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R&D Newsletter

INDIAN INSTITUTE OF TECHNOLOGY KANPUR

artistic impression of Flexible Electronics Centre

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Inauguration of
National Centre for Flexible Electronics

The Launch and Foundation Stone Laying ceremony of National Centre for Flexible Electronics took place on July 1st, 2015 at Outreach Auditorium of IIT Kanpur. This event was a part of the 'Digital India' initiative of Government of India which was held in the Indira Gandhi Indoor stadium, Delhi. Honourable Prime Minister, Shri Narendra Modi launched the National Centre for Flexible Electronics which is established jointly by the Department of Electronics and Information Technology (DeitY) and IIT Kanpur. Director, Prof lndranil Manna, was present in the main function. The event was webcasted live in the outreach auditorium of IIT Kanpur and was witnessed by many faculty members and students. Deputy Director, Prof. Ajit Chaturvedi unveiled the foundation stone of the centre in the presence of Prof. Amalendu Chandra, Dean Research and Development and other faculty members involved with this centre.

The centre is being established to provide developmental platforms to industry while acting closely with them to prototype innovative products. The group at IIT Kanpur has been working in this area for over a decade with focus on organic electronics and OLED displays, and has developed national and international collaborations for projects on printing of polymer transistors, solar cells, sensors and other components. The centre will strive to bring together material suppliers, requisite unit processes and components needed for system development. It will also spearhead the preparation of a national roadmap for the area of flexible electronics keeping in mind international developments. The centre would work closely with industry to develop such products for commercialization.

BHEL & IIT Kanpur Collaboration

BHEL, one of the Navratnas in the public sector, and a premier electrical engineering company & IIT Kanpur have signed industry-academia agreement. This agreement was signed by Dr. Umakant Choudhury, Executive Director (R&D), BHEL Corporate R&D Division, and Prof. Manindra Agarwal, Acting Dean, Research and Development, IIT Kanpur, in the presence of Shri TN Veeraghavan, Director (Engineering, R&D), BHEL, and Prof. Indranil Manna, Director, IIT Kanpur. This agreement is aimed at leveraging the extensive and state of the art infrastructure available at BHEL with the high end intellectual and technological capabilities of IIT Kanpur to undertake path breaking research relevant to energy transportation, transmission and industry. This collaborative effort would also aim to the enhancement of human resource of BHEL in frontier technology domain through an extensive capacity building exercise. BHEL has also agreed to donate an endowed chair-position at IIT Kanpur to facilitate this effort. The primary focus areas of collaboration to name a few would be in the domain of combustion process, thermodynamics, fluid mechanics, mechanical design/analysis, acoustics, manufacturing, materials, surface engineering, nano technology, electrical machines and power systems.

8th Indo-Singapore Symposium in Condensed Matter Physics

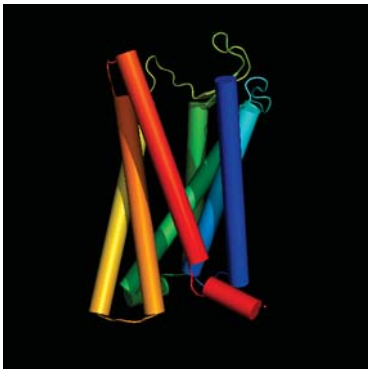
The 8th Indo-Singapore Symposium in Condensed Matter Physics was held in IIT Kanpur during 25-27 February, 2015 in the outreach auditorium. The symposium had 11 invited speakers from Singapore and 21 from within India speaking on their work in the following theme areas: Graphene & other 2D Materials, Magnetism and Multiferroicity, Strongly Correlated Systems, Meta Materials/Soft Condensed Matter, Materials and devices for nano, bio or energy applications. This symposium brought together a group of active scientists in relevant areas from within India and Singapore to facilitate scientific communication and collaborations. More information about this symposium is available on http://www.iitk.ac.in/indosing2015/. The financial support was provided by IITK, DST, and industrial sponsors (Icon Analytical, Gatan, JEOL and Excel Instruments). About 70 junior scientists or Ph.D. students also presented their work as posters in two different sessions. Four posters were selected for best poster awards.

Structural basis of the Human Complement Anaphylatoxin C5a Interaction with its Cognate G Protein-Coupled Receptor, the C5aR

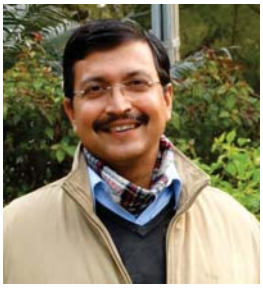
PI: Prof. Arun Shukla, Dept. of Biological Sciences and Bioengineering

Sponsor: Department of Science and Technology

The "complement system" is a critical part of body's defense mechanism against pathological infections. One of the most potent inflammatory peptides of the complement system, the C5a, exerts its effect by binding to, and activating a G Protein-Coupled Receptor, the C5aR. The interaction of C5a and C5aR and downstream signaling is critical for rapid response to pathogenic infections. Here, we propose to crystallize and determine the crystal structure of C5a-C5aR complex to reveal the structural basis C5a-C5aR interaction. This novel information should improve our understanding of C5a-C5aR signaling system and provide a structural framework to facilitate novel drug discovery and design for sepsis and inflammation.



This figure represents a structural model of the C5a receptor generated using the program MODELLER. Crystal structure of a chemokine receptor CXCR4 was used as a template to generate the C5a receptor structural model.



Indo-UK joint project on South Asian Monsoon: Monsoon Dynamics and Thermodynamics from the Land Surface through Convection to the Continental-Scale (INCOMPASS)

Prof. S.N. Tripathi, Dept. of Civil Engineering and
Centre for Environmental Science and Engineering (CO-PI)

Prof. G.S. Bhat, IISc Bangalore (PI from India)

Sponsor: Ministry of Earth Sciences

The monsoon is the primary driver of the agriculture and industry in South Asia, and is thus significant in the lives of more than a billion people residing in the region. In fact, inter-annual variations in the monsoon can even have economic consequences on an international scale. The growing population and developing economy makes understanding and predicting the monsoon of vital importance. Unfortunately, our capability to forecast the monsoon is limited by large, incremental errors. The poor performance of weather prediction models over India is due to a complex set of interactions between the land, ocean and atmosphere of the region.

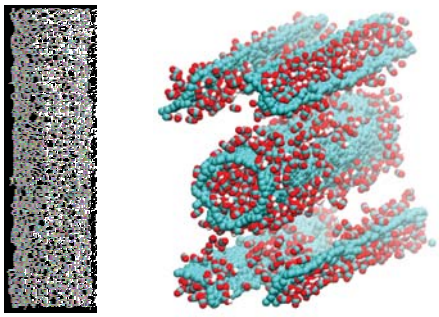
To quantify the land surface properties and fluxes, which interact with the monsoon on different temporal and spatial scales, an eddy covariance flux tower will be set up in Kanpur, which will be the first such measurement site in the region. Other than the standard meteorological observations, the tower will also directly measure the sensible and latent heat fluxes, which will help us understand the land-atmosphere feedback processes and how they relate to the monsoon climate of the region. The other Co-PIs of this project are Dr. E. N. Rajagopal and Dr. Ashis Mitra, NCMRWF Noida; Dr. Ranju Madan, IMD New Delhi; Dr. Muddu Sekhar, IISc Bangalore; Dr. Sandeep Pattnaik, IIT Bhubaneswar; Dr. G. Mrudula and Dr. T. N. Venkatesh, NAL Bangalore.

Aligned Carbon Nanotubes as Porous Materials for Selective Carbon-Dioxide Adsorption and Desorption: Effect of Pressure and Charge

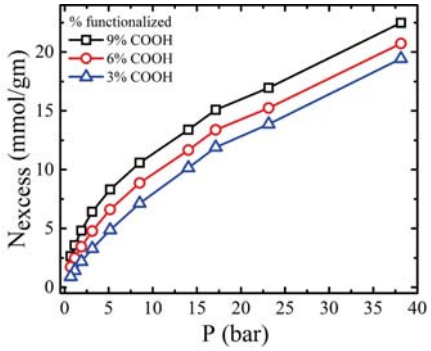
PI: Prof. Jayant K. Singh, Dept. of Chemical Engineering

Sponsor: Ministry of Earth Sciences

The escalating level of atmospheric carbon dioxide is one of the major pressing needs for efficient deployment of carbon capture and storage at the major sources for reducing CO_2 emission. This project aims to address carbon capture and storage aspects using novel techniques from a molecular perspective. The main goal of this research project is to gain a solid theoretical understanding of the adsorption/desorption behavior of CO_2 in the presence of CH_4, N_2, SO_2, NO_2, H_2S and H_2O in 3D vertically aligned carbon structures with charged/uncharged or/and functional groups under low and high pressure (0 to 30 bar). This project is in collaboration with an experimental group in Germany.



a) Carbon pipe model obtained after using the silica template (MCM 41); b) A typical snapshot of CO_2 adsorption onto a functionalized (COOH) carbon nanopipe bundle at 30°C and 8 bar.



Effect of functionalization on the excess adsorption of CO_2 on carbon nanopipe bundle

A Multi-dimensional Smart Energy Grids Analysis for Indian Scenario

PI: Prof. S.N. Singh, Dept. of Electrical Engineering

Co-PI: Prof. Y.N. Singh, Dept. of Electrical Engineering

Sponsor: Department of Science and Technology

The aim of this research is to develop a holistic understanding of how smart grid systems, both in urban and rural India, can support India's transition to a low carbon electricity supply system. The main objectives include the development of a shared and cross-disciplinary understanding of smart grid systems and distributed storage facilities for urban and rural areas in India, with an emphasis on scaling-up potential; to understand interactions of technologies, resources, communication systems and stakeholders towards development of secure and cost-effective smart grid design, operation and management; to validate the modeling framework through a laboratory-scale, flexible, modular demonstration facility; and to analyze the system. This project is jointly carried out by IIT Kanpur and IIT Mandi. The lab demonstration setup is proposed at IIT Mandi.

Recently Registered Projects

Virtual Laboratory, Phase II

PI: Prof. Kantesh Balani, Dept. of Materials Science & Engineering

Sponsor: MHRD

In the Phase-II of Virtual Lab, idea is to make all the developed labs into an open source repository that is available to community/academic institutes, whether in India or abroad, for use and development. The idea now is to convert all the licensed content into a platform that is independent of any licensed software. Further, a target is set for creating as many nodal centers in and around Kanpur and achieve a participation of over 54,000 users by the end of year 2015. Since physical distances are no more a constraint in today's technological world, the lack of infrastructure/ resources in many educational institutions can be overcome through online demonstration/operation of sophisticated instruments. Good teaching and web-based video courses (complementing the NPTEL lectures) can serve as a useful resource for upcoming colleges and, thus, imparting a quality education through the use of technology.

After the successful conclusion of the pilot phase (remote trigger based experiments), and a second phase (the Main Phase where a large number of simulation based laboratory experiments have been developed), now the direction is towards outreach of these labs making them openly and easily accessible to the community. These Internet-based experiments permits use of resources – knowledge, software, and data available on the web, apart from encouraging skillful experiments being simultaneously performed at points separated in space (and possibly, time). And by opening these labs to community, the usage will continue to increase and will automatically invite community to develop the labs and make *learning* through technology better.

Reduction of Earth Metals in Chalkopyrite based Solar Cells

PI: Prof. Sarang Ingole, Dept. of Materials Science & Engineering

Sponsor: Indo-German Science & Technology Centre

Relatively limited reserves of Indium and Gallium are expected to result into increased cost of $CuInGaSe_2$ (CIGS) based solar-cells. To address this challenge, (a) one could replace Indium and Gallium with Zinc and Tin that are relatively abundant, and also, (b) improve the CIGS material itself so that less amount of In and Ga (Thinner CIGS film) is required for the same-efficiency solar-cell. This project aims at pursuing both of these alternatives. Thin-film solar cells will be fabricated using sputtering and CBD technique followed by high temperature treatment.

Three other collaborators in this project are Dr. Nagesh Kini from Thermax Ltd., Pune; Prof. Dr. Roland Scheer from Martin-Luther-University Halle-Wittenberg, Germany; Dr. Ralf Sorgenfrei, Manz CIGS Technology GmbH, Germany.

Effects of Climate Change on Cryosphere-river Linkages: Insights from Seasonal and Inter-annual Variation of Glacial Melt Discharge in the Headwaters of the Ganges River

PI: Prof. Indra Sekhar Sen, Dept. of Earth Sciences
Co-PI: Prof. Rajiv Sinha, Dept. of Earth Sciences
Dr. Bernhard Peucker-Ehrenbrink, Woods Hole Oceanographic Institution, USA

Sponsor: National Academy of Sciences (USA)

Global warming and climate change issues are adversely affecting the health of the Himalayan glaciers, which feed the large rivers in the Indian subcontinent such as the Ganges. Questions and concerns have been raised about the melting of the Himalayan glaciers, and how this will impact downstream water supplies, hydropower generation, irrigation, as well as future supply of potable water. However, the impacts of climate change on the hydrological budget of the Ganges River are currently not well known. This project is attempting to develop a hydro-geochemical model for snow/ice melt waters to the headwaters of the Ganges River. The model will use time-series observations of water discharge, physical, and chemical parameters of water samples, particularly their stable isotope signatures near glaciated Ganges headwaters. The findings of this project will provide important insights into the effects of climate change and retreating Himalayan glaciers on the hydrological budget of the Ganges River.

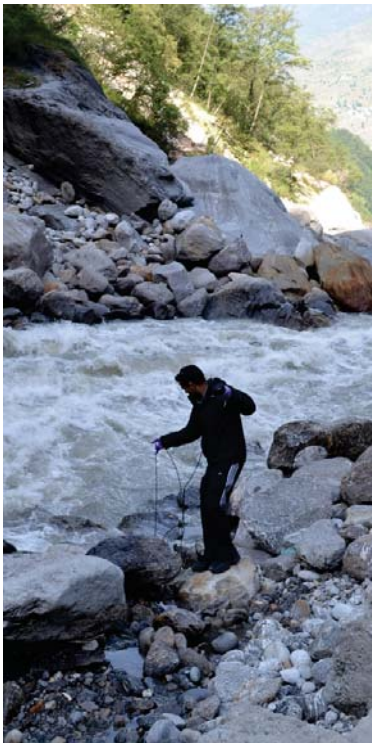


Figure left: Multi-parameter water quality probe in use to measure the water temperature, pH,dissolved oxygen and electrical conductivity

Figure right: Sediment filtration unit in use, the filtered water is stored in acid pre-cleaned vials for nutrient, radiogenic Sr isotope, stable O and H isotopes, and trace metal analysis

Local Heat Transfer Coefficient during Film Condensation of Stream Hydrogen Mixture

PI: Prof. Sameer Khandekar, Dept. of Mechanical Engineering
Co-PI: Prof. K. Muralidhar, Dept. of Mechanical Engineering

Sponsor: BRNS

Condensation in the presence of non-condensable is an area of concern for long time especially in nuclear reactor containment cooling system. In recent years, lot of research work is being carried out for effectively predicting the condensation phenomena in nuclear reactor containments. This proposed research work would explore the condensation on nuclear reactor containment walls (steel/concrete with epoxy coating) through dedicated experiments, and would generate sufficient data for improvement of CFD based containment thermal hydraulics framework, based on local measurement of parameters viz. condensate film thickness, gas and wall temperatures and pressures, bulk gas concentrations, dynamics of condensate film via imaging etc. The condensation will take place over vertical flat plate (made of steel/ concrete with epoxy paint coating) placed centrally inside a rectangular test facility, injected with helium gas as the simulator for hydrogen. The experiments will be performed at different operating conditions viz., steam pressure, temperature, helium concentration, and upward or downward flow configurations, etc. The measurement of local film thickness will be carried out by non-intrusive optical means. The local heat transfer will be measured by using heat flux sensors placed vertically along the length of the plate. The generated data will be used for the measurement of local and average heat transfer coefficient. Comparison/ validation of experimental data will be done with existing heat transfer models and numerical results. Design equations shall be improved/ new equations will be generated based on the experimental data.

Feedback/Suggestions

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