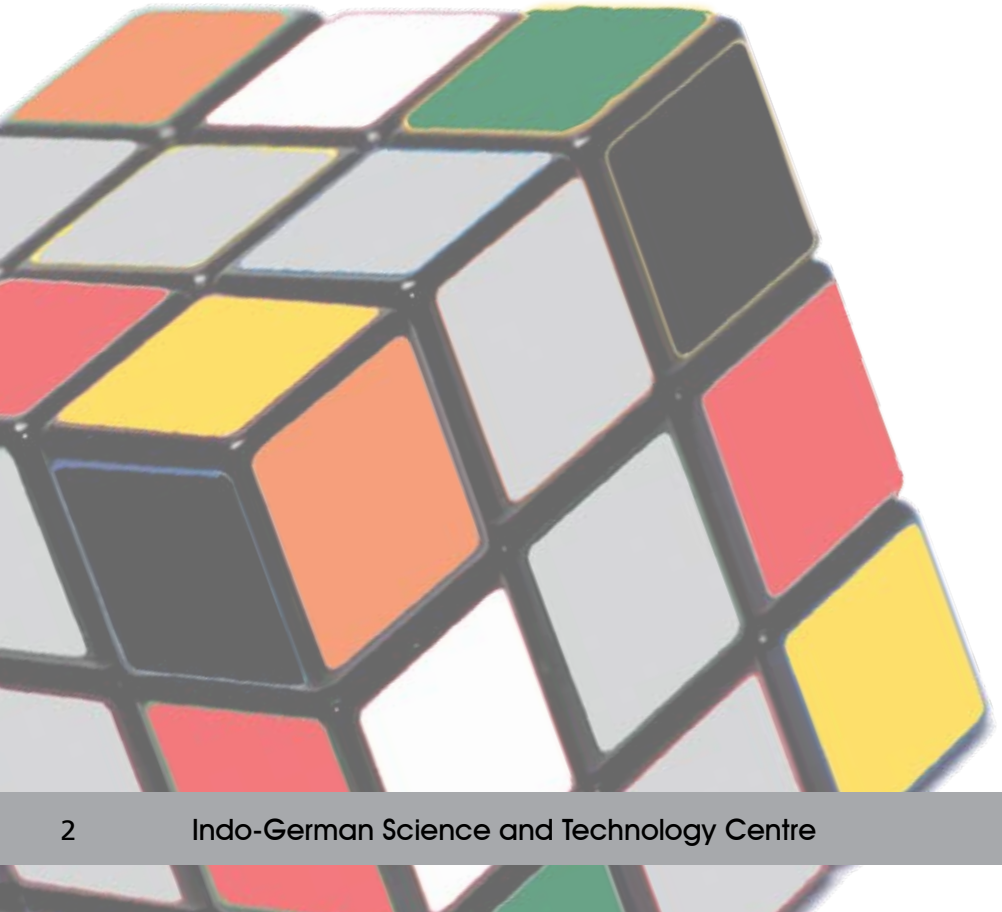
INVENTION | INNOVATION

ANNUAL REPORT
2011-12

IGSTC
INDO-GERMAN SCIENCE AND TECHNOLOGY CENTRE

Indo - German Science and Technology Centre
Catalysing Partnerships





Indo-German Science and Technology Centre

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ANNUAL REPORT 2011-2012

Signing of MoU for the establishment of Indo-German Science & Technology Centre
30 October 2007

Contents

From the Director's Desk

The year 2011 was, without doubt, an excellent year in terms of Indo-German relationship in the field of Science and Technology. Germany and India 2011-12: Infinite Opportunities was celebrated throughout the year in different cities in India to mark the 60 years of diplomatic relationship. Academic and scientific partnership remained in focus.

India's declaration of 2010 – 2020 as the Decade of Innovation to develop an ecosystem to stimulate translational research coincided with Germany's High Tech Strategy 2020 with its aim of connecting science with industry. This led to the emergence of Indo-German Strategic Partnership for Innovation and also gave birth to Indo-German Science & Technology Centre (IGSTC). Setting up of IGSTC marked the onset of a new era of our S&T relationship through research partnership of industrial relevance, connecting science and industry across the boundaries.

It has to be recognized that India and Germany have been partner in S&T domain for almost 40 years now. Research fellowships offered by Humboldt Foundation / DAAD/ Max Planck Society and many other joint initiatives of both the Governments provided a strong foundation for scientific connectivity by creating opportunities for research networking. It is not incidental that Germany is the second most productive partner of India, as reflected in globally co-authored joint research publications (h-index of 79 for the 5954 joint publication in 2004-09) as per the findings of a recent study sponsored by DFG - Deutsche Forschungsgemeinschaft.

IGSTC is built on this strong existing foundation. The origins of IGSTC can be traced to the meetings between Dr. Manmohan Singh, the Prime Minister of India and Dr. Angela Merkel, the Chancellor of Germany in April 2006. The joint statement issued at the conclusion of that visit expressed the

A young but confident and ambitious institution, IGSTC looks forward to fulfilling its mandate in the years ahead. It seeks new horizons to bring together the immense scientific talent in both countries to work together and resolve immediate and future S&T challenges. The challenges are enormous, but so are the opportunities. IGSTC has begun its journey and is running hard.

intention of both nations to establish a Centre to expand the horizon of Indo-German S&T engagement. This was followed with the signing of an MoU at the ministerial level for establishment of IGSTC with annual funding commitment of 2 million Euros (₹ 13 Cr.) by each side. Finally the Centre was born, being formally inaugurated on 7th December 2010.

Emphasising on applied research connecting science and industry in the PPP mode, IGSTC launched its call in 2009/2011 for 2+2 research project partnership involving academia and industry from both the countries. This resulted in selection of 11 projects (out of about 70 proposals received and response) with 44 institutional partners. The projects emanated from a wide range of emerging areas such as biotechnology, solar-thermal hybridisation, nanotechnology, information & communication, advanced materials and energy research. The total investment from both sides for these projects add upto about 6 million Euros (about ₹40cr.) by both sides. These projects are already off the ground and some details on the progress made in these projects are listed in this report.

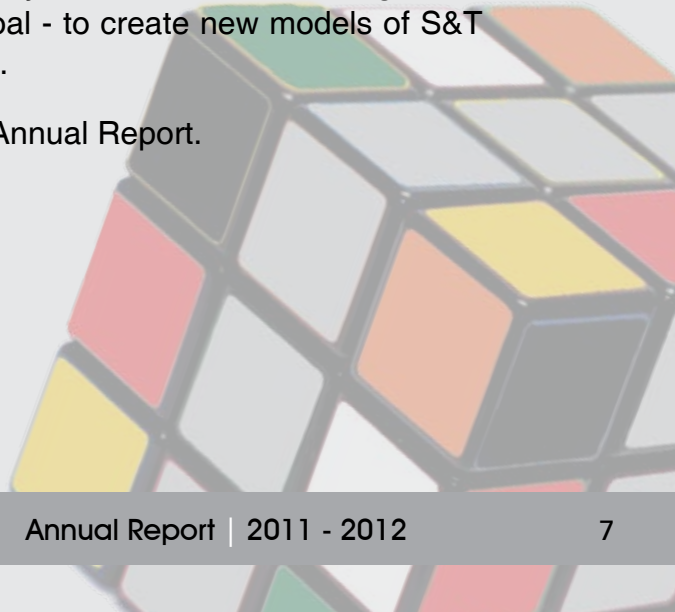
In addition to managing its own research program IGSTC has also been entrusted with the responsibility of administering and implementing the DST-Max Planck Society Program as an extra mural activity. “Max Planck Partner Groups at Indian Institutions” and “India - Max Planck Visiting Fellowship” are the two schemes being implemented under the program. DST-Max Planck Society Program is also briefly described in this report.

The year 2011-12 was the first year of IGSTC’s existence. A young but confident and ambitious institution, IGSTC looks forward to fulfilling its mandate in the years ahead. It seeks new horizons to bring together the immense scientific talent in both countries to work together and resolve immediate and future S&T challenges which are enormous, but so are the opportunities.

IGSTC’s confidence about achieving its goals has a lot to do with its distinguished Mentors, members of the Governing Body and Joint Scientific Council. Their vision and guidance is, and will continue to be, critical in the years to come as IGSTC gathers momentum and speed in its journey towards its goal - to create new models of S&T research partnerships between India and Germany.

The team IGSTC takes pride in presenting its first Annual Report.

A. Chakraborty
Director



History of Indo-German S&T Cooperation

Milestones behind | Miles ahead

1959

1959
Setting up of IIT Madras with German Technical Assistance

1960-69

1960
DAAD Established its New Delhi Office

1965
CSIR/DAAD Letter of Intent for Exchange of Scientists

1969
Germany-India Cultural Exchange Program

1970-79

1971
Indo-German Agreement on the Peaceful Uses of Nuclear Energy & Space

1974
Indo-German Agreement on Cooperation in Scientific Research & Development

1976
ICMR-GSF Agreement. (Renewed Subsequently as ICMR-BMBF in 2005)

1980-89

1982
CSIR/DLR Special Arrangement in Aeronautical Sciences

1990-99

1994
CSIR/FhG Letter of Intent

1996
Establishment of Indo-German Joint Committee on Science and Technology (JCST)

1998
DST /DAAD Project Based Research Promotion Program

IIT/DAAD Master Sandwich Program

2000 →

2001
India joins Annual Nobel Laureate Meeting in Lindau

DBT -BMBF Special Arrangement for Cooperation in Biotechnology

2002
AIU /HRK MoU on Academic Cooperation (Including Mutual Recognition of Degrees)

2004
DST /DFG Agreement

2006
MoU between ICMR and Helmholtz Association (HGF) for Setting up of Indo-German Science Centre for Infectious Diseases

2007
Agreement for Establishment of Indo-German Science & Technology Centre (IGSTC)

2008

Indo-German Joint Declaration of Intent on Research Cooperation on Science for Sustainability

DST/Humboldt Foundation MoU on Frontiers of Engineering

2010
IGSTC inaugurated

Launching of Indo German Max Planck Centre on Computational Science at IIT Delhi

2011
DST /Leibnitz Agreement

Indo-German Science and Technology Centre
Office Premises
(Plot No. 102, Sector-44, Gurgaon, Haryana)

Inaugurated by

Secretary T Ramasami
Department of Science and Technology
New Delhi

Parliamentary State Secretary Thomas Rachel
Federal Ministry of Education & Research
Germany

on
Tuesday, 7th December, 2010

Federal Ministry of Education and Research

Department of Science & Technology
Government of India

IGSTC
INDO-GERMAN SCIENCE AND TECHNOLOGY CENTRE

The Indo-German Science & Technology Centre (IGSTC) has been established to facilitate Indo-German R&D networking through substantive interactions among government, academia/ research systems and industry to foster innovation and application for the overall economic and societal developments of both the countries. Both Governments will be contributing Euro 2 million (₹ 13 crore) every year for realizing the goals.

IGSTC aims to:

- play a proactive role in facilitating participation of industry in joint R&D projects,
- provide/assist in mobilizing resources to carry out industrial R&D projects,
- promote electronic exchange and dissemination of information on opportunities in bilateral S&T 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, one from each country,
- provide individual advice to institutes and industries from either country, the possibilities of Indo-German cooperation and help in the identification of suitable partners,
- facilitate and promote Indo-German bilateral collaboration in basic and applied science, research and technology through substantive interaction among government, academia and industry,
- encourage public-private partnerships (PPP) to foster elements of innovation and application and cultivate a culture of cooperation between science and industry,
- nurture contacts between young and mid career scientists and technologists to develop a sense of mutual trust, leadership and entrepreneurship,
- develop cooperation through the identification of scientists and scientific institutions of the two countries,
- organize workshops, seminars, training programmes and other types of events on topics of mutual interest.

Mentorship and Governance

MENTORS

T Ramasami
Secretary
DST (India)

Thomas Rachel
Parliamentary State Secretary
BMBF (Germany)

GOVERNING BODY

Arabinda Mitra
DST
Indian Co-chair

Christian Joergens
BMBF
German Co-chair

Anuradha Mitra
DST

Clas Neumann
President, SAP India

Krishnan Balasubramaniam
IIT Madras

Eberhard Abele
TU Darmstadt

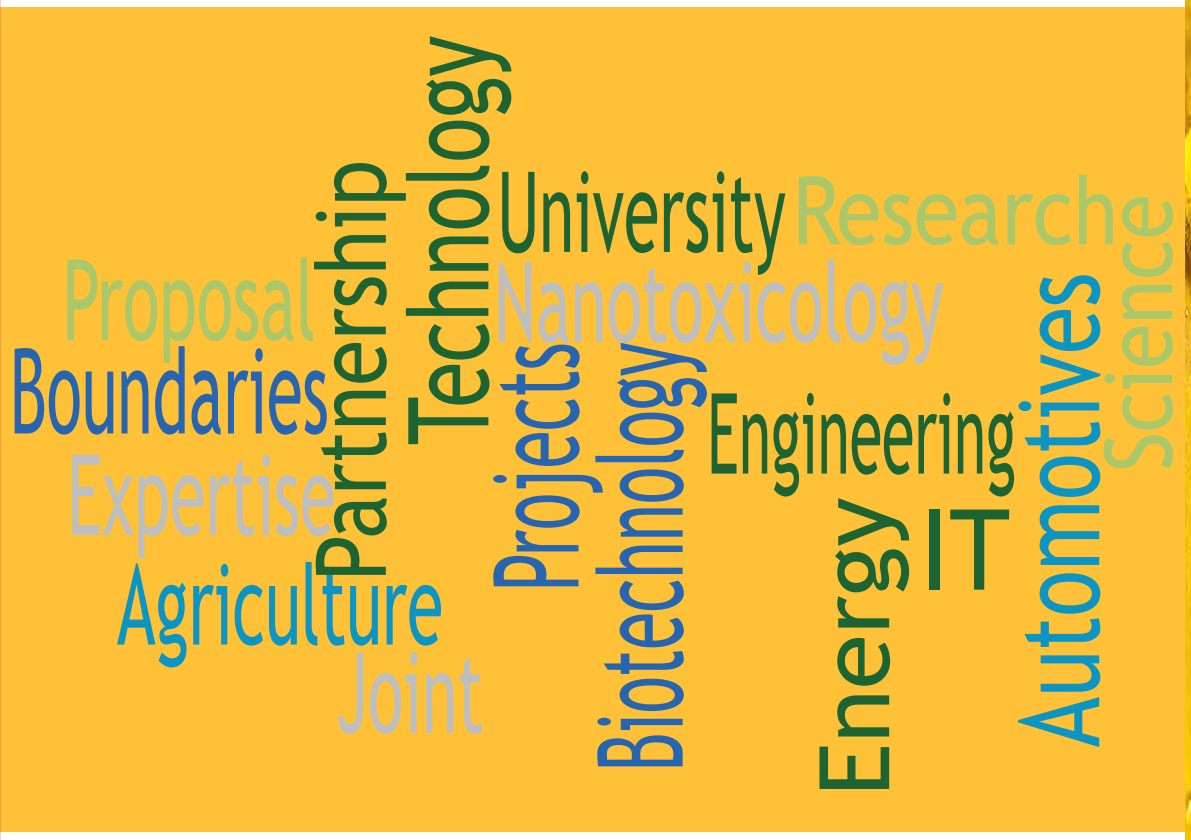
Anjan Das
Confederation of Indian Industry

Philip Petit
German Embassy in India

Shailja Gupta
DBT

Gerold Heinrichs
IB-BMBF

- **Christian Streffer, Essen University represented German Side in the Governing body till October 2012**
- **Christian Aulbach, German Embassy in India represented German Side in the Governing body till October 2012**



Program Activities

(2+2 Projects)

Agriculture

Source : gettyimages

Imparting drought stress-tolerance to crop plants by heterologous transfer of high altitude plant protection mechanisms

Background

Loss of crop productivity due to drought stress and the resultant economic loss is a major concern in the world of agriculture. It is essential to develop drought-tolerant crop varieties that deliver stable and viable yields under drought conditions.

This project seeks to identify stress tolerant genes in plants that grow in high altitude zones and successfully handle extremes of cold and moisture stress. Once identified, these genes will be transferred in the model plant *Arabidopsis thaliana*. Genes providing stress tolerance will be used to develop superior and durable drought-tolerant varieties of various crops.

Project Partners

वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद • CSIR.INDIA •

JÜLICH FORSCHUNGSZENTRUM

KRISHIDHAN Seeds Private Limited

DSV

Objectives

The project involves:

- identification of molecular mechanisms that enable high altitude plants to tolerate moisture stress,
- transfer of these mechanisms into crop plants,
- analyse the resultant transgenic plants by high throughput, field-close, standardized phenotyping technologies.

Deliverables

The project expects to deliver:

- Transferable drought stress tolerance mechanisms operative in high altitude Himalayan plants,
- Crop lines with improved and durable drought stress tolerance traits as analyzed by high throughput phenotyping platform.

Strategic Approach

The work envisaged under the project has been divided between partner institutions as per details below :

FZJ

Establishment of controlled field comparable stress conditions

- Establish drought stress conditions for *Arabidopsis thaliana* and characterise wild types and transgenic plants,
- establish Rapeseed phenotyping for irrigated as well as drought-stressed plants.

Identification and characterisation of stress specific promoters & genes and construction of expression constructs (IHBT and KRFPL)

- Prepare a cDNA library of leaf and root tissues of *Potentilla atrosanguinea* for SOLEXA sequencing,
- clone full-length genes in plant transformation vector,
- develop expression vectors acceptable for commercial application and clone the relevant genes.

CSIR-IHBT, KRFPL and DSV

Development of transgenic (model and crop) plants

- develop seven gene-constructs and generated transgenic *Arabidopsis*.
- clone SOD and Succinyl-CoA-ligase in marker free vector for transformation of maize.
- develop segregating lines for 4 constructs (55 – 93 lines) of Rapeseed.

KRFPL and FZJ

Phenotyping impact of high altitude plant genes on stress tolerance, growth and yield

Project Leadership

Sanjay Kumar
CSIR-Institute of Himalayan
Bioresources Technology Palampur, India

Anika Wiese - Klinkenberg
Forschungszentrum Jülich GmbH
Jülich, Germany

G.K. Garg
Krishidhan Research Foundation Pvt. Ltd.
Jalna, India

Dieter Stelling
Deutsche Saatveredlung AG
Lippstadt, Germany

- characterise 7 gene constructs in *Arabidopsis thaliana* and also standardize phenotyping for oilseed Rape.

Progress Made

During the period, possible genes that impart stress tolerance to plants under study were identified. These include *RaWRKY, RaAPX, CsThaumatin-like protein, PaSOD, CjSuccinyl-CO A-Ligase, and CjQM* family.

Genes were cloned in relevant constructs for plant transformation. The constructs were made available by CSIR-IHBT to KRFPL and DSV who generated transgenic plants.

Seeds of the transgenic *Arabidopsis* were sent to FZJ for phenotyping for which data was generated. Performance of transgenic *Arabidopsis* over expressing *RaWRKY* were evaluated by CSIR-IHBT in response to drought.

An interactive partners meet was held at Jülich on 7 May 2012.

Constructs of seven genes and the transgenic *Arabidopsis* plant over-expressing the said genes were provided to the partners. First transgenic lines of oilseed rape were developed and concomitantly, *SOD* and *Succinyl-CoA-ligase* were cloned in marker free vector for transformation of maize. Under the project, drought stress conditions were established for *Arabidopsis thaliana* and wild types and transgenics plants were phenotyped.

Path Forward

- Intensive analysis will be performed both at Jülich Plant Phenotyping Centre (JPPC), Jülich, Germany and at CSIR-IHBT on wild type and transgenic *Arabidopsis* including over-expression of a thermostable *SOD* on drought and temperature tolerance.
- Wild type and transgenic oilseed varities will be phenotyped for drought tolerance.
- Transgenic maize will be developed with the target genes. More sources of thermostable *SOD* will also be identified.
- Transcriptomes of *Potentilla atrosanguinea* and *Caragana jubata*, the plant species thriving in extreme environment of high altitude cold desert, will be analyzed for stress responsive gene suits.

German and Indian Partners at the project meeting

Solar Energy

Source : gettyimages

Compact Linear Fresnel Reflector (CLFR) for solar thermal power and process heat

Background

Compact Linear Fresnel Reflector System (CLFR) comprises of a series of long, narrow, shallow-curvature (almost flat) mirrors that focus light onto a linear receiver positioned above the mirrors. A small reflector can be attached on top of the receiver to further focus the incoming solar radiation. CLFR system promises lower overall costs due to ground level laid reflectors, while still using the simple line-focus geometry with one axis for tracking.

This project envisages setting up of a 500kWth CLFR facility and integrating the same with an existing thermal power unit. The demonstration project will set up alongside the thermal power unit at the Heavy Water Plant (Department of Atomic Energy, Govt. of India) at Manguru, Andhra Pradesh, India.

Project Partners

Fraunhofer ISE

THERMAX

SCHOTT glass made of ideas

Objectives

- To generate fast track and cost effective solar power through integration of solar power generation system with an existing fossil fuel fired power generation unit.
- Research, design and proto-type development of high efficiency, low cost Compact Linear Fresnel Reflectors (CLFR) for application in distributed solar power generation systems and hybridizing the solar power units with existing thermal power plants.

CLFR is a single axis solar concentrator which focuses sun rays onto a fixed receiver tube. Ground laid reflectors direct the rays to receiver which has an inverted secondary reflector (just above the receiver tube). This ensures that all incoming rays are reflected to evacuated and selective by coated receiver tube which in turn heats the flowing fluid inside.

Deliverables

- Design of a 230 kWh demonstration CLFR unit with an objective of optimizing efficiency and cost.
- Design and development of critical components of system envisaged including the primary mirror system, secondary concentrator, receiver mounting, tracking system, heat exchangers, evaporators etc.
- Designing of structural systems in a manner that minimises the overall cost of the entire support system
- Testing & integration of the system with an existing thermal power plant to address all the above aspects and quantify the efficiency and cost. This will be the cheapest way to produce solar power in shortest period of time.

Strategic Approach/Action Plan

The work envisaged under the project has been divided between partner institutions as per details below :

Thermax Limited

- Project coordination,
- engineering of Balance of System (BOS),
- design for manufacturing and fabrication of collector,
- erection of collector, commissioning and operation of solar field,
- assistance for monitoring and cost evaluation,
- development plan for applications.

IIT Bombay

- Structural engineering and simulation of structural loads,

Project Leadership

Prasanna Mujumdar
Indian Institute of Technology
Bombay, India

Werner Platzer
Fraunhofer ISE
Freiburg, Germany

R. R. Sonde
Thermax Ltd.
Pune, India

Thomas Kuckelkorn
SCHOTT Solar
Mainz, Germany

- modelling of the system,
- system dynamics and controls,
- procurement of material and components for demonstration unit in the project.

Fraunhofer Institute for Solar Energy Systems (Fraunhofer ISE)

- Optical design and thermal heat transfer analysis,
- Collector optimisation based on minimising levelised electricity costs, experimental characterisation of solar collector materials and components,
- Performance testing and monitoring of solar collector prototype, energy yield simulation for solar thermal power system,
- Control algorithms and control implementation (mirror drives, mass flow), general knowledge and background on concentrated solar thermal power and buildings.

Schott Solar CSP GmbH

- Adaptation and delivery of receiver tube based on vacuum technology or air-stable absorber coatings,
- Consulting for receiver integration into optical secondary concentrator construction,
- Consulting for receiver tube integration into heat transfer fluid system.

Progress Made

- 4m long Prototype has been designed, manufactured and commissioned at Thermax R&D facility and is now under testing.
- Optical design done by Fraunhofer ISE with inputs from Thermax.
- Different conceptual designs of each critical component like Reflector, Secondary Reflector are finalised and tested.
- Optimal designs chosen and manufactured with necessary fixtures.
- Structural analysis of the module is being done by IIT Bombay so as to improve the design.
- Two PTR 70 Receiver tubes sent by SCHOTT for erection and testing at Thermax R&D Lab.
- Fraunhofer has completed optical design and Thermax has setup a lab-scale model at its campus at Chinchwad, Pune to check and refine its design. IITB is working closely with Thermax for structural design and analysis of LFR components.

Path Forward

Performance testing of lab scale Prototype is in progress. Detailed engineering is completed. Manufacturing of components to begin in April 2013.

Plant Biotechnology

Source : gettyimages

Developing sustainable transgenic crop plants tolerant to drought stress.

Background

Environmental stresses are a primary cause of loss of productivity of agricultural crops across the world. Enhanced production of Reactive Oxygen Intermediates (ROIs) during phases of environmental stress pose a serious threat to survival of plants. Efficiency of the ROI scavenging mechanisms in a plant is an important determinant of its tolerance for different environmental stresses.

This project aims at over-expressing genes involved in the ascorbate-glutathione pathway in crop plants to deactivate ROI molecules and protect plant cells from oxidative damage. The project also seeks to over express ABA catabolism genes for regulating the expression levels of plant stress hormone ABA.

Project Partners

ICGEB

IPK GATERSLEBEN

SAATEN UNION BIOTEC

NSL GROUP Transforming Lives

Objectives

- To improve the biotechnological resources in modern agriculture through collaboration with research partners at the International Centre for Genetic Engineering and Biotechnology (ICGEB) New Delhi, Leibniz Institute of Plant Genetics, Crop Plant Research (IPK) Gatersleben, along with their industrial partners Nuziveedu Seeds (P) Ltd., India and Saaten-Union Biotec (SUB) GmbH, Germany, to improve the agronomic performance of barley and maize crops.

Strategic Approach/Action Plan

- In vitro gene pyramiding and construction of plant transformation vector with all genes [Superoxide dismutase (SOD), Ascorbate peroxidase (Apx), Mono dehydroascorbatereductase (MDHAR), Dehydroascorbatereductase (DHAR) and Glutathione reductase (GR)]
- Encoding for enzymes involved in Ascorbate-glutathione pathway (at ICGEB)
- Preparation of constructs for manipulating ABA levels under drought using key genes of ABA metabolism and catabolism as well as alterations for ABA signaling to elevate hypersensitivity to ABA under drought (at IPK Germany)
- Transformation of selected maize lines through Agrobacterium- mediated transformation. (at Nuziveedu Seeds (P) Ltd)
- Transformation and characterization of primary transgenic barley lines, transgenic double haploid line production and screening barley transgenic plants for terminal drought tolerance (at IPK and SUB, Germany)
- Molecular analysis of transgenic maize plants for stable integration of trans genes and their expression at both RNA and Protein levels (at both ICGEB and Nuziveedu Seeds (P) Ltd components).
- Validation of selected transgenic maize and barley events for their stress adaptation in the greenhouse under different stress conditions (at ICGEB, Nuziveedu Seeds (P) Ltd and IPK).

Progress Made

Plants use Ascorbate-glutathione cycle for scavenging reactive oxygen intermediates in multiple redox reactions to prevent cellular damage. The project team has successfully cloned entire Ascorbate-glutathione pathway encoding genes into a single plant transformation vector and generated putative

Project Leadership

M. K. Reddy
International Centre for Genetic Engineering and Biotechnology
New Delhi, India

P. Sateesh Kumar
Nuziveedu Seeds (P) Ltd
Hyderabad, India

N. Sreenivasulu
Leibniz Institute of Plant Genetics and Crop Plant Research (IPK)
Leibniz, Germany

Jens Weyen
Saaten-Union Biotech GmbH
Hovedissen, Germany

transgenic maize plants in India and barley plants in Germany. The analysis of these transgenic lines for transgene integration, expression and stress tolerance is now underway.

Plants also use elevated phytohormone ABA as an essential messenger to trigger the expression of down-stream stress adaptive genes. However, the sequestration of ABA to the basal level is required under prolonged stress to promote the photosynthesis and better grain set and grain filling. A research strategy has been developed to overexpress ABA catabolism genes under drought-induced promoters (LEA and salt promoters) to reduce ABA levels during terminal drought stress for improved grain yield in barley and maize.

The plant transformation vector expressing all the genes encoding for enzymes involved in Ascorbate-glutathione pathway i.e. Superoxide-dismutase(SOD), Ascorbate peroxidase(Apx), Monodehydroascoorbatereductase (MDHAR), Dehydroascorbatereductase(DHAR) and Glutathione reductase (GR) was constructed and used for maize transformation.

Putative transgenic maize plants were regenerated from transformed calli. Analysis of putative transgenic lines for the transgene expression and stress adaptation in the stimulated stressed environment is in progress. Gene pyramiding and construction of plant transformation vector with the selected genes involved in ABA signaling has been initiated.

Plant Biotechnology

Source : gettyimages

Biotechnological approaches to improve chickpea crop productivity.

Background

Chickpea (*Cicer arietinum*) is an important grain legume of semi-arid tropics and forms one of the major components of human diet. It is a major pulse produced in the Indian Farming system. Abiotic stresses such as drought regularly limit production of chickpea. Specific breeding and selection for tolerance to drought in chickpea is a major research priority.

Breeding efforts to improve drought tolerance in chickpea have not succeeded due to its narrow genetic base and poor understanding of the physiological factors that determine chickpea yields.

The project seeks to identify candidate genes and gene network associated with drought tolerance in chickpea that will help in developing drought-tolerant breeding lines.

Project Partners

ICRISAT
Science with a human face

GOETHE UNIVERSITÄT
FRANKFURT AM MAIN

GenXPro

BenchBio
creative trait discovery

Objectives

Chickpea offers a high value alternative to cereals, is an important disease break, provides opportunities for grass/weed control and gives a respite from high nitrogen application.

Even though India is a leading producer of chickpea (annual production ~7.5 million MT) it still has to import large quantities of chickpea to meet domestic demand.

Due to insufficient rainfall in arid and semi-arid areas where chickpea is cultivated, the crops often suffer from recurrent droughts.

The primary objective of this project is to identify candidate genes and underlying mechanisms responsible for drought tolerance in chickpea to enhance breeding efficiency for developing chickpea varieties with superior yields under rainfed conditions.

Deliverables

- Candidate genes for drought tolerance in chickpea,
- Gene expression (qRT-PCR) assays for drought responsive candidate genes,
- Perfect gene-based molecular markers and expression Quantitative Trait Loci (eQTLs) associated with drought tolerance in chickpea for the breeding community,
- Drought tolerant pre-breeding chickpea lines.

Strategic Approach/Action Plan

The work in the project is split into four distinct Work Packages (WP) to be jointly pursued by partner institutions.

WP1: Selection of candidate genes from available datasets,

WP2: Large scale single nucleotide polymorphisms (SNP) genotyping for association genetics studies,

WP3: Integration of candidate genes with chickpea genetic map and identification of candidate genes associated with drought tolerance,

WP4: Expression mapping of selected candidate genes for identification of eQTLs.

Once the candidate genes are identified through above approaches, work will be started for this work package.

Progress Made

- Transcriptome assembly comprising of 60,000 contigs (University of Frankfurt)
- 2005 KASPar assays and a transcript map comprising of 1328 loci (ICRISAT)
- 200 highly reliable SNPs in MACE

Project Leadership

Rajeev Varshney
ICRISAT
Hyderabad, India

Günter Kahl
Goethe-University
Frankfurt, Germany

Manas Chatterjee
BenchBio Pvt. Ltd.
Vapi City, India

Peter Winter
GenXPro GmbH
Frankfurt, Germany

reads and 45 associated with strongly differentially expressed transcripts. (GenXPro)

- 92,000 (50,016 annotated) RAD-alleles from three different genotypes (JG11, ICC4958 and ICC1882) (University of Frankfurt)
- 75,450 SNPs and 3,281 indels identified based on 33.9 Gb raw data (17.9 Gb clean) from 57 (43 Desi and 14 Kabuli) genotypes. (University of Frankfurt and ICRISAT)
- 4,975 transcripts showing down-regulation of 1-2.7 folds and 2,557 transcripts showing up-regulation of 1-2.7 folds. (GenXPro)

Publications

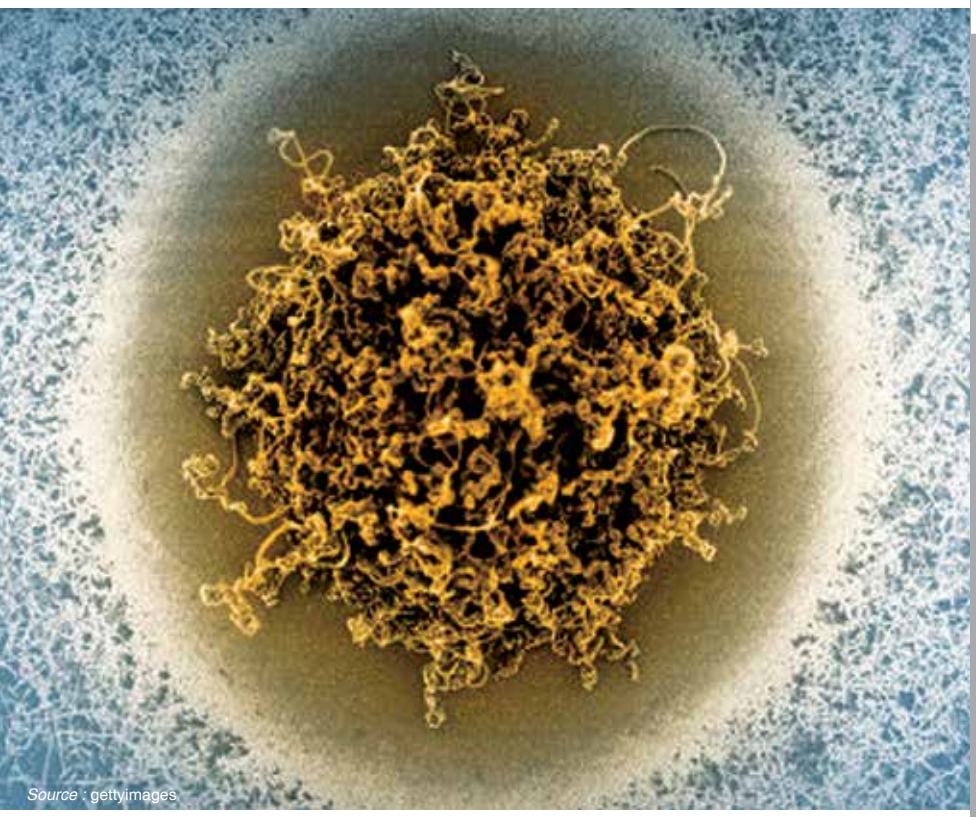
Hiremath PJ, Kumar A, Penmetsa RV, Farmer A, Schlueter JA, Chamarthi SK, Whaley AM, Carrasquilla-Garcia N, Gaur PM, Upadhyaya HD, Kavi Kishor PB, Shah TM, Cook DR and Varshney RK (2012). *Large-scale development of cost-effective SNP marker assays for diversity assessment and genetic mapping in chickpea and comparative mapping in legumes.* Plant Biotechnology Journal, 10: pp. 716–732.

Path Forward

Gene expression of the 50 selected candidate genes using qRT-PCR assays would be validated and high-density gene-based expression marker maps, eQTLs and candidate genes/QTLs associated with drought related traits would be developed. In broad-term, the results will be used in breeding programs for developing superior varieties for both farming community and pulse industry.

German and Indian partners at the project meeting

Nanotechnology



Source : gettyimages

Chemoenzymatic synthesis and development of biodegradable, structurally persistent core-shell nano-architectures for drug delivery applications (NANOTRANS)

Background

Ingestion (in the form of tablet, capsule or liquid) is the most widely accepted form of drug delivery to human body. However oral administration of drugs has its limitations because of short duration of circulation of drugs in blood stream, partial degradation of drugs before reaching the target site etc. This often forces an enhancement of drug dosage with associated problems of drug toxicity. Moreover, conventional drug delivery methods present difficulties for several new classes of pharmaceuticals and biologics such as peptides, proteins and DNA-based therapeutics.

This project aims at designing and developing novel nanomaterials based on a combination of linear and dendritic architectures to study the entrapment of the drug molecules and their controlled release at the target site.

Project Partners

University of Delhi

Freie Universität Berlin

nanopartica

Piramal
knowledge action care

Objectives

Medical sciences have benefitted from several path breaking discoveries from the past. However number of basic issues continue to exist as unresolved challenges.

One of the most daunting challenge is the problem of indicating dosage of orally administered drug reaching the target sites in the human body. This happens due to partial degradation of the drug due to bodies metabolism before it reaches target site. Increasing dosage in response is not the answer due to adverse side effects, systemic complication and toxicity problems. The goal of targeted drug delivery systems is to prolong localised target and have a protected drug interaction with the diseased tissue.

Advances in block co-polymer synthesis have led to polymeric micelles which have emerged as a novel and promising colloidal carrier for the targeting of poorly water soluble and ampiphlic drugs.

Polymeric micelles have been used as a potential carrier for a wide variety of drugs, due to their solubilization, low toxicity, long circulation, targeting and nano-size.

The objective of the project is to design and develop novel nanomaterials based upon a combination of linear and dendritic architectures and study the entrapment of the drug molecules in the nanoparticles and their biological response.

Strategic Approach/Action Plan

The work envisaged under the project has been divided between partner institutions as per details below :

Department of Chemistry, Univ. of Delhi

- Synthesis of Polyethylene Glycol (PEG) dicarboxylic acid, glycerol – PEG and azido glycerol- PEG diblock polymers.
- Synthesizing carbohydrate based building blocks for polymer synthesis.

Research Center of Electron Microscopy | Institute of Chemistry & Biochemistry, Freie Universität Berlin

- Synthesis of dendronized polymers from diblock polymers synthesized at Delhi University. Encapsulation and binding studies of dendronized polymers.
- Study of the structural properties of nanomaterials using electron microscopy.

Project Leadership

Sunil Sharma **Ashok Prasad**
University of Delhi
New Delhi, India

Christoph Böttcher **Rainer Haag**
Freie Universität Berlin
Berlin, Germany

Piramal
knowledge action care

Piramal Life Sciences Ltd.
Mumbai, India

Paul Servin
Nanopartica, GmbH
Berlin, Germany

Nanopartica

- Synthesis of alkyne functionalized [G1.0] (8) and [G2.0] (9) PG dendrons.

Piramal Life Sciences

- Formulation development and in vitro & in vivo studies.

Progress Made

- Synthesis of polyethylene glycol (PEG) dicarboxylic acid by the oxidation of PEG diols (Mn 1000, 1500, and 2000),
- The diacids were subsequently converted to diethyl esters for further polymerization with glycerol and related derivatives.
- Synthesis of amphiphilic polymers. First glycerol – PEG diblock polymer was synthesized using PEG (Mn 250) (Scheme 1). Presently work done to acylate the secondary hydroxyl of glycerol moiety with long chain aliphatic acids.

Synthesis of amphiphilic polymers

- Synthesis of 2-azido-1,3-propanediol by following Scheme 2.

Multi-gram synthesis of 2-azido-1, 3-propanediol (4).

- Synthesis of biodegradable (AB) n-type diblock polymer (6) from 2-azido-1,3-propanediol (azido glycerol) (4) and PEG-600 diethylester (5) using Novozym-435 (Candida antarctica lipase) as biocatalyst (Scheme 3). The diblock polymer 6 was used further for the synthesis of grafted polymers (10a-f) from alkyne functionalized [G1.0] (8) or [G2.0] (9) dendrons and octadecyl propargyl ether (7) (Scheme 3).

Synthesis of dendronized polymers

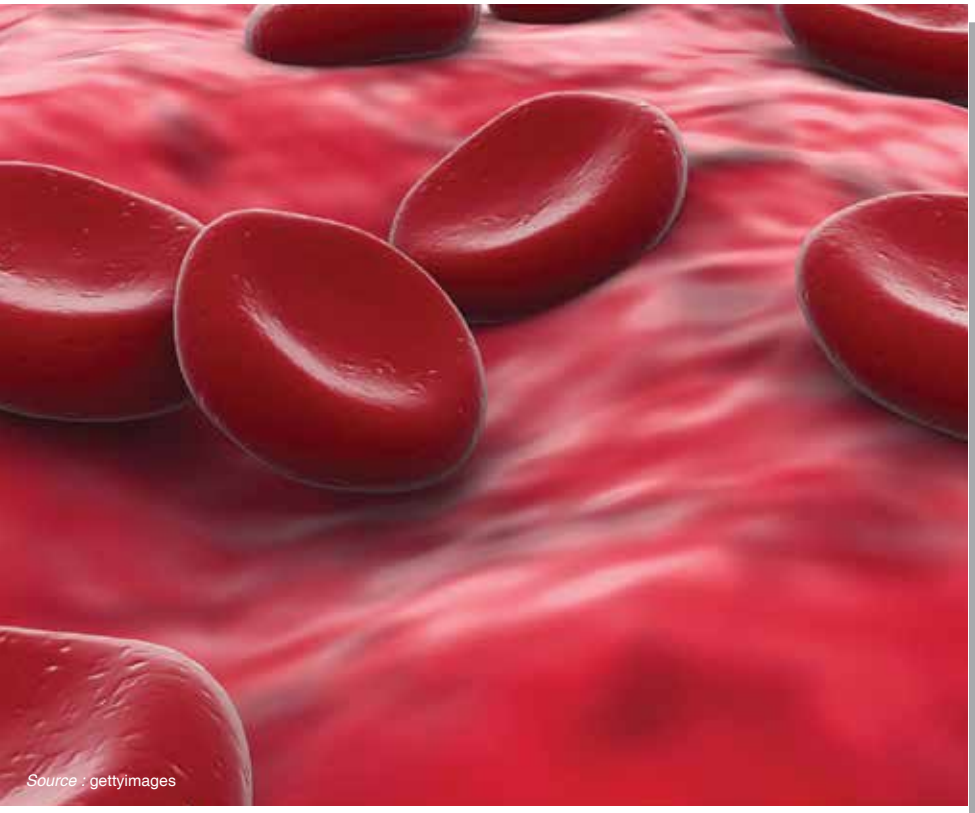
- Spectral and physical characterization of polymer 6 and dendronized polymers 10a-10f.
- Investigation of supramolecular self-assembly of the synthesized non-ionic multiamphiphilic polymers 10a-f in aqueous media using surface tension measurements, dynamic light scattering (DLS), and cryogenic transmission electron microscopy (cryo-TEM).
- Evaluation of the transport capacities of the aggregates using pyrene as a surrogate drug and the interaction with the guest molecules were investigated by ANS binding experiment.

Publications

Paper “Polyether based amphiphiles for delivery of active components” published in journal ‘Polymer’ [53, 3053-3078 (2012)] as a ‘Feature Article’.

A manuscript “Dendronized Multi-amphiphilic Polymers as Non-ionic Nano-transporters for Biomedical Applications: Synthesis, Aggregation Behavior and Transport Properties” published in the journal ‘Small’ 9(6), 894-904 (2013) by Willey Publications.

Nanotoxicology



Source : gettyimages

Development, characterisation and validation of nanoparticles for the adsorption of hydrophobic uremic toxins in renal failure patients (NPORE)

Background

The kidneys perform the essential function of removing waste product from the blood and regulating fluid levels. Kidneys of individuals suffering from chronic renal failure are unable to perform this task. Dialysis helps in alleviation of this condition. However, current dialysis techniques suffer from a major drawback in terms of poor elimination of protein-bound hydrophobic low molecular uremic toxins. This situation is strongly associated with cardiovascular disease in end-stage renal failure patients. So far, there are no available methods to eliminate these hydrophobic substances.

The goal of this project is the development/modification, characterisation and validation of nanoparticles for adsorption of the hydrophobic uremic toxins from serum of renal failure patients.

Project Partners

University of Hyderabad

Charité

Helmholtz-Zentrum Geesthacht
Zentrum für Material- und Küstenforschung

eXcorLab
BIOMEDICAL RESEARCH

Objectives

Patients with chronic kidney disease (CKD) and also those on dialysis (CKD-5D) show an increased cardiovascular mortality and morbidity due to several risk factors including diabetes, hypertension, and uremic retention solutes toxicity. Accumulated uremic toxins in CKD patients contribute substantially to the progression of cardiovascular disease. Hydrophilic toxins can be removed by conventional dialysis methods. However, hydrophobic uremic toxins, due to their protein-binding, are poorly cleared during conventional hemodialysis or even hemodiafiltration.

The project aims at the development, characterisation and validation of adsorbant particles for the removal of hydrophobic uremic toxins from plasma of chronic renal failure patients.

Deliverables

Synthetics: Optimised adsorbant nanoparticles for efficient binding of uremic toxins,

Analytics: Determination of capacity of modified nanoparticles in terms of binding to various hydrophobic uremic toxins such as phenylacetic acid, indoxyl sulfate and p-cresylsulfate

Biocompatability: A better understanding of biocompatability of nanoparticles and feasibility of their sterilization.

Biosafety: Determination of biosafety of particles in terms of toxic side effects using human cell culture models.

Strategic Approach/Action Plan

The work envisaged under the project has been divided between partner institutions as per details below :

Helmholtz-Zentrum Geesthacht

- Preparation of medical grade polymer particles in kg-scale with defined size and nanoporosity as well as comprehensive physico-chemical characterization thereof,
- Hydrophilic modification of the outer particle surface for optimization of the particles wettability and hydrophobic modification of the nanoporous inner surface for selective adsorption of uremic toxins,
- Development of a suitable sterilization process for the modified particles.

Charite, University Berlin

- Analytics of toxin adsorption by nanoparticles (Preparative and analytical RP-HPLC and LC-MS),

Project Leadership

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School of Life Sciences
University of Hyderabad

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Helmholtz-Zentrum Geesthacht,
Institute of Biomateral Science

Joachim Jankowski
Department of Nephrology
Charité, Universitätsmedizin Berlin

Syngene International Ltd.
Bangalore, India

Horst-Dieter Lemke
eXcorLab GmbH,
Obemburg, Germany

- Quantification and identification of protein species adsorbed to the nanoparticles - (chromatographic and mass-spectrometric methods),
- Absorption capacity of the nanoparticles to uremic toxins (LC and MS techniques),
- Surface characterisation of the nanoparticles (MALDI imaging mass spectrometry).

eXcorLab GmbH
Determination of suitable sterilization protocol for nanoparticles – steam and irradiation methods,

Bio/hemocompatibility of nanoparticles with human blood cells (neutrophils and platelets)– ELISA, flow-cytometry and microscopy

University of Hyderabad

- Inflammatory effect of nanoparticles on cultured human blood monocytic cell line: ELISA, flow-cytometry and RT-PCR,
- Inflammatory and oxidative stress effect of nanoparticles on cultured vascular cells of human arterial origin- ELISA, flowcytometry, gene chip assay and RT-PCR,
- Apoptotic effect of nanoparticles on vascular cells of human arterial origin – RT-PCR, fluorimetric and colorimetric assays.
- Animal studies - Determination of biocompatibility of nanoparticles,
- Development of animal models of Chronic Kidney Disease and quantification of hydrophobic uremic toxins,
- Determination of hydrophobic uremic toxin adsorption by nanoparticles in animal models of CKD.

Automotives

Source : gettyimages

Architecture-aware timing analysis and optimization of safety-critical automotive software (AUTOSAFE)

Background

Today, high-end cars have between 50-100 processors or electronic control units (ECUs) which support a variety of safety-critical, driver assistance and entertainment applications. However, ensuring the correctness of such software involves several software engineering, testing and debugging challenges, and pose major hindrance to the introduction of advanced functionality like next-generation driver assistance systems.

Current software testing and debugging methods are focused on functional verification. Ensuring the real-time properties of software is still largely done on an ad-hoc basis, with high post-implementation testing, debugging and integration costs.

The goal of this project is to develop systematic approaches to timing analysis and optimization of automotive software.

Project Partners

Objectives

The goal of this project will be to develop systematic approaches to timing analysis and optimization of safety-critical automotive software. In particular, we will develop a design flow and associated tool support using which software timing issues may be addressed at the initial design phases. This will significantly improve the reliability of safety-critical automotive software, will increase the level of confidence in the software, will help in certification or regulatory compliance, and will cut down integration, testing and debugging costs.

Strategic Approach/Action Plan

The above research plan will be executed in the form of the following work packages.

WP1 (Tool study): A detailed study of the capabilities and the workings of the various tools involved.

WP2 (Timing analysis of code from Simulink/ Stateflow/Statechart specifications):

Program path analysis techniques for code generated from Simulink/Stateflow or Statechart specifications. In particular investigations on how much improvement may be obtained by taking into account model-level information.

WP3 (Extending Model Analyzer from TRDDC with system-level timing information): Finding the longest feasible path in a Statechart specification, which in turn will be used to check if the reaction time of the Statechart is always less than the budgeted time to give a reasonably good approximation of whether the Statechart is guaranteed to react within a given deadline.

WP4 (Language formalisms for capturing safety-critical real-time requirements and interactions between multiple high-level models):

The outcome of this WP will be a reference language and a study on complexity of verifying different performance requirements.

WP5 (Verifying control performance): Compute lower bounds on timing constraints that are necessary to satisfy control goals and verify them using code and system-level timing analysis techniques. This will involve an integration of several tools like Model Analyzer, TECA and chronVAL.

WP6 (Tool integration for improved testing): The AutoGen tool from TRDDC generates test data for Modified Condition/Decision Coverage (MC/DC) as well as for boundary value coverage. The goal of this WP will be to extend AutoGen for timing analysis for which

Project Leadership

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Pune, India

Karsten Albers
INCHRON GmbH
Potsdam, Germany

new coverage criteria will be explored to help detect timing- related bugs.. This will involve integrating AutoGen with chronSIM from INCHRON.

WP7 (System optimization): As outlined in the research plan, we will also investigate techniques for automatically synthesizing implementations from high-level models and control performance requirements. Towards this, advanced optimization and schedule synthesis techniques will be explored. Multi-objective optimization techniques will also be studied.

WP8 (Case studies): The research results and tool integration techniques developed in the project will be evaluated through a number of realistic case studies, which will be formulated in consultation with all the industry partners.

Deliverables

Work done in all the work packages (WP1 – WP8) will be documented as research reports. WP2, WP3, WP5 and WP6 will lead to new interfaces and integration of testing and verification tools from TRDDC and INCHRON. Depending on the results of such integration, the involved industrial partners might decide to develop new tool sets.

WP4 will result in a reference specification language and the work from WP5 and WP7 will be implemented as software prototypes. Over the 3 years (duration of the project), at least 6 peer-reviewed (two/year) research papers will be submitted for publication.

Photovoltaics


Source : gettyimages

Reduction of earth metals in chalkopyrite-based solar cells (REMSOLAR)

Background

Solar films currently in are based on the Copper-Indium-Gallium Diselenide (CIGS) compound. Though well proven, CIGS is going to face a significant increase in production costs in the future due to limited known global reserves of Indium and Gallium.

To overcome this challenge it is required to : *a) develop compounds for use in solar films that do not have Indium/Gallium as constituents* and *b) reduce thickness of existing CIGS based solar films to reduce the quantity of Indium/Gallium used per unit area. Copper-Zinc-Tin-Sulfide (CZTS) compound is viewed as a potential substitute for CIGS (as it replaces Indium/ Gallium with Zinc and Tin).*

This project focuses on improving efficacy of CIGS based solar films as well as development of a better understanding of CZTS compound starting with its precursors.

Project Partners

manz
passion for efficiency

Objectives

Copper - Indium - Gallium - Diselenide (CIGS) based thin-film solar-cells have promising characteristics for large scale implementation. However, relatively limited reserves of Indium and Gallium used in this material are expected to result in increasing costs of CIGS. To address this challenge what is required is a two pronged approach. It is an urgent need to find substitutes for Indium and Gallium in manufacturing of solar cells. In the interim we need to reduce the thickness of solar film so that less of Indium and Gallium is used per unit area, but without compromising on efficacy and efficiency.

The objectives of this project are

- to develop a better understanding of Zinc and Tin as substitutes for Indium and Gallium and develop the compound Copper-Zinc-Tin-Sulfide (CZTS) as a substitute for CIGS, and
- to improve the efficacy of CIGS itself to enable use of thinner films requiring less of Indium and Gallium per unit area.

Deliverables

- Model process for CIGS growth with reduced layer thickness and preserved or improved photovoltaic properties
- Model process for Kesterite growth with reduced layer thickness and preserved or improved photovoltaic properties
- Report on scientific and economic potential of both approaches and benchmarking

Strategic Approach/Action Plan

The work envisaged under the project has been divided between partner institutions as per details below :

IIT Kanpur

- Deposited Kesterite layers will be comprehensively characterized in terms of geometrical, chemical and physical properties.
- Ready solar cells prepared from the layers will be characterized in terms of photovoltaic properties.
- Special attention will be paid to the role of sulfur for film growth and photovoltaic performance.

MLU Halle

- Deposited CIGS layers will be comprehensively characterized in terms of morphological, chemical and physical properties. Complete solar cells prepared from the layers will be characterized in terms of photovoltaic properties. Special attention will be paid to the role of sulfur

Project Leadership

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Roland Scheer
Martin-Luther-University
Halle-Wittenberg, Germany

Moser Baer India Ltd.
NOIDA, India

manz
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Ralf Sorgenfrei
Manz CIGS Technology GmbH
Sechwabisch Hall, Germany

for film growth and photovoltaic performance.

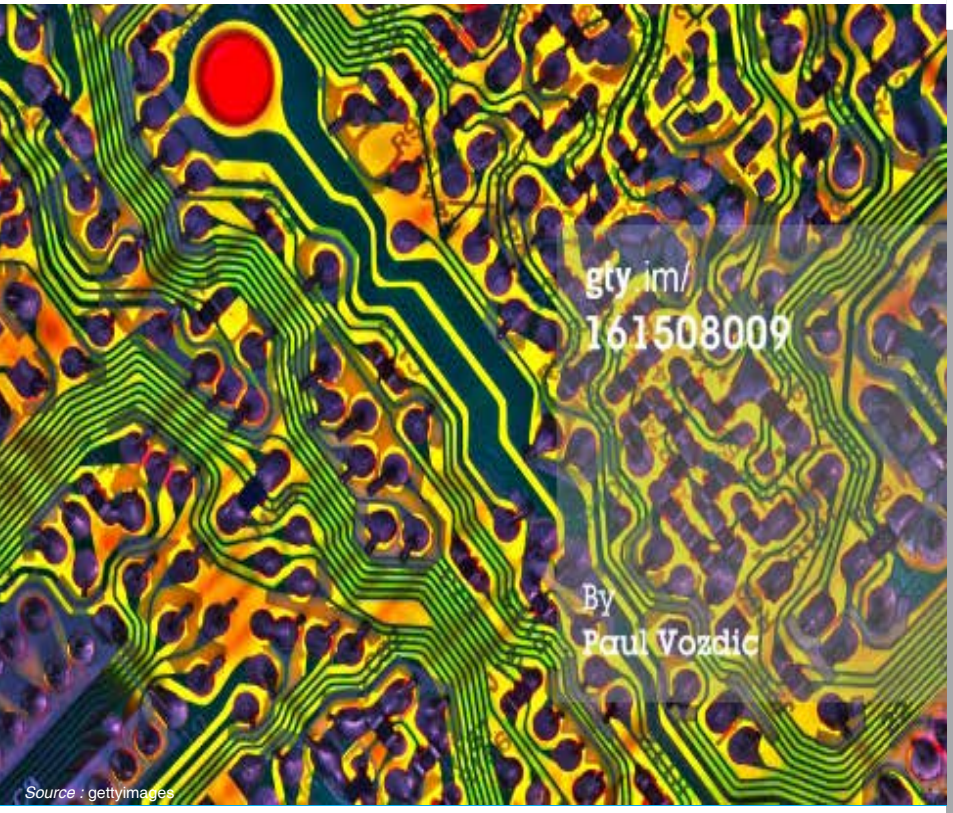
Moser Baer

- Kesterite layers of different compositions will be grown using vacuum deposition techniques under varying conditions.
- An optimized model process for the growth of Kesterite will be developed and demonstrated by improved solar cells.
- Growth processes for Kesterite compatible with an industrial scale will be designed and realized in prototypical experiments.

Manz

- CIGS layers of different compositions will be grown using vacuum and atmospheric deposition and annealing techniques under varying process conditions.
- Growth processes for CIGS layers compatible with an industrial scale will be designed and realized in prototypical experiments. These processes will be benchmarked against established technologies for CIGS-layer formation.

Electronics



Source : gettyimages

Flexible printed integrated disposable electronics (FLEXIPRIDE)

Background

Flexible Electronics is a technology for assembling electronic circuits by mounting electronic devices on flexible plastic substrates using printing technology.

This project focuses on development of multifunctional flexible electronic circuits by integrating electronic components with circuit design and simulations.

It also plans to develop an optical device to monitor substrate layer thickness of flexible electronic circuits, including structural defects that occur during printing.

Project Partners

Indian Institute of Technology Kanpur

Technische Universität Chemnitz

chromasens
Imaging for Professionals

Anil Printers

Deliverables

- Develop a demonstrator with printed solar cell and an active RFID with printed antenna and with printed connectors.
- Develop a device model to simulate the circuits and other individual components like solar cells, transistors and electrochromic or light emitting displays in the circuit.
- Develop an optical system using different sensors and methods for detection of defects.
- Develop an optical system to measure the thickness of the printed layers.
- Combine defect detection and thickness measurement in one system to be mounted on the printing machine.

Strategic Approach/Action Plan

The work envisaged under the project has been divided between partner institutions as per details below :

TU Chemnitz
TU Chemnitz will work as the project coordinator. TU Chemnitz will research on improving the performance of the solar cell in terms of lifetime and efficiency including the printing of different printed electronic components like pressure sensors conductive lines and RFID antennas will be integrated on one substrate.

Chromasens
Chromasens will develop inline system to inspect and control the quality of roll-to-roll printed functional layers and printed electronic devices. The inline system will detect structural defects and inhomogeneity in layer thickness by optical methods.

Anil Printers
Inexpensive conductive ink will be tested for printing of antennas on paper or plastic substrate and process parameters will be optimized for antenna design and conductivity of the printed layers. Coding and decoding algorithms will be developed for the printed RFID technology. Communication between reader and printed RFID tag will be optimized.

IIT-Kanpur
IITK will engage in development of printed low power polymer EL segmented mono-color. Device modeling along with parameter extraction for the printed electronic components alongwith the design and simulation of a 1-bit RFID circuit will be carried out. Circuit designs will be optimized for different frequencies 2D device simulations will be used to fine tune the device design to achieve optimal circuit performance.

Project Leadership

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Materials Science

Visualization of automated multi-sensor NDT assessment of concrete structures (NDT DATA FUSION)

Background

Regular inspection of concrete structures with respect to strength and other structural properties, forms the basis for planning their maintenance and repair. Effective inspection of a body of concrete for structural and material properties is not possible with any one single method. Effects of deterioration processes and structural changes are non-uniform in nature and must be addressed by a combination of tools and approaches.

The objective of this project is to develop an automated scanning system that is capable of collecting multi-sensor data on the same test object and effectively combining the multimodel results. This involves a series of mechanical adjustments and software enhancement.

Project Partners

CSIR.INDIA

BAM

LUCID

SPECHT KALLEJA PARTNER
GMBH · BERATENDE INGENIEURE
INGENIEURBÜRO FÜR BAUWESEN

Deliverables

Concept for scanning system
Development of conceptual design for electro-mechanical parts of the scanning system, including holders for sensors, definition of test area (movement area of sensor heads), and mounting of scanner on object being investigated.

Scanning system Prototype
Development of prototype technology to examine functionality and performance of the system proposed to be developed. This prototype will be equipped with the selected sensors and will have most of the basic functions of the final device. Tests in laboratory and preliminary field tests can be carried out with this early stage demonstrator.

Description of Data Fusion algorithms and implementation
Examine the effectiveness of various algorithms for fusion of measurement data coming from different sources.

Concept for data acquisition, data processing and visualisation

Description of the conceptual framework for handling of recorded data and creation of modular software toolbox containing multiple data and image processing algorithms and components for active data visualization.

Progress Made

A literature survey was carried out on various non-destructive methods such as ground penetrating radar, ultrasonic pulse echo and impact echo techniques. Concrete specimens with induced defects such as honeycombs as well as the concrete specimen structure with reinforcements and ducts of 60 mm diameter were cast.

The data was collected with radar, impact echo and pulse echo techniques manually, after curing and laying a 50mm spacing grid on the specimen.

Each individual modality has been seperately analysed and various fusion schemes were tried on this preliminary dataset. In addition, the specifications for the automatic scanner have been worked out.

Project Leadership

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Materials Science

Source : gettyimages

Integration of non-destructive evaluation based ultrasonic simulation (INDEUS)

Background

Safety critical Aerospace, Civil and Mechanical structures require advanced inspection toward early detection of material flaws and structural damages. Durability and life span of these structures can be predicted once these flaws are monitored whenever required and accurately. Therefore, Non-Dectructive Evaluation (NDE) of structures toward Structural Health Monitoring (SHM) is an emerging field of technological development.

This project aimes at integrating Non Destructive Evaluation (NDE) based ultrasonic simulation with other commercially available open simulation platform for a structural health monitoring of Safety critical aerospace, civil and mechanical structures for optimum life cycle.

Project Partners

Indian Institute of Science

IZFP

IMA Dresden

Mahindra Satyam

Objectives

The objective of this proposal is to establish a simulation platform in NDE with an emphasis on Structural Health Monitoring (SHM).

This is to facilitate the understanding of physical parameters travelling through arbitrary structures and to identify an optimum transducer configuration for structures to become self-monitoring in the sense of SHM.

Strategic Approach

The project proposed is split into eight work packages and also includes full validation of a series of open issues related to acoustic waves and their 3D visualization mainly on a proof of concept basis.

It will then look into getting the simulation platform established in terms of adding a variety of essential plug-ins and standardizing interfaces including Graphic User Interfaces. Finally a complete documentation will be established.

The project will include a variety of simulation cases as well as experimental validation.

Deliverables

Significance of the project can be seen in a way that an open simulation platform is provided that allows latest findings in wave propagation to be merged with commercial software codes allowing SHM systems to be determined for individual damage tolerant components at optimized conditions.

Results expected include:

- A simulation platform linking RTSFEM with conventional CAD, FEM and NDE software to allow for simulation of NDE phenomena in the light of designing optimized SHM systems including the respective software manuals.
- Plug-ins for integrated simulation of stress analysis, fatigue life prediction for simulated probability of damages,
- A validation test performed in accordance to a defined aeronautical component,
- A comprehensive report including a number of tests, simulations and validation studies,
- A documentation of the simulation platform itself.

Project Leadership

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Bangalore, India

Christian Boeller
IZFP, FhG
Saarbrucken, Germany

Rainer Franke
IMA
Dresden, Germany

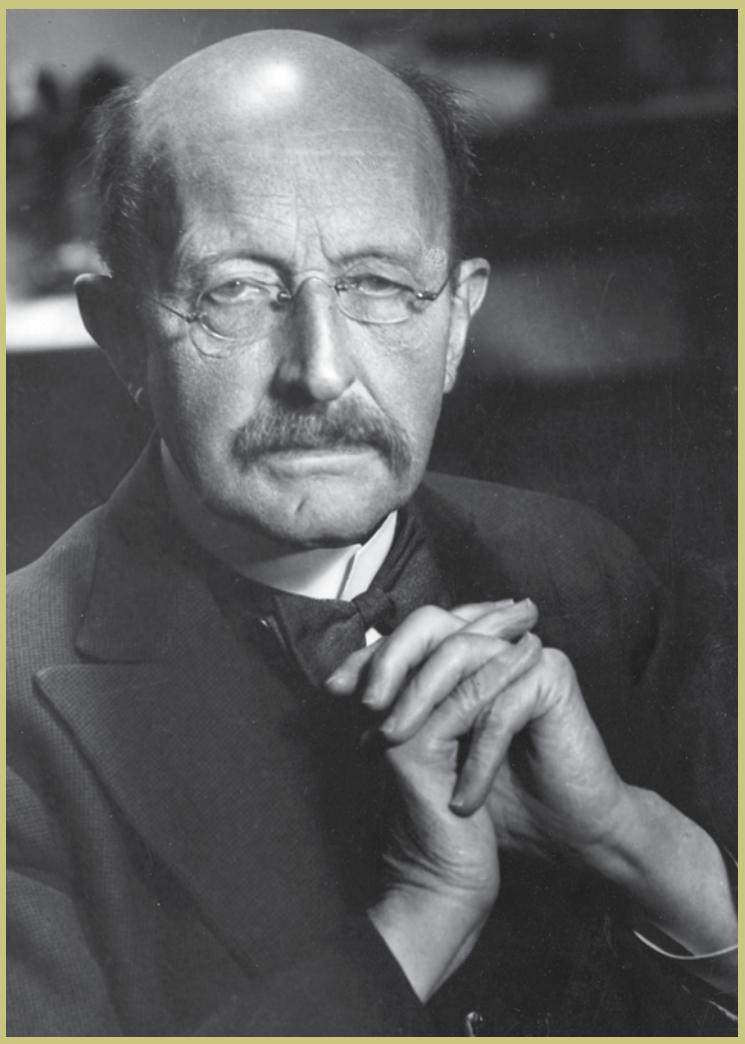
Srinivasan Ramaprasad
Mahindra Satyam Ltd.
Bangalore, India

सत्यमेव जयते
Department of Science & Technology
Government of India

MAX-PLANCK-GESELLSCHAFT

DST–Max Planck Society Program

Connecting Excellence



Source : Max Plank Society

The Department of Science & Technology (DST), Govt. of India and Max Planck Society (MPG), Germany have collaborated, through an agreement signed in 2004, to constitute and operationalise DST – Max Planck Society Program.

IGSTC has been entrusted with the responsibility of implementing the DST/MPG Program from Indian side.

'Science cannot solve the ultimate mystery of nature. And that is because, in the last analysis, we ourselves are part of nature and therefore part of the mystery that we are trying to solve.'

Max Planck

Ongoing Initiatives

Running since year 2004, the DST-Max Planck Society Program has two flagship initiatives under its umbrella aimed at creating opportunities for collaboration and sustained interactions with S&T research priorities.

Max Planck Partner Groups at Indian Institutes

The "Partner Group" is an instrument created by the Max Planck Society (MPG) for the purpose of strengthening the ties between Max Planck Institutes and research institutes from other countries. Partner Group is a mechanism to intensify cooperation between individual scientists through jointly conceptualized and implemented S&T research projects.

The "Max Planck Partner Groups at Indian Partner Institutes" has been developed as an instrument for supporting collaborative research in target areas prioritized on the basis of their relevance to immediate problems and interests of institutions involved from both sides.

Partner Groups are headed by Indian scientists who return to India after completing their extended research residency at a Max Planck Institute. Partner Groups allow the involved scientists to lead appropriately equipped research groups in order to continue their research activities in close co-operation with their former German hosts.

Each Partner Group is supported to the tune of €20000 per year by MPG with a matching contribution of equivalent ₹ amount by the DST. Grants are expected to be utilized, as far as possible, for the purpose of creating MPI like facilities at the respective Indian host institutions.

Max Planck-India Visiting Fellowship

Max Planck-India Visiting Fellowship is a distinction for highly qualified and talented scientists. The Fellowship is awarded to scientifically outstanding, promising young Indian scientists.

Individuals selected for the award get the opportunity to work with Scientists at the Max Planck Institute (MPI) relevant to their area of expertise for up to 2 months a year for four consecutive years.

Fellowship holders receive from MPG a sum of €3,000 per year, for up to four years, with Indian side providing travel support for each research stay.

Max Planck Partner Groups at Indian Institutes

The Partner Groups that have been set up at various institutions are as under:

Gravitational Wave Physics
(2011 - 14)

Indian Institute of Science Education and Research Thiruvananthapuram	 Archana Pai	Max Planck Institute for Gravitational Physics Potsdam	 Bernard Schutz

Gravitational waves (GW) are ripples in the curvature of spacetime which propagate as a wave, travelling outward from the source. The Partner Group will work on generating analytical waveform and gravitational wave data analysis to focus on solving the equation of motion through detection and parameter estimation of GW.

Cosmology & Gravity
(2011 - 14)

Indian Institute of Science Education and Research Thiruvananthapuram	 S. Shankaranarayanan	Max Planck Institute for Gravitational Physics Potsdam	 Herman Nicolai

The partner group shall focus on the top-down approach to quantum gravity as opposed to the traditional bottom-up approaches like the string theory or loop quantum gravity. The main aim will be to use observations to build reliable models of quantum gravity and look for broad features with robust experimental signatures.

Genetic Diversity Studies
(2011 - 14)

Centre for DNA Fingerprinting and Diagnostics, Hyderabad	 Madhusudan Reddy Nandineni	Max Planck Institute for Evolutionary Anthropology, Leipzig	 Mark Stoneking

The partner group aims at discovering new bacterial species which can affect the residing salivary microbiome in the human population of India from various regions having differing food habits and cultural backdrops. The group seeks to determine whether the Indian population have a basic core microbiome for saliva.

Glyconano-Technology
(2011-14)

Indian Institute of Science Education and Research, Pune	 Raghavendra Kikkeri	Max Planck Institute for Colloids and Interfaces	 Peter H Seeberger

The Partner Group will focus on engineering of multifunctional nanoparticles that can exploit biological processes to guide the carbohydrate mediated targeting, self-assembly, and remote actuation of nanoparticles to treat tumors in mouse models of cancer. The longterm goal of this project is to amplify carbohydrate mediated tumor targeting to enhance diagnostic and therapeutic capabilities.

Chemical Ecology (Plants-insect interaction)
(2011-14)

Indian Institute of Science Education and Research Kolkata	 Shree Prakash Pandey	Max Planck Institute for Chemical Technology Jena	 Ian T. Baldwin

The Partner Group plans to undertake detailed study to understand the role of small-regulatory RNAs (SmRNAs) in plant defence mechanisms against herbivores. The main hypothesis being tested as part of the project is the post-transcriptional regulation by small RNAs and the insect defense pathways.

Structural Biology of Vesicular Trafficking
(2011-14)

Indian Institute of Science Education and Research, Bhopal	 Sunando Datta	Max Planck Institute of Molecular Cell Biology and Genetics, Dresden	 Marino Zeria

The partner group is focussing on Screening of putative Rab5 GAPs for their role in Rab5 to Rab7 conversion with Structural elucidation of P5 protein complex: towards understanding the structure-function relationship in a highly conserved endocytic protein machinery.

Atmospheric Chemistry & Composition
(2011-14)

Indian Institute of Science Education and Research, Mohali	Vinayak Sinha	Max Planck Institute for Chemistry Mainz	Jos lelieveld
			

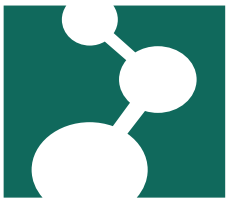
The OH radical is key to understanding the overall chemistry of the atmosphere and fuels ozone and secondary organic aerosol formation. The partner Group aims at initiating a systematic state of the art measurement program in India for understanding the atmospheric oxidation capacity driven by the OH radical and reactive VOC emissions and their climate and air quality ramifications.

Data Management & Mining
(2011-14)

Indraprastha Institute of Information Technology, Delhi	Srikanta Bedathur	Max Planck Institute for Informatics, Saarbrucken	Gerhard Weikum
			

The partner group is working on various facets of large-scale graph mining and searching. The focus will be mainly on developing scalable algorithms which can be integrated into the modern graph data management systems such as RDF-3X, with three components: (i) navigation problems on large graphs, (ii) visual exploration of graphs and (iii) modelling and mining of dynamic graphs.

Polymer Synthesis and Application
(2011-14)

Indian Institute of Technology Guwahati	Parameswar K. Iyer	MPI for Polymer Research Mainz	Klaus Muellen
			

The Partner Group aims to develop new conjugated co-polymers with enhanced optical, electrical and thermal properties that can be used as material for efficiently harvesting light and electric charge in devices such as photovoltaic cells and light emitting diodes.

Max Planck-India Visiting Fellowship

Since the involvment of Indo-German Science and Technology Centre with the Max-Planck India Visiting Fellowship program the following three fellowships have been awarded :

Polyphasic Taxonomic Characterization of Marine Bacteria

National Institute of Oceanography, Goa	S. Krishnamurthi	MPI for Marine Microbiology Bremen	Rudolf Amann
			

The project focuses on isolation and valid taxonomic characterization of marine bacteria on the application of a set of cultivation-independent tools of molecular biology. The team envisages use of combination of molecular techniques including tag sequencing of 16S rRNA genes, CARD-FISH (catalyzed reporter deposition FISH) and GeneFISH.

Deciphering the Role of the Flanking N- and C- Terminal Regions in Modulation of Photocycle Kinetics of a LOV Domain

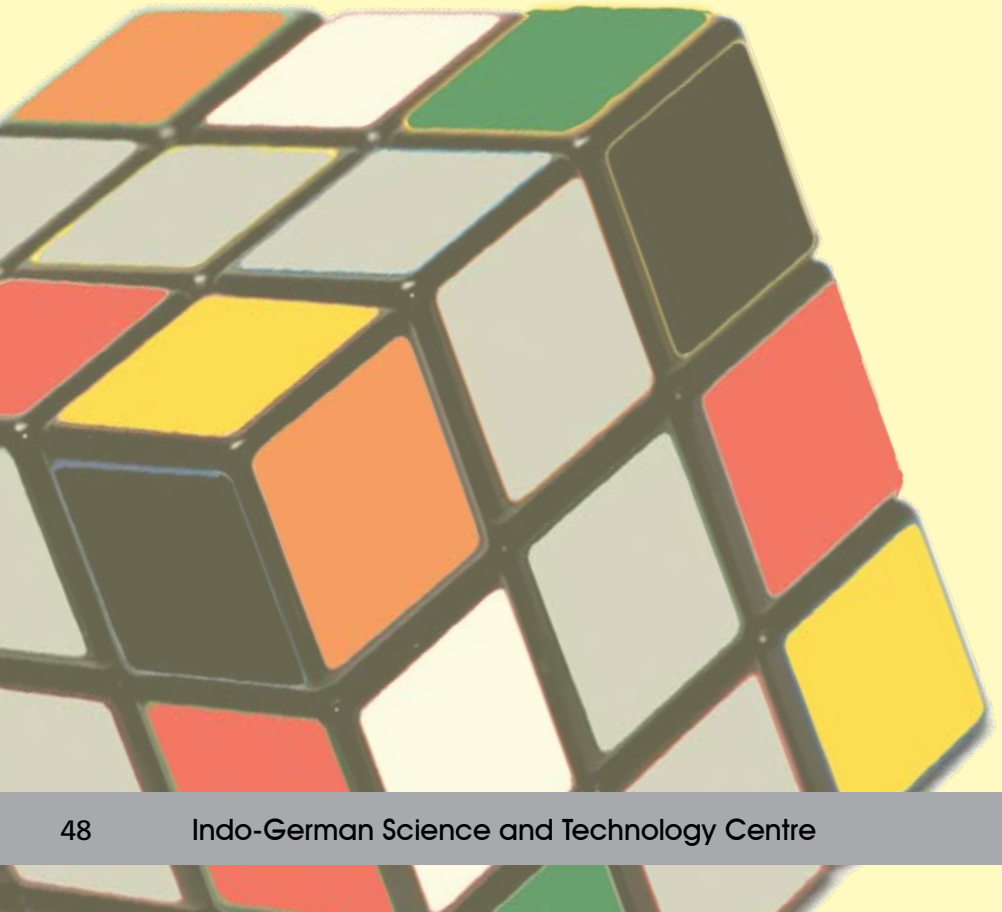
Delhi University	S. Kateria	MPI for Bioinorganic Chemistry Mülheim	Wolfgang Gaertner
			

This is a collaborative project in the area of photoreceptor biology. It shall focus on deciphering the mechanistic basis of modulation of recovery of OLOV1 domain using structural, biochemical, spectroscopic and bioinformatic tools. It seeks to develop new light sensor-based protein tools for biotechnological applications and optogenetics.

Transition Metal Dithiolato Complexes as Functional Models for Hydrogenases

Delhi University	Sandeep Kaur	MPI for dynamics of complex technical systems, Magdeburg	Matthias Stein
			

The collaboration aims at theoretical characterization of biomimetic complexes that catalyse the reversible reduction of protons to molecular hydrogen. Structure-function relationship of synthesized model complexes may develop into unprecedented bio-inspired proton reduction catalysts for low cost hydrogen production.



Source : gettyimages

Memorandum of Understanding

MEMORANDUM OF UNDERSTANDING
on the creation of an
Indo-German Science and Technology Centre
between
THE MINISTRY OF SCIENCE AND TECHNOLOGY
of the Government of the Republic of India
and
THE FEDERAL MINISTRY OF EDUCATION AND RESEARCH
of the Government of the Federal Republic of Germany

In pursuance of the joint statement issued on 23rd April 2006 by the Heads of Government of the two countries, the Ministry of Science and Technology (MST) of the Republic of India and the Federal Ministry of Education and Research (BMBF) of the Federal Republic of Germany reiterating the importance of continued cooperation between India and Germany in the fields of science, research and technology as well as industrial research and development, decide to establish an Indo-German Science and Technology Centre (IGSTC), within the framework of the provisions of the Inter-Governmental Agreement on Cooperation in the Field of Scientific Research and Technological Development signed in 1974. The Department of Science and Technology (DST) and BMBF are the nodal implementing agencies. Other departments, councils and agencies involved in bilateral science and technology cooperation between India and Germany are invited to actively participate and support this Centre and fund joint projects in their respective field.

Name and Location

The Centre will be named the **"Indo-German Science and Technology Centre"** (IGSTC) and will be established in New Delhi. The IGSTC in New Delhi would be registered as Society under the Societies Registration Act (Act XXI of 1860, Punjab Amendment Act 1957) as extended to Delhi. The IGSTC will be linked to the International Bureau (IB) of the BMBF in Germany.

Objectives

The IGSTC shall facilitate and promote the interaction, in India and Germany, of government, academia and industry, in science and technology. It is to build and improve research and technology synergies

between both countries, focusing primarily on natural, life, and engineering sciences. The programme funding by the IGSTC will be provided by the two governments and the private sectors of both countries based on the principle of reciprocity in areas of combined interests of both countries.

The objectives of the IGSTC are to

- play a proactive role in facilitating participation of industry in joint R&D projects,
- provide/assist in mobilizing resources to carry out industrial R&D projects,
- promote electronic exchange and dissemination of information on opportunities in bilateral S&T 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, one from each country,
- provide individual advice to institutes and industries from either country, the possibilities of Indo-German cooperation and help in the identification of suitable partners,
- facilitate and promote Indo-German bilateral collaboration in basic and applied science, research and technology through substantive interaction among government, academia and industry,
- encourage public-private partnerships (PPP) to foster elements of innovation and application and cultivate a culture of cooperation between science and industry,
- nurture contacts between young and mid career scientists and technologists to develop a sense of mutual trust, leadership and entrepreneurship,
- develop cooperation through the identification of scientists and scientific institutions of the two countries,
- organize workshops, seminars, training programmes and other types of events on topics of mutual interest, and to
- support or conduct any other mutually agreed future activities.

Involvement of Industry (Public-Private Partnership for Industrial Research, Technology Development and Transfer)

- The IGSTC will primarily act as a catalyst for synergizing resources with industrial relevance and application; it will also further strengthen bilateral cooperation in basic research.
- The IGSTC will fund selected R&D projects linking research and industry ("2+2 schemes").

Administration & Organization

- The IGSTC will work according to Terms of Reference (t. b. d.) mutually agreed by both governments.
- The IGSTC will have a "Governing Body" (GB) comprising of up to 5 members from each side representing the ministries, academia and industry. The GB shall be chaired by the chairs of the bilateral inter-ministerial working group agreed upon in the summary record of the Indo-German Committee on Science and Technology on 25th September 2006. Therefore meetings of the GB will be coordinated with the meetings of the inter-ministerial working group. Both sides will nominate its other members of the GB from ministries, academia and industry and may also include expert members as invitees.
- The GB shall meet annually alternately in India and Germany.
- The IGSTC will be administered by an Indian Director, nominated by consensus by the Indian and German governments. The Director will have a term of 3 years with the possibility of a 2-year extension. His responsibilities will be agreed upon by both ministries in the Terms of Reference (t. b. d.). Support staff as approved by the GB will be recruited locally by the Director.
- The IGSTC's work relating to jointly funded projects will be linked to BMBF (Germany) and DST (India), which will be responsible for administration of the jointly funded projects on the German and Indian side respectively for (co-) publishing joint calls, receiving proposals, coordinating the evaluation, funding and managing the joint projects. Details will be laid down in the Terms of References (t.b.d.) of the Centre.
- The GB shall receive an activity report of the Director before its meetings and agree in advance to all major decisions and the annual plan of activities proposed by the Director.

Financing

- The IGSTC itself will be funded jointly by the governments of India and Germany.
- Both governments will allocate up to 10 million Euros each to meet the objectives of the Centre and its running expenditure for initial 5 years. The annual expenditure may be enlarged by mutual agreement.
- For industrial R&D projects a substantial part of the project cost must be met by industry in compliance with the national laws of the respective sides and EU-laws as far as applicable to the German side.

Status Evaluation

The status of the IGSTC and its progress in carrying out the Terms of Reference (t. b. d) will be jointly reviewed after 3 years from the start of operation of the Centre. Given a positive result both ministries will continue their commitment for an additional 2 years. After this period both ministries will jointly decide on their further commitment.

Done at New Delhi on the _____* in two originals in the English, Hindi and German languages, all texts being equally authentic. In case of any divergence in interpretation, the English text shall prevail.

Dr. Annette Schavan
Federal Minister of Education
and Research of the
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Kapil Sibal
Minister of Science & Technology
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* Signed on 30th October 2007

Notes

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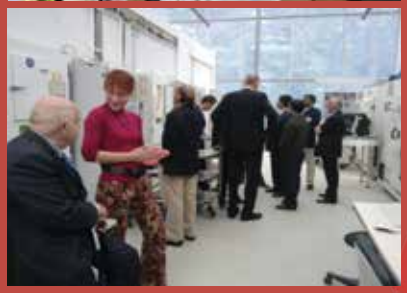
IGSTC Over the Years
Through the Lens



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