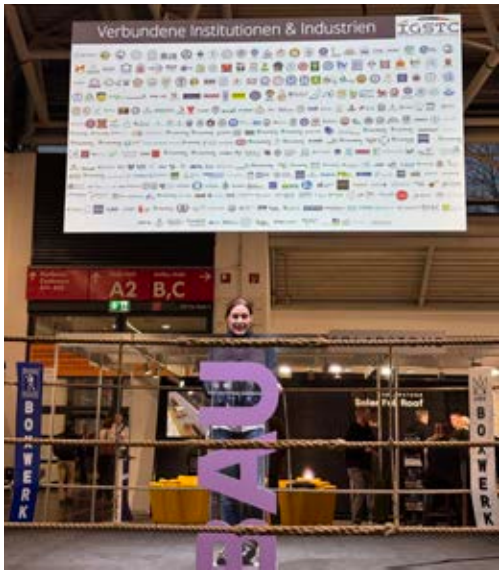
Participants at the IISER Tirupati on 06th August 2024

Outreach at IIT Tirupati on 06th August 2024

Participants at the NIT Silchar event on 29th October 2024

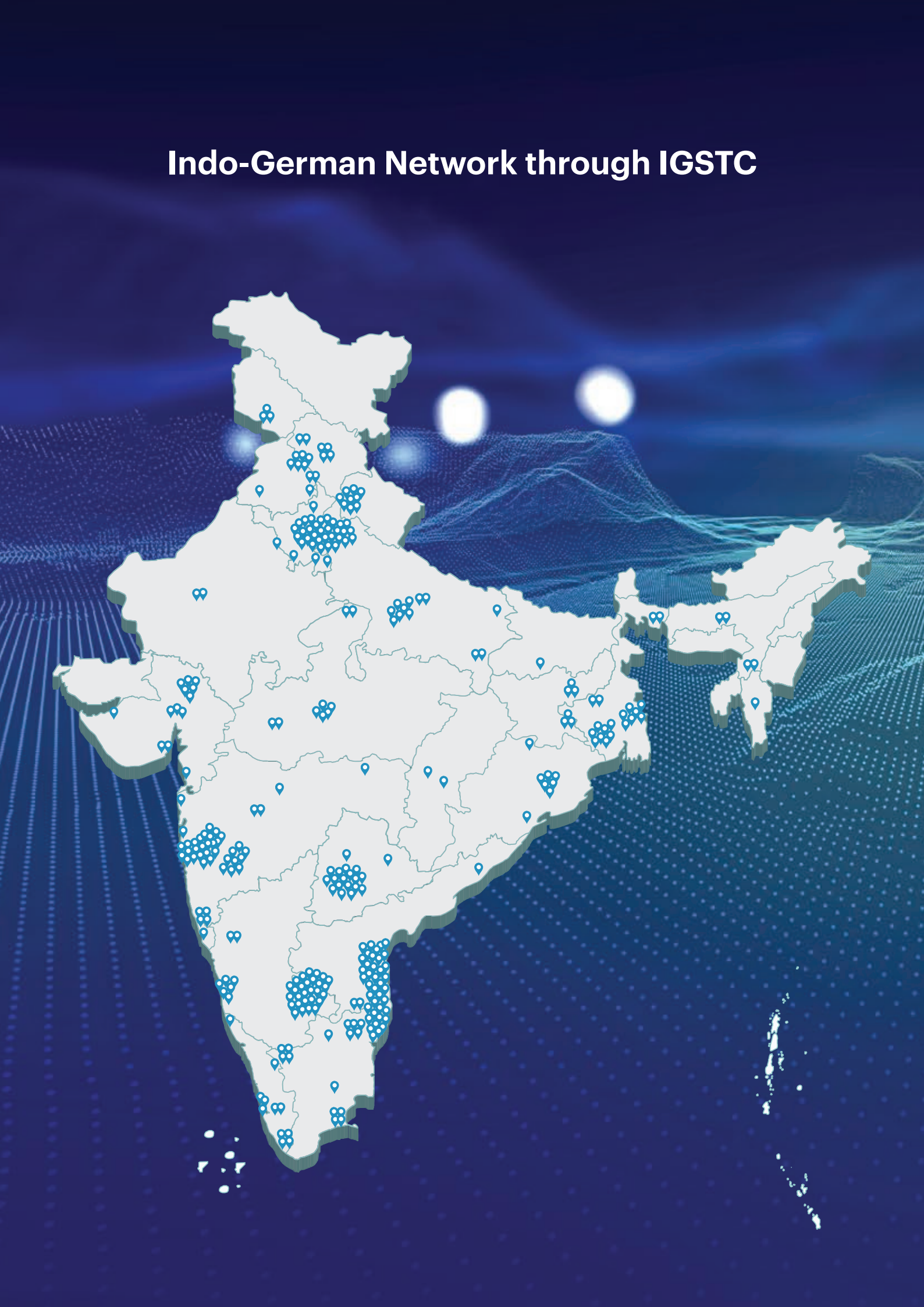
Participants at the IIT Jammu event on 27th September 2024

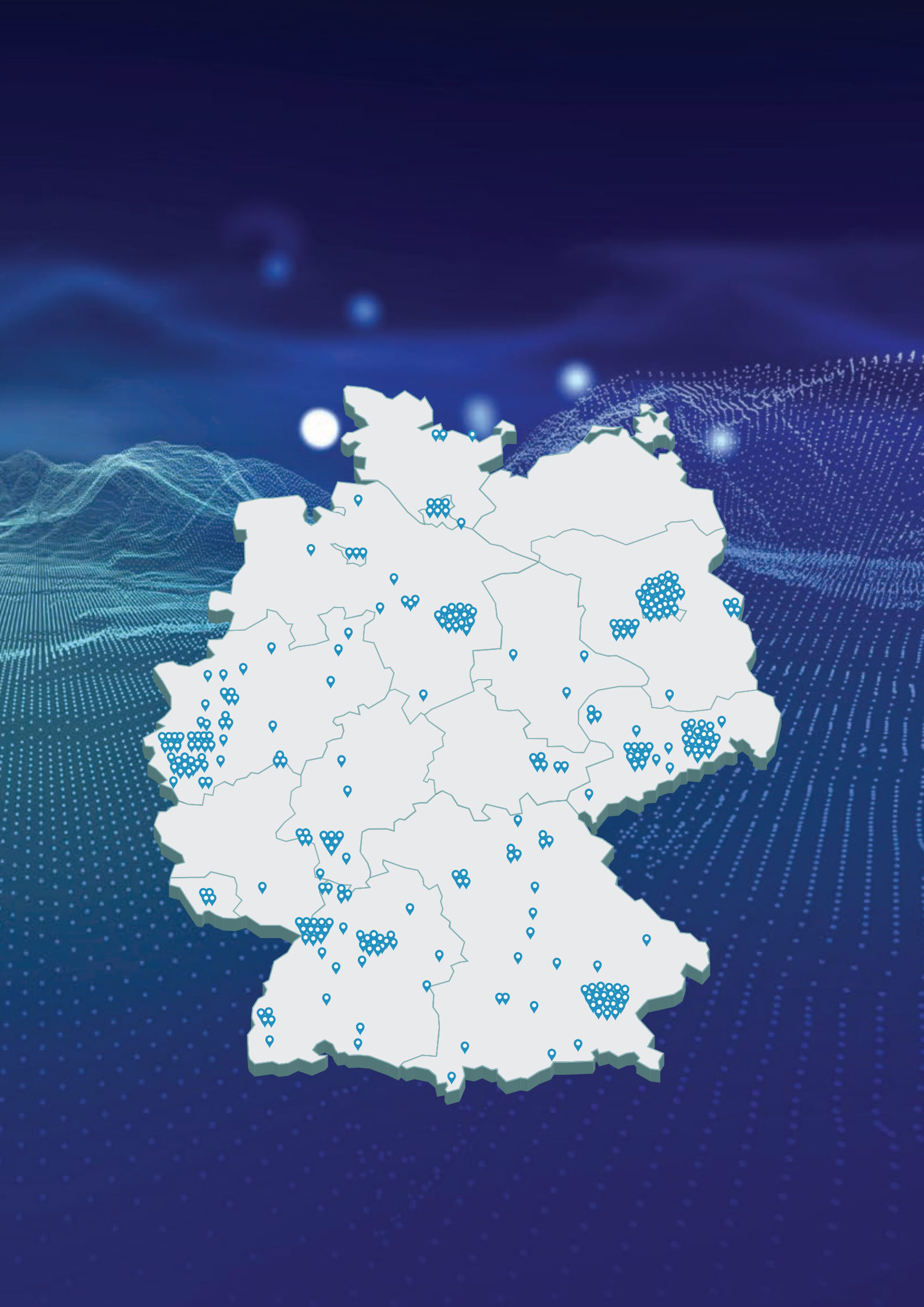




IGSTC team in BAU Fair 2025, Munich, Germany

Indo-German Network through IGSTC





Indo-German Science & Technology Centre

IGSTC Secretariat – India
Indo-German Science & Technology Centre
Ground Floor, Block – II, Technology Bhavan,
New Mehrauli Road, New Delhi – 110016
Phone: +91-011-26543500

German Project Office
German Aerospace Center (DLR-PT)
Project Management Agency
Heinrich-Konen-Str. 1, Bonn- 53227
Phone: +49-228 38211473

info.igstc@igstc.org

company/indo-german-science-tech-centre

@INDOGSTC

IGSTC.IndoGerman

www.igstc.org