SHORT TERM QIP COURSE

ON

Mastering Advanced Techniques of Characterization for High-end Research (MATCH® -2018)

…enabling engineers to pursue globally competitive and advanced materials research

August 27-31, 2018

Venue:

PBCEC, Visitors Hostel
Indian Institute of Technology Kanpur

Advanced Center for Materials Science
Indian Institute of Technology Kanpur
Kanpur, 208 016

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ABOUT THE COURSE

An engineer is always faced with a challenge to make things work! So, knowing 'how' automatically *becomes* the prime-most aspect of work-description. But, many a times, an engineer's curiosity is curbed because of lack of understanding of its know-why. This course is specifically designed for engineers (specially from *Metallurgical Engineering, Mechanical Engineering, Chemical Engineering,* and *Materials Science* backgrounds) and scientists (with *Physics, Chemistry and Biology* background) to synergize the understanding of material's performance by 'seeing' and 'quantifying' what happens inside a material.

The lack of exposure induces ignorance, and the limited exposure and/or access to advanced material characterization facilities restrict utilizing the capabilities of translating one's ideas to high-end publications and products. This course is targeted to provide detailed insights to the topics discussed in the next section.

1. Sample Preparation and Optical Microscopy:

Sample preparation is highly important to ensure that the sample is representative of what we intend to observe. Also, the damage to sample must be minimized in order to safeguard induction of artifacts that might creep in during the sample preparation itself. Sample-preparation specific to various processes will also be highlighted during the introduction to those advanced characterization techniques.

The first observation is made by naked eyes, and optical microscopy enhances the material features at micrometer length scales. Thus, appropriate emphasis is also placed on the second and quick insights via optical microscopy.

Various ways of quantification of microstructure will also be dealt with in order to extract more information out of what appears to be a 'simple microstructure'.

2. Surface/ Interface Characterization:

This section will incorporate the fundamentals of '***scanning electron microscope (SEM)***' and '***transmission electron microscope (TEM)***'. This tools comes to rescue realizing the very surface specific topography via SEM, to the advanced phases/interfaces of bulk/surface even at nanometer length scales (via TEM). The conceptual notes will discuss:

- Electron beam interaction with matter (Auger electrons, Secondary electrons, back-scattered electrons, x-rays, transmitted electrons, etc)
- Sample preparation (thinning, etching, ion-beam milling)
- Topography and compositional contrast
- FE-SEM & EPMA (Electron probe micro-analysis)
- Bright field/dark field imaging/ Selected area diffraction
- High resolution, lattice fringe imaging
- Study of biological samples

Further, the specific surface-area dominant catalysis is booming up and has become quintessential for energy applications. Achieving enhanced reactive area by playing with porosity/size of material can be assessed via BET. Further, the surface, being the first line of defense, is crucial in dictating the response to the harsh environment. Thus, these subtle changes on surface upon interaction with the immediate surroundings can be evaluated via:

- BET (Brunauer–Emmett–Teller: surface area measurement)
- Surface Profilometry
- Atomic Force Microscopy (AFM)

3. Other Advanced Characterization Tools:

Usually, the purpose of correlating the material performance to a property does not end with mere observation. It requires state-of-the-art characterization tools to observe their *mechanical-, chemical-, biological-, and electrical- properties*. Some of them are highlighted to provide a deeper insight to understanding of material:

- Instrumented indentation (nanoindentation and scratching)
- X-ray photoelectron spectroscopy (XPS)
- Auger electron Spectroscopy (AES)
- Near-field Scanning Optical Microscopy (NSOM)
- Electrochemical Impedance Spectroscopy (EIS)
- Atom Probe Tomography (APT)

Mere exposure to these advanced material characterization tools will help enhancing the appreciation of 'what is possible, and this experience will highly benefit the *college teachers* and *researchers from national labs* and ***students*** from IITs, IISc, NITs, and other government funded colleges. Industrial researchers will also learn a lot out of this course.

SCOPE AND OBJECTIVE OF THE COURSE

This course is targeted to attain better insight in taking research to a globally competitive level. This course also encourages teachers, students, researchers, and industrial participants to build 'self-confidence' by enhancing their learning and understanding the underlying mechanics of 'why' a material performs the way it does!

Theoretical conceptualization will help in grasping the basics and then the lectures will build up the understanding of abstract concepts. Later, the demonstration or 'lab-visits' will reinforce the understanding of the participants. Tutoring sessions (with real-life data/challenges) will also allow quantifying and comparing the performance of two competing materials.

The detailed insights to material performance will be attained via:

- Conceptualization of material and its microstructure
- Optical microscopy and quantification of microstructure
- Electron Microscopy for observing topographical and compositional contrast.
- Electron mediated signals that can be attained in obtaining material-specific information (i.e. elemental analysis, phase distribution, crystal structure, spread of crystallite, inter-planar spacing, interfaces, etc)
- Surface area of powders for catalytic performance and optical profilometry for quantifying roughness and/or surface specific damage
- Advanced characterization tools for customized analysis of intriguing and fascinating behavior of materials (such as nanostructures providing superhydrophobicity, adhesion strength of bacteria, role of valence of cation in affecting the ion transport, micro-spread/agglomeration of atoms at interfaces, etc).

APPLICATION/REGISTRATION PROCEDURE

1. Take approval from your Head/ Dean/ Director and then fill in registration form for participation here (copy and paste the link): (https://docs.google.com/forms/d/1fFv4wChtGuJApSJRTiRu9OVejfBQXTDTBJF4lDRbfxk/viewform?)
2. (i) Take print-out of the google-form or its receipt. (ii) Attach the approval from your Head/Dean/Director (original signed copy on letterhead), and (iii) attach cheque/DD of the registration fee.
3. Last submission date of registration fee and form: ***20/08/2018*.**

REGISTRATION FEES

A maximum of 40 participants will be selected (first-come-first serve basis) and the participants need to send a letter from their Head of the Institute/Department, in support of their application. Ph.D Students should route their application through supervisor/HOD.

1. Faculty from AICTE Institutes coming under QIP program (***refundable only on participation***): Rs. 1,000/
2. Faculty from private/autonomous Institutions: Rs. 10,000/-
3. Ph.D Students of IITK Rs. 3,000/-
4. Ph.D Students from Educational Institutions: Rs. 6,000/-
5. Participant from Industry and R&D labs: Rs. 15,000/-

Cancellation charges before 15/07/18 all categories: Rs. 1,000/-

After 15/07/18 no refund of registration Fee

Payment only by demand draft in favour of "Continuing Education Programme, IIT Kanpur"

ABOUT ACCOMMODATION

Accommodation in the IIT Kanpur guest house will be available upon request during the time of registration for the course. Accommodation charges are to be paid by the participants themselves. The refundable deposit of Rs. 1000/- from QIP candidates will be adjusted for accommodation for the course. The remaining amount has to be paid by the participants themselves. The guest room occupants should agree to abide by the existing rules and regulations of guest house. In case single occupancy becomes unavailable, participants will need to share the accommodation.

Please plan to arrive by the evening of Aug. 26, and plan to leave after late evening (after 8 pm) of Aug. 31, 2018 or by early morning of Sept. 01, 2018.

Guest-Room Rental Details:

For participants other than students (per-day cost):

AC Single occupancy – Rs.700 (in VH)/ Rs. 600/- (in VH Extension)
AC Double Occupancy- Rs. 1100 (in VH)/ Rs. 800 (in VH Extension)
Non-AC Rs. 200 (Single) and Rs. 300 (Double) in VH Extension

ARRANGEMENT FOR FOOD

Food is being arranged in Visitor's Hostel (VH) dining hall for all the registered participants. Breakfast, lunch, dinner will be arranged by the course organizers. Tea/coffee and snacks will also be provided at the venue during breaks. Reaching VH from VH extension is at walkable distance of 1 km. Venue for lecture session (PBCEC classroom) is located within VH premises.

Travel Assistance:

TA via III A/C train fare will be provided to participating teachers of AICTE approved colleges.

For further information and queries contact:

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