

# Electron Microscopy: Basics and Applications

18<sup>th</sup> July 2016 – 29<sup>th</sup> July 2016 at IIT Hyderabad

## Overview

Human eyes can differentiate two objects only when separated by more than 0.2 mm. For smaller distance distinction, humans require aid in form of microscopes. This course will give introduction to primitive microscope (optical based), its properties (optics) and limitations (in terms of poor resolution, brightness of the source, aberrations, etc) and then will take to the needs of higher end microscopy (electron based). In electron microscopy, fundamental of electron-matter interactions and generation of various rays will be explained. This will be followed by complete utilization of scanning electron microscopy (SEM): SEM sample preparation, electron gun types, SEM scanning methods in terms of raster; signals generation and their capturing in terms of energy and detector placements with various examples (secondary electron imaging, backscatter electron imaging and diffraction, elemental analysis mapping through energy dispersive spectroscopy and wavelength dispersive spectroscopy, electron beam induced current). In transmission electron microscopy (TEM), the parts of TEM (like gun, lenses, detectors, screen) and its principles (aberrations, structure factor, diffraction pattern indexing, reciprocal lattice, Ewald sphere, Kikuchi pattern, image contrast mechanism) would be explained in details with their advantages and limitations. All through the lectures, talks will be well supported with several examples and case studies. In lab work, live demonstrations/usages on electron microscope will be performed. After having the theoretical background and the experimental knowledge with demonstration to characterize a material by the usual techniques the participants would also be provided with additional knowledge about the emerging techniques like TKD (Transmission Kikuchi Diffraction in the SEM), ECCI (Electron Channeling Contrast Imaging in the SEM), EBSD 3D (Three Dimensional Electron BackScatter Diffraction in the SEM). All through the lectures, talks will be well supported with several examples and case studies.

<b>Modules</b>	<b>A: SEM and Usages : July 18 – July 22, 2016</b> <b>B: TEM and Advance EM Techniques : July 25 - July 29, 2016</b> <b>Number of participants for the course will be limited to fifty.</b>
<b>You Should Attend If...</b>	<ul style="list-style-type: none"><li>▪ You are executives, engineers and researchers needing materials microstructural characterization from sectors of materials manufacturing, service and government organizations including R&amp;D laboratories.</li><li>▪ Student or faculty from academic institution interested in learning the basics of electron microscopy and its latest related techniques.</li></ul>
<b>Fees</b>	The participation fees for taking the course is as follows: <b>Participants from abroad : US \$500</b> <b>Industry/ Research Organizations: INR 15,000</b> <b>Academic Institutions Faculty/Staff: INR 10,000; Research Scholar/Student: INR 2,000</b> The above fee include all instructional materials, tutorials, and Internet facility during class hours. The participants will be provided with single bedded accommodation on payment basis based on the availability of hostel facilities.

## The Faculty



**Prof. Emmanuel Bouzy** is Professor at the University of Lorraine, France. He has a great experience of teaching. He teaches Materials Characterization Methods for more than 25 years at the level of the *Licence* (Bachelor) and at the level of the *Masters*. He is responsible of the course "Physical methods of materials characterization" in the Masters of MMSP (Materials, Mechanics, Structure, Processing). His research activities are made in the Laboratory LEM3 (Laboratory of Microstructure Studies and Mechanics of Materials, Metz) and in the Laboratory of Excellence 'DAMAS' (Design of Alloy Metals for low-mAss Structures). In the LEM3, he is the group Leader of the research group 3TAM "Transformations, Texture, Topology and Anisotropy of Materials" (4 Professors + 6 Assistant Professors + 2 Research Engineers + 2 Technicians and about 15 PhD Students). The research group 3TAM is responsible of the electronic microscopy platform of the LEM3 (1 TEM + 3 SEM + 1 Dual Beam). In the LabEx DAMAS, he has been one of the editor for the Conference nanoSPD6-2014 (more than 600 participants). Prof. Emmanuel Bouzy developed a new technique of orientation mapping by TEM from Kikuchi diffraction patterns. He also applied and improved CBED (Convergent Beam Electron Diffraction) technique for the measurement of strains. These studies have been published in reference journals as Ultramicroscopy and are largely cited. Currently, he is involved in the development of a new technique TKD (Transmission Kikuchi Diffraction in the SEM).

He is a member of the French Society of Microscopy. He is also vice-president of the "Gump" which is a FEI-TEM-users association. He organized two FEI-TEM-users meetings in Metz, France.



**Dr. Suhash Ranjan Dey** is an Assistant Professor of Indian Institute of Technology, Hyderabad. His research interest is emerging alloy design using combinatorial approach. He uses electron microscopy and its related techniques for materials characterization. He has 15 years of working experience with electron microscopy and has 5 years of teaching electron microscopy at IIT Hyderabad. Recently, he has conducted TEQIP workshop on Optical and Scanning Electron Microscopy at IIT Hyderabad.

## Course Co-ordinator

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