



AICTE SPONSORED SHORT TERM COURSE

ON

MATERIALS ENGINEERING AND INDUSTRIAL APPLICATIONS: HYBRID NANOCOMPOSITES FOR PHOTONICS, ENERGY AND ELECTRONIC DEVICES

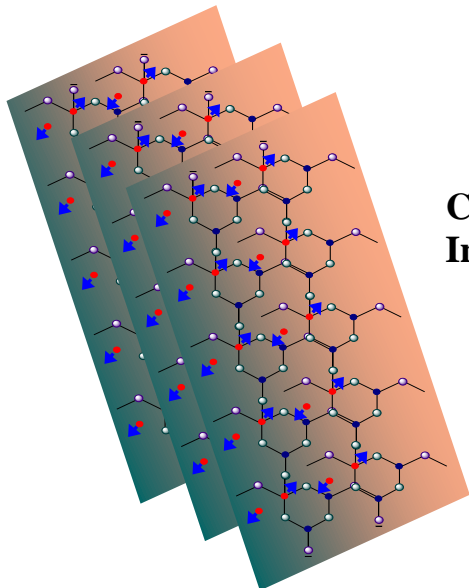
NOVEMBER 11-22, 2013

COORDINATORS

Prof. S. Ram

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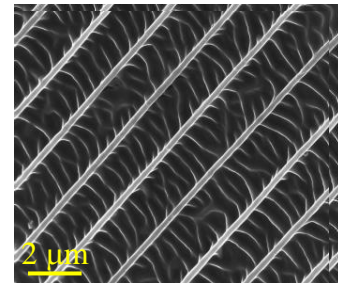


Organized by

**Continuing Education Programme (CEP)
Indian institute of technology, Kharagpur**

in

**MATERIALS SCIENCE CENTRE
INDIAN INSTITUTE OF TECHNOLOGY
KHARAGPUR-721 302, W.B.**



1. THEME OF THE COURSE:

A hybrid nanocomposite, which builds-up with a unique kind of a surface interface, especially involving an exchange coupled electron-phonon band structure, spintronics, or ferroics in a commensurate material (which may be a ceramic, polymer, or even a metal/alloy), has made great strides in the past decades due to progressively growing advances in materials science, engineering and technologies. Such materials represent leading cutting edge high-tech materials nowadays for diversified applications. Some of the identified applications include civil structures, aerospace engineering, armaments, medical tweezers, cutting tools, electronic devices and components, different kinds of sensors, spin valves and spin polarizers, ferrofluids, biomaterials, drugs and drug delivery systems, catalysts, porous membranes, hot filters, high temperature solid electrolytes, optical and optoelectronic materials, MEMS, magnetic or optical data storage systems, ferroelectrics, hydrogen storage and devices, or super-capacitors. Newer achievements in tailor made nanomaterials or hybrid nanocomposites have made a tremendous impact on quality production of high performance materials, components and devices, and basic understanding of their physical and chemical properties and, in turn, diverse applications in engineering, medicines, defence, and other various disciplines.

A solid (which may be a metal/alloy, ceramic, polymer, or composite) made-up of finite dimension limited to a few tens of nanometers differs inherently from its equilibrium bulk dimension in the sense that a significant fraction (N) of the atoms occupies the surface or surface boundaries in an altogether different thermodynamic state. N in a particle of a model spherical shape in general can be as large as 40-60 % for diameter (D) \sim 2 nm. As $D \rightarrow 20$ nm, i.e. the bulk value, $N \rightarrow 0$. As such, these kinds of surface atoms often suffer from (i) a lower co-ordination number, (ii) a lower co-ordination symmetry, (iii) a lower atomic density, and (iv) a larger interatomic distance than the core atoms. A redistribution of atoms can occur in the positions and/or electronic charges in optimizing the internal energy ϵ and entropy S in a feasible energy state ϵ . Thus, a specimen of such tiny structures or assemblies often involves a manifested value of enthalpy H and/or volume V with a wide energy-entropy phase diagram relative to the bulk values. A high-energy metastable polymorphic change might be encountered to cope with the instantaneous ϵ , V , or S values that reflect in distinctly modified electronic structure and associated functional properties. As a result, it is well argued that a nanostructured material (effective dimension in general can span over 1-100 nm scale depending on its shape) altogether defines a new materials class in which neither quantum chemistry nor non-classical laws of physics hold in the virginal forms.

Synthesis, processing and fabrication of such materials for industrial applications are a big challenge today to meet the high performance requirements with desired size, shape, surface topology, and derived properties. The properties as well as the performance in a device depend on (i) average crystallite, particle, or pore size (also morphology), (ii) distribution of crystallites and/or particles (or pores), (iii) average composition of sample, (iv) degree and length of chemical homogeneity, (v) structure of the basic surface or surface interface, (vi) microstructure of pores if any, (vii) agglomeration, and (viii) average distance between the basic structures, and (ix) macroscopic interactions in the basic structures.

So, the established procedures, the basic knowledge, and mechanism of synthesis and/or fabrication of typical nanostructured materials, and the structure-property

correlation must be developed. A clear view has to be achieved for their possible applications in medicines, defense, and chemical, structural and electronic industries. With a view to address or resolve some of these technological issues, it is a timely approach to hold a short-term course in this discipline on “Materials engineering and industrial applications of hybrid nanocomposites for structure, photonics, energy and electronic devices” with a special emphasis on anchoring the structure-property correlation and industrial applications. This is in continuation to similar short-term course organized earlier by the coordinator at Materials Science Centre, Kharagpur, during 1999, 2006, and 2007.

2. The major disciplines:

The present course will cover the following major topics:

- Introduction to hybrid nanocomposites, high-energy interfaces, and their industrial applications.
- Need of scaling down geometrical size to a nanometric scale of ideal single domains in engineering useful functional properties.
- Different kinds of advanced nanocomposites for applications in photonics, energy, structure, and magnetic, ferroelectric, and electronic devices.
- Porous and nonporous supercapacitors and their applications.
- Nanoporous composites in hydrogen storage and other applications.
- Biocomposites and applications.
- Supercapacitors for high temperature energy devices.
- Nanocomposites for gas sensors and reaction catalysts.
- Methods for synthesis of composite powders, films and other engineering shapes.
- Applications of gel casting in multiferroics and devices.
- Fabrication of high quality multiferroics, phosphors and devices from glasses.
- Microwave sintering of nanocomposite structures.
- Characterization in relation to the crystal structure, microstructure, and magnetic, electronic, ferroelectric, optical and mechanical properties.
- Role of particle size, morphology, surface structure, and microstructure in structural, optical, electrical, ferroelectric, energy, and other useful properties.
- Simulation/modelling of thermal stability, reactivity, phase transformation, and other properties in confined dimension of nano-entities or assemblies.

ABOUT IIT KHARAGPUR AND MATERIALS SCIENCE CENTRE

IIT Kharagpur is the oldest and largest amongst the sister institutions. Teaching and research in all major branches of engineering as well as science are conducted here with 19 different Departments, 12 Centres and 4 Schools. Selected students from all over the Country as well as from abroad come here for their undergraduate and postgraduate studies. In addition to the regular academic programmes, we have Continuing Education Programme, Science and Technology Entrepreneur Park (STEP), and Technology Foundation. There is a full-fledged residential campus for all students, faculty members,

and other employees of the Institute. Both the institute and residential campus are full of lovely natural greenery with variety of trees, plants and green surroundings.

The Materials Science Centre is about 42 years old and is actively engaged in high level teaching, Ph. D. Programs, and R & D of advanced materials and their science and technology. Semiconductors and allied electronic materials, glass and ceramics, polymers, composites, and nanofluids are the main research areas. The Centre offers a four semester M. Tech. course on Materials Science and Engineering with specialization in either of the above three categories of the materials and applications. It offers more than a dozen UG/PG courses on “materials processing, characterization and structure-property correlation” to other Departments/Centres of the Institute. The faculty members are highly expertised and renowned in the research and teaching of advanced materials and materials science.

ELIGIBILITY

The teachers, engineers, technologists, and scientists respectively from the AICTE affiliated colleges/universities/NITs, IITs, industries, and R & D organizations with background of engineering, materials science, as well as pure solid-state physics/chemistry and related fields may participate in this short-term course program. A background of materials science will be preferred for better understanding of the course.

HOW TO APPLY

Send your bio-data in the enclosed proforma. Important publications and other achievements/ recognition related to the topic may be sent along with the bio-data. It will help in selecting the candidature. The number of the participants will be limited to 30. The selection will be made on the basis of qualifications and experience.

SPECIAL LECTURES

Eminent professors/scientists with expertise in nanomaterials, composites and applications from leading institutions, universities, and laboratories will deliver the lectures in this short-term course. Experts from industries will be invited. The language of the communication will be English.

ACCOMMODATION - LOCAL HOSPITALITY

The participants will be provided with furnished double bed room accommodation in our continuing education programme (CEP) Guest-House in the IIT campus. On special request, limited number of accommodation may be arranged in the Technology Guest House on personal basis. Breakfast, lunch and dinner will be served in the Guest-house. However, the participants may take their food outside if they so desire.

REGISTRATION and FEES

Category-1:

All the participants have to be registered for the short-term course. The teachers from the AICTE sponsored colleges/universities /NITs/IITs need not pay for the registration. The selected candidates will be reimbursed 2nd class to and fro railways fare via shortest route. Also accommodation and food will be free from additional charges for them. To

ensure the registration, the participants need to submit Rs 1000/ (by self-addressed check) as a security deposit.

Category-2:

The participants from industries and R & D organizations have to pay Rs 15,000/- per person as the registration fee. This includes the basic charges for the food, lodging and lecture materials. The registration fee may be paid by demand draft in favour of CEP-STP payable at IIT Kharagpur.

LAST DATE OF APPLICATION

The complete application must reach the coordinator before October 10, 2013. The selected participants will be informed before October 15, 2013.

LOCATION and WEATHER

Kharagpur is well connected by railways with all major centers of India. The railways station holds the distinction of the longest platform in the world. It is situated 116 km southwest to Kolkata and is very well connected by superfast, fast, and local trains. There are taxis, 3-wheelers, and cycle rickshaws available at the Kharagpur railway station throughout the day and night. IIT campus is situated 4 km away from the railway station. The approximate fares are taxi-Rs 130/-, 3- wheeler-Rs 65/-, and cycle rickshaw-Rs 70/-.

In November, the weather at Kharagpur is very pleasant with cool fresh air and greenery all around. The day temperature is around 15-25°C and at night it comes down to 10-20°C. Unless it is raining the sky is mostly sunny and clear.

TO SUPPORT R & D-ACADEMICS IS OUR MOTTO

CONTACT ADDRESS

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REGISTRATION FORM

AICTE sponsored short term course on
**“Materials Engineering and Industrial Applications: Hybrid Nanocomposites for
Photonics, Energy and Electronic Devices”**
November 11-22, 2013

Full Name: _____

Designation: _____

Highest qualification: _____

Department: _____

Postal Address: _____

Tel./Mob.: _____

E-mail: _____

Gender: _____ M / F

Whether the employing Institute is AICTE approved: YES / NO

Accommodation required: YES / NO

Signature of the candidate

Date _____

Signature and Seal of Head of Organization

For others (Category-2):

Draft No. _____ dated _____

Of amount Rs. _____ drawn on

_____ Bank

Fill out above information and send it to the address shown on the reverse side (either soft copy or hard copy) along with your brief bio-data.