

Recent Developments in Nano Materials for Energy and Health Care Applications

Overview

With the ever increasing demand for sustainable energy and need for therapies to cure life-threatening diseases, there is little doubt that these two areas will dominate the future of modern science in the 21st century. The advancements in Science and Technology in the past three decades have brought in revolutionary changes in both of these areas, although they are unable to catch pace with the gradually multiplying energy demand on one hand and the microbes that are getting drug-resistant on the other. Recent studies indicate that nano-materials are emerging as key materials in offering creative solutions to both of these areas. Properly designed nano-structures show superior efficiencies for solar-energy conversion, thermo-electric energy harvesting, wasted biomass conversion to fuels, hydrogen storage and cost-effective electrodes for hydrogen generation. Likewise, nano-magnetic materials are the preferred choice for targeted drug delivery and contrast agents in clinical diagnostics. For the present collegiate student community to stay competitive, it is imperative that they equip themselves with the knowledge and expertise in the area of nano-materials and technologies. For this to happen, a thorough understanding of the design, synthesis and physico-chemical properties of nano-materials is critical.

Knowledge of materials chemistry, quantum effects, magnetic properties and textures of nano-particles are essential for young students to be competitive in the high-tech workforce market. The art of designing the nano particles for a given application requires a mastery of these topics. A short-term multi-disciplinary course, covering these topics, is very useful and value-addition to the academic qualifications. Attendance at this work shop will expose the participants to cutting edge developments in the design and development of novel materials for applications in energy generation and creative ways by which nano-materials can be exploited for therapeutic/diagnostic applications. The proposed topic is interdisciplinary in nature and would be useful for cohorts of students with varied scientific and engineering backgrounds. Course participants will learn these topics through lectures and hands-on experiments. The study materials and assignments will be shared to stimulate research motivation of participants.

Objectives:

The primary objectives of the course are as follows:

- Exposing the participants to the concept of nano-materials, the importance of particle dimensions on the structural, textural, physical and chemical properties.
- To provide participants with an understanding of magnetism at nano-scale and its implications in medicinal applications.
- To train and enhance the knowledge of participants in the area of water splitting by using nano-sized catalysts as electrodes.
- To impart theoretical and practical skills to participants about the scope of harvesting energy from biomass using nano materials with controlled shape and composition.
- Providing exposure to practical issues and problems associated with the use of nano-materials for drug delivery and their curative efficiency for cancer.

Modules

A: Duration: December 19 – 24, 2016
B: Venue Department of Chemistry, Jamia Millia Islamia, New Delhi – 110025, India

Lecture-wise course plan: (December 19-24, 2016)

Monday, December 19, 2016:

- **Lecture 1:** 9:30 am – 10:30 am
 - An Overview of Nanotechnology.
- **Lecture 2:** 11:00 am – 12:00 noon
 - Chemistry and Physics of Nanomaterials.
- **Hands-on Tutorial 1:** 12:30 pm – 1:30 pm

Tuesday, December 20, 2016:

- **Lecture 3:** 9:30 am – 10:30 am
 - Essentials of Solid State Chemistry.
- **Lecture 4:** 11:00 am – 12:00 noon
 - Crystal Structures of Functional Materials.
- **Hands-on Tutorial 2:** 12:30 pm – 1:30 pm

Wednesday, December 21, 2016:

- **Lecture 5:** 9:30 am – 10:30 am
 - Origin of Magnetic Properties in Solids.
- **Lecture 6:** 11:00 am – 12:00 noon
 - Magnetism at Nano Scale.
- **Hands-on Tutorial 3:** 12:30 pm – 1:30pm

Thursday, December 22, 2016:

- **Lecture 7:** 9:30 am – 10:30 am
 - Nano Materials for Sustainable Energy.
- **Lecture 8:** 11:00 am – 12:00 noon
 - Water Splitting by Nano-sized Catalysts as Electrodes.
- **Hands-on Tutorial 4:** 12:30 pm – 1:30pm

Saturday, December 24, 2016:

- **Lecture 9:** 9:30 am – 10:30 am
 - Nano Materials in Health Care Applications.
- **Lecture 10:** 11:00 am – 12:00 noon
 - Current Trends and Future Prospects of Nano Materials in Diagnostic and Curative Therapies.
- **Exam and Evaluation of Participants:** 12:30 pm – 1:30 pm

Number of participants for the course will be limited to forty.

You Should Attend If...

- you are a scientist/researcher from industry and government organizations.
- you are a student of **MSc/MTech/PhD, post doctoral fellow or faculty** from reputed academic institutions interested in pursuing research career in Nanotechnology.

Fees

The participation fees for taking the course is as follows:

Participants from abroad : US \$200

Industry/ Research Organizations: INR 5000

Academic Institutions:

- **Faculty members:** Rs. 2000/-
- **Students:** Rs. 1000/-

The above fee includes all instructional materials, tutorials and assignments. The participants will be provided accommodation on payment basis, subject to the availability.

The Faculty



Prof. K.V. Ramanujachary is a Senior Professor in the Department of Chemistry and Biochemistry at **Rowan University, New Jersey, USA**. His research interests encompass Advanced Materials for Hydrogen Production through the design of novel electro-catalytic materials, Oxide Chemistry of Transition Metals, Mixed Metal Chalcogenides, Electrical and Magnetic Properties of Materials, Conducting Polymers, Electrochemical Sensors, Heterogeneous Catalysis, etc. Prof. Chary has developed novel methods of fabrication of ceramic materials, inorganic oxides and other novel functional nano materials. He is an exponent in the operation and interpretation of modern material characterization techniques such as XRD, SEM-EDAX, TEM, AFM, STM, EMPA, ICP-MS, ESR, etc among others. He is a fellow of American Chemical Society. He has executed many USA NSF Granted Projects worth over US \$ 15 Million (Equivalent to about Rs. 90 Crores). He has published more than 200 papers in highly reputed journals of high impact factor and authored a couple of John-Wiley and Oxford University Press Books on Solid State Chemistry, Nano Materials and Inorganic Chemistry. Being an excellent teacher and effective communicator, he is one of the most sought after academicians for invited and guest lectures at many Indian higher education institutes such as IITs, NITs, etc. Further details about Prof. Chary can be seen at his homepage: <http://www.rowan.edu/centers/materials/rama.htm>



Dr. Tokeer Ahmad is an Assistant Professor in the Department of Chemistry, Jamia Millia Islamia, Delhi. He did his Masters from IIT Roorkee and Ph.D. from IIT Delhi in the area of Nanoscience. He also worked with Bharat Ratna Prof. C.N.R. Rao as visiting scientist. His current research area includes processing of various nanostructures and their size and shape dependent properties. Dr. Ahmad is keenly interested in developing advanced nanomaterials for sensor and energy applications. He has supervised five PhD and more than 30 post graduate students. Dr. Ahmad has received several research grants including international agency. Dr. Ahmad has published 73 research papers in peer-reviewed journals of high repute, delivered 48 Invited lectures and coauthored a book on Nanotechnology. His current research citation is 1425 with h-index of 22. Dr. Ahmad has been the active life member of various National and International academic societies and reviewers of various journals of repute in his area of research. Dr. Ahmad has also received DST-DFG award from Govt. of India (2009), ISCAS Medal (2011) for the significant contribution on Solid State Chemistry and Allied Areas and Inspired Teachers recognition from President of India (2015). Further details about Tokeer Ahmad can be seen at his homepage: <http://jmi.ac.in/tahmad3>

Course Co-ordinator

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Course Registration Link:

<http://www.gian.iitkgp.ac.in/GREGN>