
IGSTC
INDO-GERMAN SCIENCE AND TECHNOLOGY CENTRE
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IGSTC
TO CATALYSE INDO-GERMAN
STRATEGIC R&D PARTNERSHIPS

INDEX

VISIT OF GERMAN CHANCELLOR H. E. OLAF SCHOLZ TO INDIA

Hon'ble Prime Minister Modi and H.E. German Chancellor Olaf Scholz (Pic courtesy: Press Information Bureau of India)

IGSTC in Joint Statement between India and Germany

India and Germany share a long history of cooperation in S&T research and innovation, institutionalized under the framework of the Inter-Governmental Agreement on 'Cooperation in Scientific Research and Technological Development' since May 1974. The Joint Statement released after the successful conclusion of German Chancellor H. E. Olaf Scholz's visit to India on 25th February 2023 mentioned IGSTC as one of the key S & T cooperation between the two countries. The statement recognized that academia-industry cooperation is the key to catalyse Indo-German strategic research and development partnerships. India and Germany welcome the progress achieved by the jointly funded Indo-German Science and Technology Centre (IGSTC), under which projects have been supported on national priority areas such as Advanced Manufacturing, Embedded System and ICT, Sustainable Energy/Environment, Biotechnology/Bioeconomy, Bio-Medical Technology/Water and Wastewater Technology and Smart Cities/e-Mobility.

Letter of Intent (LoI) signing by DST India and Fraunhofer ISE

Signing of Letter of Intent (LoI) on Green Hydrogen

On 25th February 2023, Department of Science & Technology (DST) India signed a Letter of Intent (LoI) with Fraunhofer Institute of Solar Energy Systems (FhG-ISE) for a long-term research partnership on hydrogen technologies. The partnership between India and Germany will fulfil the shared goal of decarbonization of economies and collaborate in the areas of energy security and climate protection. The LoI aims to trigger development of higher Technology Readiness Level (TRL) for hydrogen energy clusters established by DST. The LoI was signed by Dr Anita Gupta, Scientist G and Head, Energy Technology Cell, DST India and Prof Dr Christopher Hebling, Director, Division Hydrogen Technologies, Fraunhofer-ISE in presence of Dr S Chandrasekhar, Secretary, DST. Mr R Madhan, Director, Indo-German Science & Technology Centre (IGSTC) and Ms Anandi Iyer, Director, Fraunhofer India were also present.

Fraunhofer delegation at IGSTC Secretariat

GERMAN PARLIAMENTARY DELEGATION VISIT TO IGSTC PROJECT SITE

German Parliamentary Budget Committee at IARI, New Delhi

Inauguration of the new greenhouse at IARI, New Delhi

On 14th February 2023, the distinguished delegation from the German Parliamentary budget committee comprising of Dr Helge Braun, Mr Christian Haase and Mr Sebastian Schafer visited the IGSTC project site at Indian Agricultural Research Institute (IARI) New Delhi. Mr Kaspar Meyer and Mr Dominik Wallau from German Embassy New Delhi were also present.

This visit marked a significant milestone for the ongoing project "Development and evaluation of automated sensors for a highly-efficient nutrition management system in Indoor vertical farming (Sensvert)". The project is a collaborative effort under the IGSTC 2+2 project scheme between IARI, Hochschule Weihenstephan Triesdorf, Hahn-Schickard-Gesellscaft fur angewandte Forschung, Sondermaschinenbau Bruckner GmbH and Barton Breeze P. Ltd.

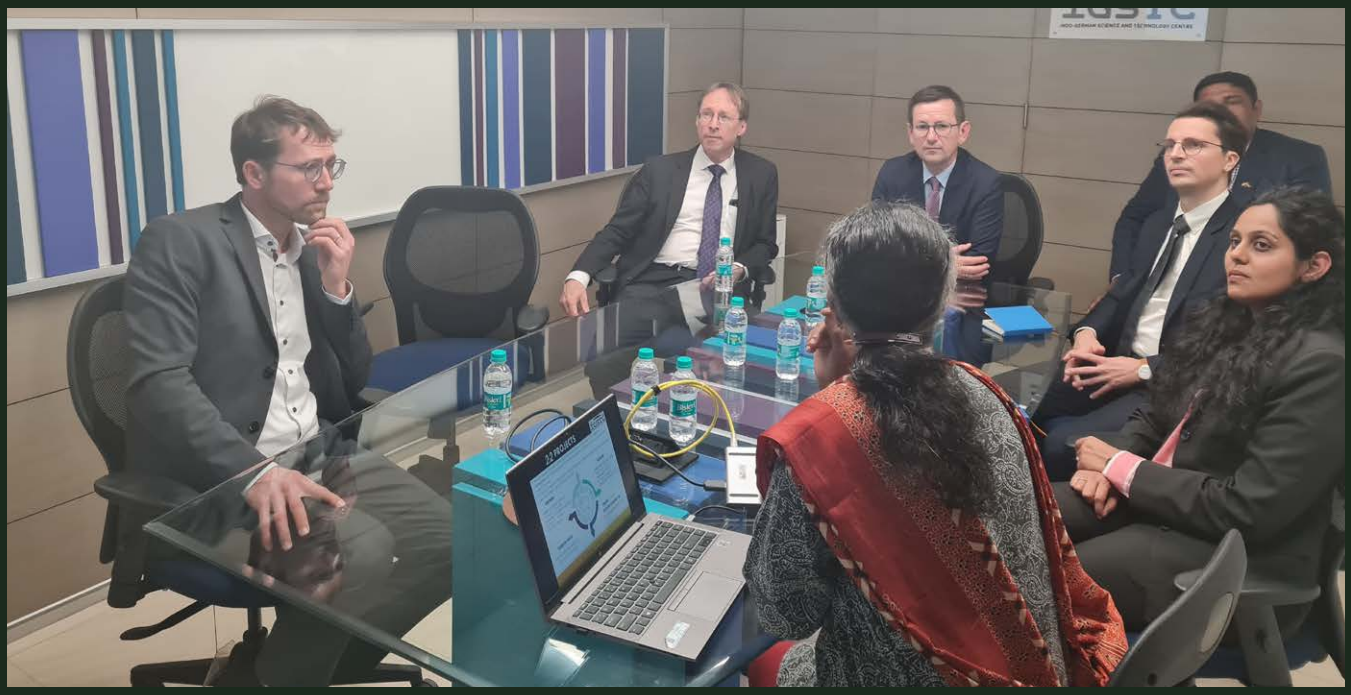
Vertical Hydroponic systems inside greenhouse

The delegation was introduced to the advanced technologies and significant accomplishments of the Sensvert project.

In this event, Dr Helge Braun and Dr Ashok K Singh, Director, IARI inaugurated the newly developed automated greenhouse setup with nutrition and climatic sensor integrated for closed loop monitoring and management.

They appreciated IGSTC for being a wonderful platform for facilitating cutting edge research collaboration on thrust areas for mutual benefit of both the countries.

VISIT OF GERMAN FOREIGN MINISTRY ASIA PACIFIC DIRECTOR TO IGSTC



Deliberations on Indo-German S & T cooperation

A distinguished delegation led by Mr Erik Kurzweil, Director Indo-Pacific, South Asia, Afghanistan, German Foreign Ministry accompanied by Mr Steffen Koch, Head of Economic Section, Mr Kaspar Meyer, German Science Counsellor at the Embassy of the Federal Republic of Germany in India visited IGSTC on 20th March 2023. Dr P. V. Lalitha, Chief Scientific Officer, IGSTC presented a brief summary of IGSTC activities elucidating ongoing S&T cooperation initiatives and highlighting various funding opportunities between the two countrieis. Engaging in fruitful discussions, the delegation and IGSTC explored avenues to expand networking opportunities and further strengthen the bilateral engagement.

VISIT OF EUROPEAN MOLECULAR BIOLOGY ORGANIZATION (EMBO) DELEGATION TO IGSTC

EMBO delegation at IGSTC Secretariat

IGSTC hosted a delegation from European Molecular Biology Organization (EMBO) comprised of Prof Fiona Watt, Director along with Dr Vid Nukala, Senior Community Engagement Officer on 2nd March 2023. The engagement between the EMBO delegation and IGSTC emphasized fostering bilateral research collaborations and creating an ecosystem towards industry-driven innovation.

2+2 PROJECTS

RAMFLICS: Robust additive manufacturing of functional lightweight integrated customisable metallic structures

CO_2BioFeed: CO_2 and biomass as feedstock for the production of fuels and chemical intermediates

Cleanwater: Modular lightweight wastewater treatment units made with TRC for rural and periurban dwellings

Sensvert: Development and evaluation of automated sensors for a highly-efficient nutrition management system in indoor vertical farming

MAMM-WAAM: Multi-axis multi-material wire arc additive manufacturing

Monitoring Meeting of Bioeconomy Projects under Call 2019

RAMFLICS Project Kick-off Meeting

RAMFLICS project team at Hindalco, Mumbai

IGSTC 2+2 project "RAMFLICS: Robust additive manufacturing of functional lightweight integrated customisable metallic structures" aims to develop a concept of hybrid manufacturing to enhance the functionality of a conventionally made part / component by adding customized features using wire arc additive manufacturing (WAAM) with a focus on modification of large-scale industrial parts. The technique will also enable the addition of customized lightweight functional features of complex shapes such as fins and flanges, webs and ribs, thin-walled stiffeners and of alloys to the contemporary industrial components such as motor casing and battery enclosures for electrical vehicles.

The consortium consists of six (6) partners Indian Partners - Prof Amitava De from IIT Bombay, Dr Murugaiyan Amirthalingam from IIT Madras, Dr Gautam Wagle from Hindalco Industries Ltd.; German Partners -Dr Max Biegler from Fraunhofer IPK, Prof Sven Goeche from Technische Hochschule Brandenburg and Mr Georg Fischer from Gefertec GmbH.

The RAMFLICS team organised project kick off meeting on 4th January 2023 at Hindalco Industries Ltd. The consortium members presented their ideas on materials/ feedstock compositions, equipment procurement and installation, defects detection, diagnostics and predictions and industry readiness. Dr Wagle from Hindalco Industries presented their vision on the hybrid manufacturing of motor casings and their preliminary efforts towards economic viability, cost comparison, suitability of feedstock and possible commercialisation.

RAMFLICS team at the kick-off meeting

CO_2BIOFEED

International workshop on CO_2 and biomass as feedstock for the production of fuels and chemical intermediates

Participants of the Workshop

The IGSTC 2+2 project CO_2BioFeed aims to develop a sustainable process to convert CO2 & biomass along with lower olefins derived from the renewable sources into value-added intermediates. The key approach of this project is to use CO_2 as oxidant for the epoxidation of lower alkenes generating CO as valuable by-product, and as carboxylation agent for the C-H bond of lower alkenes generating acrylic acid.

The project consortium is comprised with Prof Asim Bhaumik, IACS Kolkata, Prof Biswajit Chowdhury, IIT (ISM) Dhanbad, Dr Pravin Chinthala, Reliance Industries Ltd from Indian side. The German side of the partnership includes Prof Thomas Ernst Müller from Ruhr-Universität Bochum, Mr. Jens Hannes from RWE Power Aktiengesellschaft in Essen, and Mr. Gernot Nell from Parr Instrument GmbH in Frankfurt.

The CO_2BioFeed consortium organized a one-day hybrid International Workshop on "CO_2 and biomass as feedstock for the production of fuels and chemical intermediates" funded by IGSTC at IIT(ISM) Dhanbad on 23rd January 2023.

The one-day workshop was scheduled with two distinct sessions. During the first session, Mr R. Madhan, the Director of IGSTC, delivered the inaugural talk through virtual mode. Prof. Rajiv Sekhar, Director, IIT (ISM) Dhanbad spoke on CO_2 utility for use as fuels. He also mentioned about the initiative of establishing a dedicated development centre for carrying out such research at IIT (ISM) Dhanbad.

The second session involved specialised presentation by the partners showing recent developments in the project.

Dr P V Lalitha, Chief Scientific Officer, IGSTC presented a brief on bilateral opportunities and programmes at IGSTC. The inaugural session also witnessed the presentation from Prof Thomas Ernst Muller from Ruhr-Universität Bochum, on "Decarbonising the chemical industry-from catalyst to process and assessment" from sustainability and industry perspective.

The workshop was participated by students, faculty members, industry delegates and other relevant stakeholders from all parts of India.

Inaugural speech by Prof. Rajiv Sekhar, Director, IIT (ISM) Dhanbad

Dr P V Lalitha presenting bilateral funding opportunities at IGSTC

CLEANWATER

Textile Reinforced Concrete (TRC) Workshop

CleanWater team at the TRC workshop, IIT Madras

An international workshop on the Advances in TRC, the new-generation cementitious composite that uses textile fibre as continuous reinforcement to enhance the bearing capacity and ductility in concrete, was conducted on 3rd February 2023 at IIT Madras. This workshop was a part of the "Technologies for low-carbon lean construction week (TLC2)", and was coordinated by Prof Ravindra Gettu, Project Investigator of CleanWater project and Dr Keerthana Kirupakaran from the Department of Civil Engineering, IIT Madras.

Wastewater Treatment (WT) is an essential prerequisite for most rural and periurban regions of developing countries. Currently, major cities don't have access to a large-scale wastewater treatment plant, because of its size, space, transportation and large power supply requirement. Alternatively, septic tanks or soak pits are used in many regions that could be replaced with modular and lightweight WT units, which are easy to transport and handle in hard-to-reach locations. To address the problem, IGSTC 2+2 project "Modular

Ms Goezdem Dittel presenting the outcomes of IGSTC funded CleanWater project

lightweight wastewater treatment units made with TRC for rural and periurban dwellings (CleanWater)" aims to develop a lightweight, modular high-strength WTP made with Textile Reinforced Concrete (TRC).

Ms Goezdem Dittel and Ms Kira Heins from ITA-RWTH Aachen University, Germany discussed about the fabrication of textiles and gave insights into different technologies used to automate the fabrication with different weave types and highlighted the challenges and associated scope. Dr Smitha Gopinath from CSIR-SERC, Chennai, stressed upon a wide range of different applications of TRC prefabricated elements. The TRC workshop was concluded by the presentation of Dr Rupak Bhattacharya where he explained several existing bilateral funding opportunities at IGSTC for establishing long term Indo-German research collaboration and networking.

Overall, starting from glass textiles to textile fabrication process to tailoring the matrices and binders of TRC to its mechanical characterization to different applications, the workshop showcased an overview of TRC from cradle to grave.

SENSVERT PROJECT

Consortium meeting and workshop on smart vertical farming

Workshop participants at IARI, New Delhi

IGSTC 2+2 project on "Development and evaluation of automated sensors for a highly-efficient nutrition management system in indoor vertical farming (Sensvert)" deals with efficient control on major and micronutrient management for successful vertical farming though specially designed sensors.

These sensors are required for precise measurement, control and supply of nutrition (NPK, Ca, Mg) to the plants along with maintaining EC and pH in fertigation management through IoT and close loop systems. The project is partnered by two Indian partners i.e Dr Murtaza Hasan, Indian Agricultural research Institute (IARI), Mr Shivendra Singh, Barton Breeze P. Ltd, along with three German partners i.e. Prof Heike Mempel, Hochschule Weihenstephan-Triesdorf (HSWT), Mr Mohamed Bourouah, Hahn-Schickard-Gesellschaft für angewandte Forschung and Mr Georg Brückner, Sondermaschinenbau Brückner GmbH.

German project partners viz. Mr Markus Abel (HSWT) and Mr Mohamed Borouah (Hahn-Sickhard) visited ICAR-IARI during 2-9 March 2023. The project partners held a consortium meeting at IARI for evaluating the progress of the project. During their research stay, German partners also visited Kisan Mela, Centre for Protected Cultivation Technology, IARI and Barton Breeze, Gurugram.

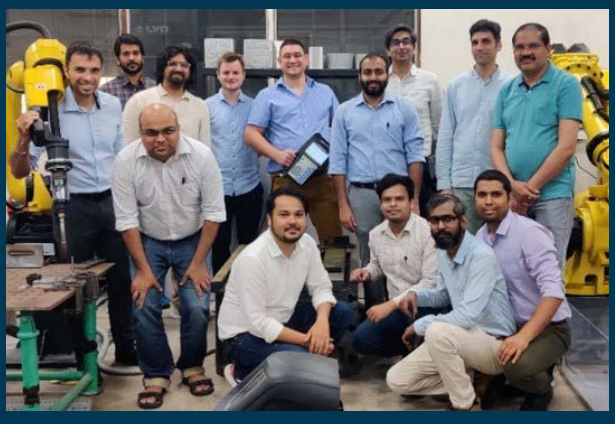
The German project partners also participated in one day workshop held on "Smart Vertical Farming Technology" held at ICAR-IARI, New Delhi on 6th March 2023. Various experts in hydroponic and smart urban farming field participated in the workshop and thoroughly discussed the challenges and advances in smart vertical farming technologies.

MAMM-WAAM

Project Consortium Meeting at IIT Guwahati

MAMM-WAAM team members at IIT Guwahati Campus

The MAMM-WAAM consortium organised their fourth in-person meet at IIT Guwahati during 21st to 24th March 2023. Multi-Axis multi-material wire arc additive manufacturing (MAMM-WAAM) is an Additive Manufacturing (AM) technique which can efficiently fabricate large-size metallic objects (up to 2m*2m*1m) of Functionally Graded Materials (FGMs). It is a hybrid robot cell consisting of two multi-wire plasma welding torches attached to two 6-axis robotic arms mounted on curved/linear tracks and a 6-axis robotic arm for machining the near-net shapes. The project is partnered by Dr Sajan Kapil, IIT Guwahati, Dr Mohit Law, IIT Kanpur and Dr Vishwas Puttige, Ace Manufacturing Systems Ltd (AMS), Bangalore from Indian side and Mr Rahul Sharma, RWTH Aachen University & Dr Denys Plakhotnik, ModuleWorks GmbH from German side.



Project team at the additive manufacturing laboratory, IIT Guwahati

The team members had a detailed discussion on the progress made so far, reviewed the targets achieved, and brainstormed the difficulties individual partners faced. A few IITK team members stayed for longer period and worked with the IIT Guwahati team to have hand-on-experience in operating Robotic Arms.

This visit was primarily to have a detailed discussion among IIT Guwahati and AMS Bangalore members to discuss the integration-related challenges associated with the MAMM-WAAM system.

PROJECT MONITORING

Meeting of Bioeconomy projects under Call 2019

Project Monitoring Meeting at IGSTC Secretariat

IGSTC organised Project Monitoring Meeting for the following four projects of Call 2019 on 26th April 2023 at New Delhi.

AutoNutri: The project aims to develop an on-site multi-ion monitoring system for automated on-line control of nutrient input in vertical hydroculture systems with closed circulation systems based on feedback-controlled supply of nutrients.

NOMIS: The project targets to address the challenge of detecting excessive presence of fertilisers and pesticides by developing an efficient multiplexed device for the detection of nitrate (a major fertilizer-based soil/ground water contaminant in India and Germany) and organophosphates (a class of pesticides) in soil samples.

Sensvert: The project aims to develop a sensor platform for acquiring major nutrients like nitrogen, phosphorous, potassium, calcium and magnesium by using ion-selective-electrodes (ISE), ion-sensitive field-effect transistor (ISFET) and a photometric in-line system for vertical farming hydroponic systems.

CirCulTex: The project aims at the development of a re-useable textile cultivation substrate following a plant performance-based approach for soilless urban cultivation systems.

BILATERAL WORKSHOPS

BIODENT: Biomaterials and implants for dental, cranio- maxillofacial reconstruction and bone regeneration

Aquasmart: Water conserved organic food production through climate smart carbon neutral aquaculture

DEEPT-2023: Indo-German Workshop on Development in established and emerging photovoltaic technologies

BIODENT

Biomaterials and implants for dental, cranio- maxillofacial reconstruction and bone regeneration

Participants at the workshop

As the life expectancy of humans is increasing there is a special need for medical support to the aging population which is more susceptible to accidental bone fractures and musculoskeletal disorders. But, providing solutions to such bone-related medical conditions is much more than an engineering challenge. Synthetic biomaterials (designed specifically for the anatomy of the patient) should not only match the properties of the natural bones but must also be accepted by the body. This requires scientists to discover the appropriate materials, biologists to understand biocompatibility, and medical doctors to validate through clinical trials for effective translational research. Keeping the above directives in mind and building upon the learnings of the previous workshop, an IGSTC-sponsored workshop **"Design and manufacturing of biomaterials and implants for dental, cranio-maxillofacial reconstruction and bone regeneration"** was held during February 13-15, 2023 at Institute of Biomaterials, University of Erlangen-Nuremberg, Germany. The workshop was coordinated by Prof. Bikramjit Basu, IISc Bangalore and Prof. Aldo Boccacini, University of Erlangen. This symposium involved the active participation of clinicians, scientists, and industry representatives. The objective of the symposium was to integrate state-of-the-art manufacturing technologies with the scientific understanding

of biomaterials and implants and their transition to clinical trials. The symposium also incentivized Indo-German joint research venture and collaboration among the participants to scale up the production and commercialization of the undergoing innovations in the respective labs.
In line with the objective of the symposium, the proceedings were distributed over 3 days and categorized under 11 technical sessions, each of which consisted of 3-4 speakers with a total of 35 presentations. The Indian delegation had representatives from academia, medical schools, hospitals, and industry including IISc (Bangalore), IIT Kanpur, IIT BHU, King George Medical College, Ramaiah University, Jaslok Hospital, and Ceramat Pvt. Ltd (a Tata Steel Enterprise). The German contingent consisted of speakers from universities and hospitals spread over Germany such as Dresden, Erlangen-Nuremberg, Frankfurt, Heidelberg, Cologne, Würzburg, Mainz, Potsdam, Bremen, and Berlin.

Inaugural session of the Workshop

AQUASMART

Water conserved organic food production through climate smart carbon neutral aquaculture

Participants at the workshop

The Indo-German Workshop on "AQUASMART: Water-conserved organic food production through climate-smart carbon-neutral aquaculture" was organized by the Kerala University of Fisheries and Ocean Studies (KUFOS) in association with Ludwig-Maximilian University of Munich (LMU), Germany. The event took place in Kochi from March 2nd to 4th , 2023, and aimed to bring together experts from various fields to explore sustainable aquaculture and elucidate its role in climate-smart, water-resilient food production systems.

The workshop focused on a wide range of topics, including sustainable aquaculture practices, stakeholder responsibilities, the transition from current aquaculture practices to future smart production methods, energy and water conservation in food production, environmental protection, competition for space and user conflicts, bio security, food safety, antibiotic residues, seafood contamination, green technologies, alternative energy sources, organic food production, and social aspects related to aquaculture.
The workshop attracted researchers and entrepreneurs from India and Germany.
A total of 12 German participants and 17 Indian participants came together under the thematic title of "Clean and Green Technology." One aquaculture technocrat from Ecuador gave a special presentation as a guest faculty.

The event featured 36 presentations, two panel discussions, and a field trip, covering topics such as energy and water conservation, technological costs of production, the impact of high-water footprints, food safety and food security issues.

The workshop yielded several key recommendations, including the importance of collaboration in scientific and feasibility studies, the integration of knowledge transfer to farming communities for more sustainable production practices, support for achieving Net Zero in Aquaculture, and the joint development of low-tech, cost-effective Integrated Multi-Trophic Aquaculture (IMTA) systems using local species. The participants also emphasized the need to rethink the sustainability of mass production, focusing on local production for local needs.

The workshop was coordinated by Prof Dinesh Kaippilly from KUFOS and Prof Dušan Palić from LMU. The inaugural ceremony was attended by Mr R. Madhan, Director, IGSTC along with Prof Rosalind George, the Vice-Chancellor and Prof Manoj Kumar, Registrar of KUFOS.

The workshop participants proposed various collaborative activities, including faculty and scientific staff exchanges, sharing of documentary resources, twinning programs for undergraduate and postgraduate students, sponsorship of international workshops and seminars, joint technical-assisted activities and research programs, the establishment of academic chairs to strengthen cultural and scientific relations between KUFOS and LMU, and the encouragement of technical collaboration between the two institutions.

Overall, the Indo-German Workshop on "AQUASMART" provided an invaluable platform for knowledge exchange, fostering collaborations, and advancing sustainable practices in aquaculture for water- conserved organic food production with a climate-smart and carbon-neutral perspective.

DEEPT-2023

Indo-German Workshop on developments in established and emerging photovoltaic technologies

Participants at the workshop

The Indo-German Workshop on "Developments in established and emerging photovoltaic technologies (DEEPT) – 2023" was successfully held during 13th-15th March 2023 at SRM Institute of Science & Technology (IST), Kattankulathur. The workshop brought together scientists and industrialists from India and Germany, facilitating an exchange of ideas and solutions in the field of photovoltaic technologies.

The workshop was coordinated by Dr Malar Piraviperumal from the Department of Physics and Nanotechnology, SRM IST, Chennai, India, and Prof. Sanjay Mathur, Director of the Institute of Inorganic Chemistry, University of Cologne, Germany. It showcased the implementation of new knowledge and material technologies in photovoltaics.

The scientific program spanned over three days and featured lectures and discussions by renowned Indian and German scientists. Topics covered a wide range of aspects, including established silicon PVs, emerging materials like hybrid perovskites, and tandem technologies that integrate new materials with existing solutions.

A significant focus of DEEPT - 2023 was on exploring materials circularity in energy transitions, highlighting both challenges and opportunities in PV module recycling. The workshop also highlighted the importance of international collaboration in emerging technologies to address the United Nations Sustainable Development Goals (UN-SDGs).

Industry partners and national laboratories made valuable contributions to the workshop, presenting innovative approaches to greener materials and the development of new products. The exchange of information on current status and emerging trends fostered a deeper understanding on technological potential.

DEEPT - 2023 served as a platform for networking and fruitful discussions among Indian and German participants. It paved the way for potential research collaborations and advancements in photovoltaic technologies, contributing to the global energy transition.

INDUSTRIAL FELLOWSHIP

Mritunjay Hiremath

Ayush Tara

Ekta Singh Shrinet

Ruchika

Sai Teja Kuchipudi

Ramakanth Dakuri

Rakesh Kumar Dhritlahre

Akhila Konala

MRITUNJAY HIREMATH

Analysing microcracks in glass fibre composites

Mritunjay at Carl Zeiss Microscopy Lab

Mritunjay Hiremath is a Doctoral student in Mechanical Engineering at IIT Bombay, working in the field of microstructural damage in glass fibre composites. The main focus of his work is to develop a mathematical framework to describe the microstructural damage in fibre composites. Mritunjay has been recently awarded the IGSTC-PIEF fellowship to carry out research work at Carl Zeiss Microscopy AG, oberkochen, Germany. At Carl Zeiss, the research is undertaken to experimentally quantify the microstructural damage using stochastic geometry and compare it with direct observations.

Through the IGSTC fellowship, he intends to assess innovative ways of acquiring 2D and 3D microstructural images. Before proceeding to any sectional 2D imaging, one must have a broad 3D understanding of the location and distribution of microcracks present in the fibre composites. Considering this, all the cyclically loaded fibre composite samples were scanned for non-destructive tomography scans. For any microstructural-based characterization, it is of utmost importance to have a properly prepared sample for imaging purposes. To analyze any potential damage, the sample preparation process involves slicing,

mounting, and polishing.
The resulting 2D data is then examined for the presence of damage. Utilizing the principles of stereology, an unbiased estimate of the damage vector can be determined from the 2D images, which is an outcome of stochastic geometry. This 2D data is then compared with directly obtained 3D tomographic data.

The international team at Carl Zeiss consists of individuals with diverse cultural backgrounds. Numerous students from all over the world are currently interning at the organization. Mritunjay expressed his happiness for the opportunity provided by IGSTC to work in such a culturally diverse setting with a variety of scientific activities and research fields.

Mritunjay at Carl Zeiss Microscopy Lab

AYUSH TARA

Advancing solar energy: new perovskite solar cells and materials

Ayush at HySPRINT Innovation Lab, Berlin

Ayush Tara is a PhD student at the Department of Electronics, University of Jammu, Jammu and a visiting research scholar in IIT Bombay under Photovoltaic User Mentorship Program, funded by National Centre for Photovoltic Research and Education (NCPRE), Ministry of New and Renewable Energy, Government of India. He is working on perovskite solar cells, the next generation photovoltaics at the HySPRINT Innovation Lab, Berlin as an IGSTC PhD Industrial Exposure Fellowship (PIEF) awardee.

Perovskite solar cells are promising candidates for creating solar panels that could be easily deposited onto most surfaces, including flexible and textured ones. These materials would also be lightweight, cheap to produce, and as efficient as today's leading photovoltaic materials, which is predominantly silicon based. Till now, mostly researchers have developed perovskite solar cells through the spin coating method, which is good for studying lab-scale devices, but it can't scale perovskite solar cells.

Therefore, for the commercialization of perovskite solar cells, shifting to more industrial based deposition methods is the relevant option, which mainly includes: Inkjet printing and Slot die coating. Mr Ayush is developing tin-lead based perovskite solar cells through inkjet printing, which includes conventional and combinatorial inkjet printing. His study focuses on the bandgap tuning of the perovskite and its further optimization, followed by the development of efficient perovskite solar cell devices through inkjet printing. Also, Mr Ayush is developing novel metal oxides that can be further employed as an electron transport layer in efficient perovskite solar cells for an enhanced performance.

The research at the HySPRINT Innovation Lab, headed by Prof. Eva Unger, mainly revolves around scalable solution-based manufacturing techniques for hybrid materials. Main focus areas of the research group include precursor ink design, rationalization and solution chemistry, in-situ monitoring during processing (using optical and X-ray based characterization techniques), device and module prototype manufacturing, optimization and high-throughput combinatorial materials synthesis, exploration of hybrid perovskites for alternative applications and the perovskite database.

The research group in the HySPRINT Innovation Lab is culturally diverse and includes researchers from India, Brazil, Colombia, Sweden, and China. Mr Ayush is considered himself privileged to work with such a prestigious research group through IGSTC Industrial Fellowship, which gave him the opportunity to explore various scientific questions.

EKTA SINGH SHRINET

Cooling down electric vehicles: the significance of battery thermal management systems

Ekta at Fraunhofer Institute for Solar Energy Systems (ISE)

Ms Ekta Singh Shrinet is a PhD student at the Department of Energy Science and Engineering, IIT Bombay. Her research focuses on the study of renewable energy storage systems under supervision of her PhD advisor, Prof. Lalit Kumar. She is currently a visiting PhD researcher at Fraunhofer Institute for Solar Energy Systems (ISE) under the supervision of Dr. Nina Kevlishvili through PhD Industrial Exposure Fellowship (PIEF) offered by the Indo-German Science and Technology Centre (IGSTC). As an IGSTC fellow she planned to have a holistic approach towards battery storage systems in an international industrial R & D environment. This fellowship aids in developing relationships for potential future collaboration as well as learning the methodology used at some cutting-edge locations.

At her host institution, she is studying battery thermal management systems of Electric Vehicles (EVs). She has been involved in thermal and electrical characterisation of the Lithium-ion battery. The facilities at Fraunhofer ISE were very helpful for learning new aspects of her research area related to computational or experimental work. The objective of the project was to decrease the maximum temperature of the battery by finding the hottest position in the battery module and eliminate it with the help of experimental and numerical analysis.

RUCHIKA

Novel rapid tests for viral and bacterial infections

Ruchika at LIONEX GmbH, Braunschweig

Ruchika is a doctoral researcher at CSIR-Institute of Himalayan Bioresource Technology (CSIR-IHBT) in Palampur, Himachal Pradesh. She received the information on IGSTC-PhD Industrial Exposure Fellowship from her supervisor, Dr Ankit Saneja, which led her to apply for the program. Ruchika was selected for the program and worked with LIONEX GmbH in Braunschweig, Germany.

During her fellowship at LIONEX, Ruchika worked on an interesting project titled "Development of novel rapid tests for differential diagnosis of bacterial and viral infections" under the guidance of Prof. Mahavir Singh and his team. She was able to purify antibodies against MxB antigen and develop a preliminary diagnostic kit. Her work will be further pursued by LIONEX, and it is expected to yield fruitful results.

Ruchika learned several new techniques, including hybridoma cell production, microbiology, product development, and development of diagnostic kits.

Apart from her research work, Ruchika was impressed by the work culture of industries in Germany. She found Germany to be a beautiful place for exploring natural places, such as Brocken Mountain in Lower Saxony and Dresden. She also found the people in Germany to be friendly and always ready to help.

Ruchika would like to express her gratitude to IGSTC for providing such an excellent opportunity to PhD and post-doctoral fellows. She believes that this is a wonderful platform for young researchers like her to expand the horizons of their knowledge and establish international collaborations at this phase of their research career.

Ruchika with LIONEX team

SAI TEJA KUCHIPUDI

Imaging of cracks in concrete structures

Sai Teja Kuchipudi is a Doctoral student, supervised by Dr. Debdutta Ghosh at CSIR-Central Building Research Institute (CSIR-CBRI), Roorkee, India. His research focuses on "Development of multiwave based Nondestructive imaging techniques for damage detection in concrete structures".

Through IGSTC- PhD Industrial Exposure Fellowship, he got an opportunity to work at the Fraunhofer Institute for Nondestructive Testing (IZFP), Saarbrücken. Fraunhofer IZFP is a leading industry-oriented research institute with a focus on developing cognitive sensor technologies for NDT of materials and structures. His mentor Prof Ute Rabe is a Chief Scientist and heads a Center of Expertise for Sensor-based Solutions & Applications at the IZFP.

During the tenure, his objective was to develop imaging techniques for detection and characterization of surface-breaking cracks in reinforced concrete structures. He primarily worked with programming an algorithm to extract meaningful insights out of the ultrasonic wave response from the defective concrete elements. This contribution strengthens the existing Structural Health Monitoring techniques to better understand the invisible,

internal defect patterns in members of the concrete structures without the need of any reference data from the past and create a practical impact by identifying probable defective areas and estimating their extent of damage in critical structures like the public infrastructure. Appropriate early-stage repairs could be devised in the identified regions to prevent catastrophic structural failures.

During the stay at IZFP, he had the opportunity to be a part of a multi-national team which broadened his perspectives with ideas coming to the table from different angles. Apart from the exposure to diverse European cultures, he was particularly fascinated by the 'German Precision' in everything. Overall, the fellowship has been an enriching experience encouraging him to be adaptable & stay relevant.

Sai with his host Prof. Ing- Ute Rabe

RAMAKANTH DAKURI

Building sustainable packaging for food products

Ramakanth at envoPAP Deutschland

Ramakanth Dakuri is a Ph.D. student at the Department of Polymer and Process Engineering, Indian Institute of Technology (IIT) Roorkee (Saharanpur Campus). Under the supervision of Prof. Pradip K Maji & Prof. Kirtiraj K Gaikwad, his research work focuses on improving food product's shelf life using active packaging technologies. In 2022, Ramakanth was awarded the IGSTC PhD Industrial Exposure Fellowship (PIEF), which enabled him to join envoPAP Deutschland, a sustainable materials company located in Frankfurt, Germany.

At envoPAP Deutschland, Mr Ramakanth worked on developing an agricultural waste-based paper or paper board that can be coated using biobased active barrier materials to enhance the shelf life and quality of food products. While the development of such a product is relatively straightforward, dealing with the post-consumption processes such as recyclability, biodegradability, and compostability is a challenge. Defining the end of the life cycle at the inception stage is crucial as the presence of coating materials or coating layers makes it difficult to recycle the base paper.

Ramakanth is impressed with the working culture in Germany, particularly when working with German natives, as he learned how to deal with multicultural aspects. The honesty, planning, proactiveness, and utilization of technology make Germans the most trusted people worldwide, he believes. Ramakanth plans to continue the networking with the industry in future.

RAKESH KUMAR DHRITLAHRE

Precision drug delivery using nanoparticles

Rakesh in DendoPharm

Rakesh Kumar Dhritlahre is an IGSTC PhD Industrial Exposure Fellow (PIEF) at DendroPharm GmbH, Berlin under the supervision of Dr. Sam Dylan Moré. Before joining DendroPharm, he spent three years working under the guidance of Dr. Ankit Saneja (scientist) at CSIR-Institute of Himalayan Bioresource & Technology (CSIR-IHBT) in India. His research work at CSIR-IHBT is focused on the development of nano formulation strategies such as Self-Emulsifying Drug Delivery Systems (SEDDS) and polymer/small molecular conjugates to augment the aqueous solubility, bioavailability, and therapeutic efficacy of nutraceuticals.

DendroPharm is dedicated to the development of safe and efficient dendritic core-multishell nanocarriers that can enhance the solubility and bioavailability of drugs. At DendroPharm, Mr Rakesh is working on DendroSol, an amphiphilic nanocarrier for safe and efficient transdermal drug delivery with minimal damage to the natural barrier function of the skin. This innovation promises to overcome the patient complications associated with enteral and parenteral route of drug administration, making it a highly promising avenue of research. His work at DendroPharm also involves the production of ointments for the topical delivery of therapeutics.

Rakesh Kumar Dhritlahre has expressed his gratitude for the cultural and academic diversity he has experienced during his fellowship at DendroPharm, thus acknowledging it as a valuable asset for his future career. His work has resulted in two promising offers, one from DendroPharm itself as a permanent employee, and another from Dr. Ling PENG, Director of the Interdisciplinary Centre of Nanoscience in Marseille, Aix-Marseille University in France, as a Post-Doctoral Fellow (PDF).

AKHILA KONALA

Developing sustainable smart food packaging.

Ms Konala (left) with her host Mr Stephan Gutowski(centre) and Mr Dakuri (right) at envoPAP

Akhila Konala is a PhD scholar from the Department of Paper Technology at IIT Roorkee. In her PhD under the supervision of Prof. Kirtiraj K. Gaikwad, she was focusing on sustainable smart food packaging. Akhila is proud to be awarded the prestigious IGSTC PhD Industrial Exposure Fellowship for the year 2022. Under the fellowship, she is working with "envoPAP Deutschland" for a period of 6 months to develop a sustainable barrier coatings for paper packaging applications.

IGSTC has provided her a platform to work and learn with an industry that has its base in Germany. The fellowship is a great way to closely observe the real-life technical problems that an industry is facing and the way of solving them. Specifically in her area of research, commercialization can be quite a challenge as it involves dealing with recycling of paper, sustainable sourcing and efficient performance. All of them were simple when dealt with at the lab scale, but a bigger picture is seen only in industries. As a technology enthusiast, she found Germany an appropriate country to explore new available technologies and learn about recent advancements.

Apart from all the research during the fellowship, she got a good chance to explore the German culture which was fascinating. She learnt how a disciplined and punctual individual makes a better version of themselves while working with fellow Germans. Last but not the least, she has become a huge fan of German cuisine.

She highly recommends fellow PhD students to take this opportunity to gain experience in industrial research and build international professional relations.

PAIRED EARLY CAREER FELLOWSHIP IN APPLIED RESEARCH (PECFAR)

Exploring biochemical stabilization techniques for tailing materials

Advancement in intelligent neuroprosthetics

Exploring translational therapeutics for gastroenterological disorders

EXPLORING BIOCHEMICAL STABILIZATION TECHNIQUES FOR TAILING MATERIALS

Ms Ana Paula Ribera

Ms Ribera obtained her Diploma in Civil Engineering from the Universidad Tecnológica Nacional in Rosario, Argentina, and completed a semester exchange program at Karlsruhe Institute of Technology (KIT) in Germany. She had also pursued a Masters degree in Geotechnics at the Universidad Nacional de Córdoba in Argentina, and gained over five years of professional experience working with foundations and retaining structures.

Recently, Ms. Ribera has received the IGSTC-Paired Early Career Fellowship in Applied Research (PECFAR). Under this fellowship, she is collaborating with Dr Surabhi Jain from the Indian Institute of Technology (IIT-ISM), Dhanbad, on a research project aimed at investigating the mechanical behavior of tailings before and after biochemical modification, and the impact of the modification on mitigating the failure mechanism. She intends to work on the engineering characterization of tailings materials (pond ash) before and after bio/chemical stabilization. The geotechnical engineering group at IIT-ISM Dhanbad is known for its strength in the characterization of various industrial wastes, including different tailings, and utilizing them after various bio/chemical treatment processes.

She is involved in characterising the basic physical and geotechnical properties related to compaction, consolidation, and strength behavior of the tailings through experimental investigation using oedometric and triaxial testing for analyzing their morphological, mineralogical, and chemical properties using advanced characterization techniques such as X-ray Powder Diffraction and X-ray Fluorescence Spectroscopy. The tailings are then stabilized by injecting various concentrations of urease enzyme and cementation reagents for biochemical stabilization to evaluate the effect and amount of calcite precipitation in the samples. The same tests are conducted on the cemented material. The shear behavior of virgin and bio/chemical modified tailings is evaluated by determining the critical state condition, liquefaction potential, and shear strength through drained and undrained situations and with static loads.

Ms Ribera is grateful for the IGSTC PECFAR Fellowship that gave her the opportunity to work in a nurturing and positive environment at IIT-ISM Dhanbad, where she worked interdisciplinary with Dr Surabhi and gained a different insight into possible solutions for the problems associated with tailing storage facilities worldwide. The experience of cultural exchange was enriching and enjoyable, as India is a vast country with a welcoming community, diverse cultures, and varied regional attractions that make the learning experience unique.

ADVANCEMENT IN INTELLIGENT NEUROPROSTHETICS

Dr Amartya Ganguly

Dr. Ganguly graduated from The University of Hull, United Kingdom with a PhD in Engineering with a focus on human postural balance with respect to ankle joint stability. He subsequently joined as a postdoctoral research associate at Keele University, where he was part of a team of British scientists who developed the leading real-time neuromusculoskeletal model of the human hand with proprioceptive models in user-in-loop scenarios. He was selected for the Horizon 2020 Innosup programme, where he worked as an Innovation Associate at Marsi Bionics, testing the world's first paediatric exoskeleton and also built a state-of-the-art Biomechanics laboratory in conjunction with CSIC-CAR Madrid. He has worked on developing hand models for clinical use cases through the EIT Health project, a partnership with the University of Heidelberg, INRIA, University of Montpellier, CNRS, Montpellier, France. He has extensive experience in neuro-musculoskeletal modelling, CE certification of medical devices, wearable assistive devices and clinical trials.

He is currently employed as a Senior Scientist, leading the Intelligent Neuroprosthetics research group at the Munich Institute of Robotics and Machine Intelligence (MIRMI), Technical University of Munich, Germany. His research includes the development of upper limb prostheses while discerning fundamental grasping mechanics of the hand.

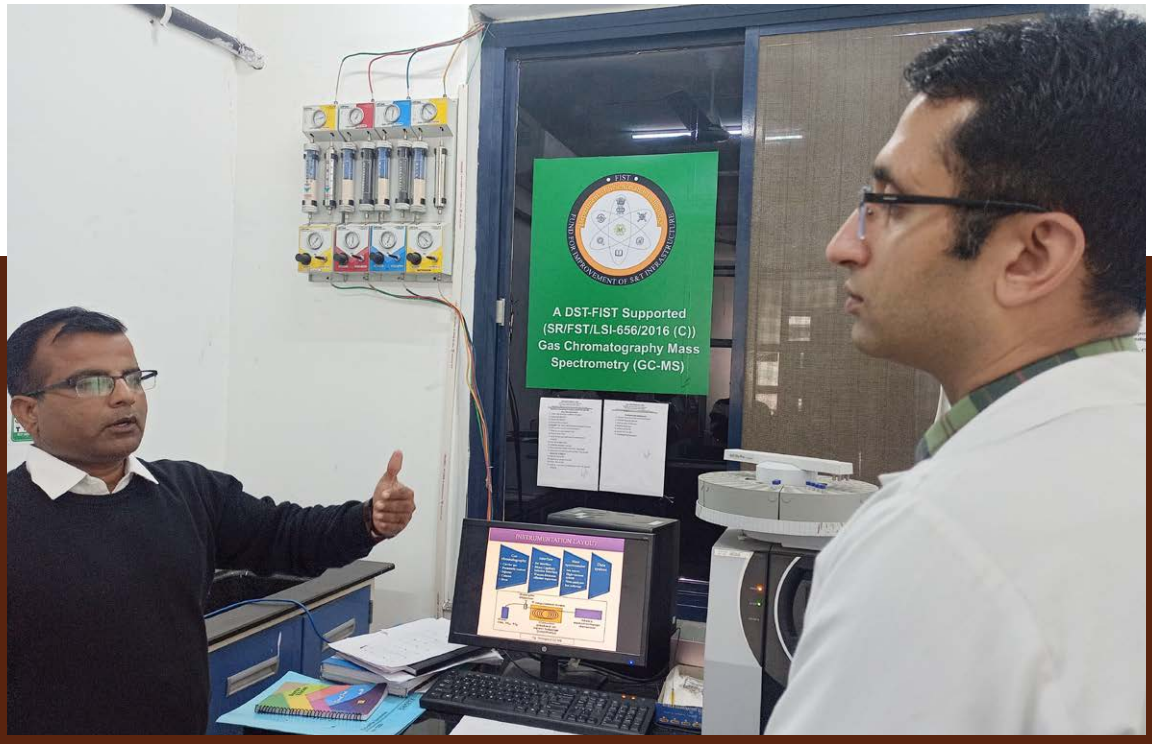
In this context, he develops neuro-musculoskeletal model frameworks that will be driven in real-time in a human-in-the-loop scenario for grasping and manipulation during activities of daily living. He also uses pattern recognition methods to analyse surface electromyographic signals to drive state-of-the-art prostheses and is involved in finding low-cost assistive and rehabilitative solutions for low-income countries.

He has been awarded the Paired Early Career Fellowship in Applied Research (PECFAR) to work at the Council of Scientific and Industrial Research (CSIR) - Central Mechanical Engineering Research Institute (CMERI), Durgapur, India. CMERI is the apex R&D institute for mechanical engineering in India under the aegis of the CSIR, Ministry of Science and Technology, Govt of India.

The institute works on various aspects of transdisciplinary mechanical engineering solutions, promoting innovation, fostering invention and development of indigenous technology, including AI driven healthcare applications. Within the framework of PECFAR, Amartya is building a musculoskeletal model of the hand which would provide a framework to test human-in-the-loop experiments designed for clinically relevant outcomes. He is also networking with National Institute for the Orthopaedically Handicapped, reference hospital for upper limb amputees as well as Shri Bhagwan Mahaveer Viklang Sahayata Samitit (BMVSS), world's largest organisation for the people with limb differences. The PECFAR fellowship has given Amartya the platform to bring together like-minded organisations to reach a common goal of providing open source solutions to empower people with upper limb difference.

EXPLORING TRANSLATIONAL THERAPEUTICS FOR GASTROENTEROLOGICAL DISORDERS

Dr Amit Khurana



Dr Amit Khurana is a Postdoctoral Fellow at the Institute of Molecular Pathobiochemistry, Experimental Gene Therapy and Clinical Chemistry (IFMPEGKC), RWTH University Hospital Aachen, Germany. His research interests include exploring translational therapeutics (gene therapy, small molecules, and peptides) for gastroenterological disorders (NASH, NAFLD, Pancreatitis) and applications of advanced drug delivery carriers for emerging health problems.

Recently he has been awarded the Paired Early Career Fellowship in Applied Research (PECFAR) funded by the IGSTC to work at Central University of Punjab (CUP), Bathinda. At the Department of Pharmacology, he intends to study the gut microbiome and its role in acute-on-chronic liver failure. He had acquired hands-on-training in the use of gas chromatography-mass spectrometry (GC-MS) to analyze short-chain fatty acids (SCFA) during different stages of chronic liver disease. Additionally, he aims to develop a 3D spheroid/organoid culture facility.

To expand his research network in India & avenues for drug discovery and development for translational liver research, he had explored potential collaborations with various research groups, including those led by Prof. Rajani Mathur and Prof. Subodh Kumar at Delhi Institute of Pharmaceutical Sciences and Research (DIPSAR), Delhi Pharmaceutical Sciences and Research University, New Delhi; Dr. Umashanker Navik, Dr. Jasvinder Bhatti, and Dr. Raj Kumar at Central University of Punjab, Bathinda; Dr. Abhinav Kanwal at All India Institute of Medical Sciences (AIIMS), Bathinda, Prof. Rahul Deshmukh at the Maharaja Ranjit Singh Punjab Technical University (MRSPTU), Bathinda, and Prof. Harlokesh Narayan Yadav at AIIMS New Delhi. He had also discussed potential research ideas and opportunities for submitting proposals for funding from organizations.

He is extremely grateful to IGSTC for giving him an opportunity to interact and formulate new avenues for future collaboration to meet his long-term research goals. He also appreciates the hospitality and warm response of the Indian Paired Member Dr Uma Shanker at Central University of Punjab.

IGSTC STAFF EXCHANGE VISIT TO GERMANY

IGSTC Team at UN University, Bonn

This visit helped to foster deeper ties between India and Germany, which will lead to close-knit teamwork in the future.

The Indo-German Science and Technology Centre (IGSTC) recently organized a staff exchange visit to Germany during February 27 to March 3, 2023. This visit aimed to strengthen collaboration between India and Germany by fostering the exchange of knowledge and expertise and strengthening cultural bonds.

Dr. Rupak Bhattacharya, Ms. Moni Konkona Boruah, and Mr. Umesh Sah represented the IGSTC during their visit. The team had the opportunity to interact with German counterparts at the DLR-PT, the Asia & Oceania division, and visited project sites related to IGSTC's flagship program 2+2 Projects (AutoNutri, CO2Biofeed, ModAMTool, and MAMM-WAAM).

The team visited one of the largest lignite power plants at RWE Power, a major player in the German energy market that is committed to transitioning to a sustainable energy system by 2030. Additionally, the team also visited the UN University at Bonn to discuss possibilities for collaboration between UNU and IGSTC. The UN University is primarily focused on research and policymaking related to climate extremes and transformative climate change.

The staff exchange visit to DLR-PT and interactions and deliberations with IGSTC German team proved to be highly enriching. This visit helped foster deeper ties between India and Germany, which will hopefully lead to close-knit teamwork in the future.

IGSTC Team at DLR-PT

IGSTC Team at RWE Power Plant

IGSTC TEAM WORKSHOP

IGSTC had organised a two-day IGSTC Team Building Workshop at Jaipur, India on 14-15 March 2023. The aim of the Workshop was to deliberate on a) reflection about team structure and structure of work processes, b) reflection of existing programmes and ideas for improvement, and c) new ideas for programmes or activities of IGSTC to further strengthen Indo-German bilateral cooperation.

Both the teams from India and Germany participated in the Event. Scientist Prof P G Diwakar, ISRO Chair Professor at National Institute of Advanced Studies, Bengaluru was the moderator for the first day of the event and Mr R Madhan, Director moderated the second day of the event. The workshop consisted of three-four major sessions per day. The entire team of IGSTC was divided into two to three groups as per the requirements of the respective sessions. Every session commenced with a brief introduction on the objective of the session followed by the formation of the groups, discussions, group presentations and final consolidation of the observations and suggestions of the session. A sense of "ONE TEAM" and receptiveness to each other ideas are valued as the strengths of the team during the Workshop.

IGSTC NETWORKING

Outreach at Guwahati and Lucknow

Other engagements

OUTREACH AT GUWAHATI AND LUCKNOW

Panel discussion at Guwahati

The Indo-German Science and Technology Centre (IGSTC) has been increasing its outreach and visibility by conducting events in various tier-2 cities of India. Recently, IGSTC organized two successful outreach events in Guwahati and Lucknow on 30th January 2023 and 18th April 2023, respectively. The events were attended by more than 100 invitees from approximately 50 institutions, including academic and research institutions as well as industries in the vicinity of both cities. The one-day interactive events included detailed sessions on IGSTC activities, descriptive

Participants at IGSTC Outreach Event at Guwahati

Participants at IGSTC Outreach Event, Lucknow

sessions for applications, presenting success stories, address from visiting dignitaries, and a panel discussion. The panel discussion, which featured panellists from academia, research, industry, and the German consulate, focused on the relevance of international science and technology cooperation in today's context and connecting industry, academia, and research. It generated an excellent response from the audience and was a great experience for all involved. The events were well received and much appreciated by the participants. They were a great opportunity for the IGSTC to connect with stakeholders and highlight the centre's mission of fostering collaboration between India and Germany in the field of science and technology.

Panel discussion at Lucknow

OTHER ENGAGEMENTS

Director, IGSTC briefed on various partnerships established though IGSTC between India & Germany at an event organized by EEPC India

Through its various programmes, IGSTC has been supporting several research/academic institutions and industries from India and Germany to catalyse Indo-German strategic R&D partnerships. IGSTC regularly engages with various stakeholders like Universities, tier I & tier II Research Institutions, Industries and Government agencies to promote IGSTC programmes. IGSTC has organised and participated in various outreach events. The outreach intends to make programmes offered by IGSTC, more visible and accessible to the larger research community from universities/institutions & Industries in India and Germany. It diversifies the pan-India and Germany presence of IGSTC and creates an impetus to increase the participation of scientists, industrialists, women researchers, young researchers and engineers representing several institutes in STEM.

Visit of delegation from National Institute Of Science Communication and Policy Research (CSIR-NIScPR)

Visit of the Director, IGSTC at Jawaharlal Nehru Centre For Advanced Scientific Research (JNCASR), Bangalore

Mr R Madhan, Director IGSTC met Prof Rajiv Prakash, Director, IIT Bhilai

Presentation by Dr P V Lalitha at Parul University, Gujrat

Presentation by the Director, IGSTC at NIT Raipur

Visit of Mr Madhan, Director, IGSTC & Dr P V Lalitha, Chief Scientific Officer, IGSTC at Airbus Munich

Visit of IGSTC delegation at HSWT

Visit of IGSTC delegation at TU Munich

Visit of IGSTC delegation at NIT Durgapur

Presentation by the Director, IGSTC at National Forensic Sciences University (NFSU), Goa

Participation in DAAD Workshop at IIT Delhi

Visit of representative from Invest in Bavaria

Meeting at MPG Bangalore

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