KNOWLEDGE INCUBATION FOR TEQIP, IIT KANPUR

Structure and Characterization of Materials

December 22 - 26, 2014

Structure and Characterization of Materials is a vital part of any material course. With this in mind a 5 day workshop on 'Structure and Characterization of Materials' was designed to demonstrate the relevance and importance of key materials characterization method to teachers, students and industrial participants. It intended to familiarize them with the technical advances that have taken over the years. The course was focused on the structure-property correlations and how these could be unraveled by the use of simple characterization methods such as optical and scanning electron microscopy, x-ray diffraction and Raman spectroscopy. It provided a brief introduction to the structure of materials and its relevance to the properties and hence applications followed by a short description of diffraction, imaging, and spectroscopy principles. It also explored techniques for quantifying microstructures (using image processing and stereology) observed using various microscopy methods.

Topics Discussed

- Introduction to Structure of Materials
- Importance of Materials Characterization
- Principles of Imaging, Microscopy and Image Processing
- X-ray Diffraction: Principles and Applications
- Phase Identification
- Stress and Texture Analysis
- X-ray Fluorescence and Elemental Analysis
- Advanced Applications of X-ray Diffraction
- Scanning Electron Microscopy and Electron Backscattered Diffraction (EBSD)
- Atomic Force Microscopy and Applications
- Raman and FTIR spectroscopy for Materials Characterization
- Thermal analysis
- Microscopy and Stereology
- Basics of TEM and Electron Diffraction
- Electron Probe Micro Analyser (EPMA)

LIST OF SPEAKERS

- Prof. Anandh Subramaniam, IIT Kanpur
- Prof. Anshu Gaur, IIT Kanpur
- Prof. Ashish Garg, IIT Kanpur
- Prof. Kallol Mandal, IIT Kanpur
- Prof. Nilesh Gurao, IIT Kanpur
- Prof. Rajesh Prasad, IIT Delhi
- Prof. Shashank Shekhar, IIT Kanpur

PARTICIPATING INSTITUTES

Institute	Number of Participants
MNNIT, Allahabad	2
HBTI, Kanpur	3
IIEST, Shibpur	3
NIT, Raipur	3
G.B Pant, Pantnagar	2
PEC, University of Technology	3
M. M. M. University of Technology Gorakhpur	2
BIET Jhansi	4
Guru Jambheshwar University of Science & Technology, Hisar	5
VNIT Nagpur	3
NIT Rourkela	4
NIT Jamshedpur	1
MNIT Jaipur	2
Govt. College of Engineering and Technology, Bikaner	1
NIT Kurukshetra	2
Kurukshetra University	1
Government Engg. College Gandhinagar, Gujrat	1
MANIT Bhopal	1
Total	**43**

SCHEDULE OF THE WORKSHOP

December 22, 2014

Time	Event
9:00 AM – 9:30 AM	**Registrations/ Inauguration**
9:30 AM – 11:00 AM	**Introduction to course Structure and Materials** *Prof. Rajesh Prasad*
11:00 AM – 11:15 AM	**Coffee Break**
11:15 AM – 1:15 PM	**Structure and Materials** *Prof. Rajesh Prasad*
1:15 PM – 2:30 PM	**Lunch Break**
2:30 PM – 3:30 PM	**Thermal Analysis** *Prof. Kallol Mondal*
3:30 PM – 5:00 PM	**Assignment**
5:00 PM – 5:15 PM	**Coffee/ Discussions**

December 23, 2014

Time	Event
9:30 AM – 11:00 AM	**Microscopy and Stereology** *Prof. Sandeep Sangal*
11:00 AM – 11:15 AM	**Coffee Break**
11:15 AM – 1:15 PM	**Scanning Electron Microscopy** *Prof. Sandeep Sangal*
1:15 PM – 2:30 PM	**Lunch Break**
2:30 PM – 3:30 PM	**EBSD** *Prof. Shashank Shekhar*
3:30 PM – 5:00 PM	**Assignment** Stereology and Image processing
5:00 PM – 5:15 PM	**Coffee/ Discussions**

December 24, 2014

Time	Event
9:30 AM – 11:00 AM	**X-ray Diffraction** *Prof. Ashish Garg*
11:00 AM – 11:15 AM	**Coffee Break**

11:15 AM – 1:15 PM	**X-ray Diffraction** *Prof. Nilesh Prakash Gurao*
1:15 PM – 2:30 PM	**Lunch Break**
2:30 PM – 5:00 PM	**Assignment** **EBSD** *Prof. Shashank Shekhar* **X-ray Diffraction** *Prof. Ashish Garg/ Prof. Nilesh Gurao*
5:00 PM – 5:15 PM	**Coffee/ Discussions**

December 25, 2014

Time	Event
9:30 AM – 11:00 AM	**Raman and FTIR Spectroscopy** *Prof. Anshu Gaur*
11:00 AM – 11:15 AM	**Coffee Break**
11:15 AM – 1:15 PM	**Atomic Force Microscopy** *Prof. Ashish Garg*
1:15 PM – 2:30 PM	**Lunch Break**
2:30 PM – 5:00 PM	**Laboratory Visit** **XRD, Raman, AFM and SEM Lab Visit in Groups**
5:00 PM – 5:15 PM	**Coffee/ Discussions**

December 26, 2014

Time	Event
9:30 AM – 11:00 AM	**Basics of TEM and Electron Diffraction** *Prof. Anandh Subramaniam*
11:00 AM – 11:15 AM	**Coffee Break**
11:15 AM – 1:15 PM	**TEM and EDS** *Prof. Anandh Subramaniam* **EPMA** *Prof. Ashish Garg*
1:15 PM – 2:30 PM	**Lunch Break**

2:30 PM – 5:00 PM	**Assignment** **TEM** *Prof. Anandh Subramaniam*
5:00 PM – 5:15 PM	**Closure/Coffee**

Summary of Faculty Feedback

WORKSHOP SESSION

Questions	**Excellent**	**Good**	**Ordinary**
Clarity of communication about	16	05	00
Organization of the sessions	19	03	01
Quality of lectures	19	04	01
Effectiveness of discussions	15	08	00
Effectiveness of learning experience	12	09	01
	Appropriate	**Short**	**long**
Duration of workshops	16	06	00
	Definitely	**Maybe**	**No**
Would you like to have more such sessions?	17	06	00
Would you like e-lectures by experts on special	20	03	00
Suggest specific topic that you would like additional expert lectures on	• Biomaterials • Polymer nanotechnology • Advanced XRD techniques • Characterization of Polymer nano-particles and nanocomposites. • Sample preparation for TEM/SEM • Structure of Amorphous materials and their electrical optical and thermal characterization. • Industry academic collaborations • Nano-Materials. • Nano Components • Renewable Energy Materials. • Spectroscopy, XPS • Magnetic and Dielectric Materials Characterization. • Other non metallic materials. • Specific applications of material science in machining. • Customized lectures for participants from bio nanotech background. • Optical Emission Spectroscopy and sample preparation for TEM.		

Additional Suggestions	• Provide course material in the form of CD etc. • More such workshop/programmes related to metallurgy and specific problems. • More handouts should be distributed. • All the presentations/ delivered lectures should be provided in the form of spiral binding after the workshop. • Handouts should be spiral form and before tutorials there should be some examples based on questions given in tutorial sheets. • Give more times for lab visit. • Softcopy of the lectures delivered by the speakers must be given to the participants. • Labs session should be increased. • Workshop on Data Analysis. • Workshop on actual sample analysis and data interpretation. • It will be much better if laboratory visit time increase. • Similar workshop on Spectroscopy may be thought of duration could be little longer.

TEACHING

Which subjects do you teach?	• Biomaterials, Materials Science & Engineering • Material Science. • Engineering Physics, Solid State Physics. • Fluid flow operation, Chemical Engg., Thermodynamics, Chemical Process Technology, Polymer Science and Technology, Energy Resources. • Physics • Solid State physics, Mechanics • Material Engg. , Process Metallurgy • Condensed Matter Physics • Measurement (mechanical) & process design. • Welding • Physics • Biotechnology, Bio-nanotechnology.		
What is average student to teacher ratio in your institute?	• 10:1 • 15:1 • 20:1 • 15:1 • 15:1 • 15:1 • 60:1 • 20:1 • 13:1 • 20:1		
Questions	**YES**		**NO**
Do you have additional support for teaching (tutors, graders, teaching Assisttants, etc)?	06		10
Do you give class projects for UG classes?	11		03
Do you give class projects for PG classes?	10		04
Do you have sufficient resources for laboratory courses?	03		10
	Sufficient		**Inadequate**
Is the library/journal/e-connection Support adequate?	06		07
	Definitely	**May be**	**No**

Would you like to have common (TEQIP) repository of course material ?	14	00	00	
Would you like to visit IITK to participate in and develop course material (existing or new)	10	02	01	
Would you like to participate in creation of the repository material (course files/lab. Manuals/question bank/etc)	10	02	01	
	e-courses	**Workshops**	**Content**	**none**
How can IITK effectively help you prepare for teaching?	10	10	07	00
How can TEQIP help improve your teaching?	• By organizing such workshops and lab visits at IITK and other Institution having excellent experimental facilities. • Along with the workshops it is important to develop research lab. • Provide guidance in development of research lab. • The content of the lecture being delivered are very much useful to improve teaching. • E-course on various subjects. • E-course content of various subjects/ lectures of famous faculties from IITs should be available online of each and every subjects. • Through attending the short term courses under TEQIP programme organized by IIT's. • By further discussing subjects. • Through conducting workshops on topics related to syllabus. • By sharing resource like knowledge bank and laboratory facilities. • By exposure to training session in centres of excellence like IITs. • By providing trainings on specific equipments and techniques. • Helping in organization of student visits. • Industries application topics also to focus.			

RESEARCH

Questions	Definitely	Maybe	No
Would you like to visit an IIT for a visiting-faculty/post-doctoral fellow ,if offered(via TEQIP)?	17	02	00
Would you like to share/use research infra-structure at IITK, if made available?	18	02	00
Would you like to conduct collaborative research with IITK?	19	02	00
Would you like lectures by experts (Indian and international) on niche research areas/topics?	18	02	00
Do you want special-topic conferences?	18	02	00
How can TEQIP help improve your research?	• Joint supervision of Ph.D/M.Tech students with IITK. • By exploring the possibility to avail lab facility for us at IITK to carry out experimental work to improve our research. • Just because of TEQIP, I will able to get nice exposure to IIT and learns till the important matter that we can use in our research later. • By letting other academics institutes use the research facilities at reasonable charges. • Lab facilities available at various TEQIP supported institutes should be accessible. • Providing research grant to individual in smooth way. • TEQIP can organize semester/workshop/short term course on amorphous semiconductors. • TEQIP can provide sufficient funds to govt. Colleges to develop good lab facilities. • TEQIP can provide the sufficient fund to the state engineering govt. Colleges to purchase necessary laboratory equipments etc. • By further interaction. • By providing opportunity to work with the team work in my area of a premium institute like IIT an IIM. • By allowing, during summer break to work in area on our choice. • By providing collaborative research projects. • TEQIP has helped in having a better understanding of the topics covered. • Similar workshops on periodic basis should be organized.		

Summary of Student Feedback

WORKSHOP SESSION

Questions	**Excellent**	**Good**	**Ordinary**
Clarity of communication about workshop	14	03	00
Organization of the sessions	14	02	00
Quality of lectures	12	05	00
Quality of labs	14	03	00
Effectiveness of discussions	03	14	00
Effectiveness of learning experience	04	11	01
	Appropriate	**Short**	**long**
Duration of workshop	08	08	01
	Definitely	**Maybe**	**No**
Would you like to have more such sessions?	15	00	00
Would you like e-lectures by experts on special topics?	14	02	00
Suggest specific topic that you would like additional expert lectures on	• XRD • SEM, TEM • Coating, biomaterials. • X-Ray • Computational Techniques. • Composites • Metallic glass • UV spectrophotometers NMR • FTIR • XPS		
Additional Suggestions	• Workshop should be of minimum two weeks. • More common topic can be given. • More time for laboratory visit. • Advanced analysis techniques based on XRD, SEM, TEM • Workshop only on one technique. • Concentrate on single topic. • Such program should be organized regularly after the interval of 6 months. • Duration of lab visit should be increase. • More time on lab sessions. • Duration of workshop should be increased. • If possible lab visits with instruments demonstration.		

LEARNING

Questions	**Yes**	**No**
Do you get enough class projects?	15	01
Is the learning adequate?	12	03
Do you have sufficient resources for laboratory	12	03
What is your area of specialization	• Nano particle, Synthesis Characterization-Application. • Electrochemistry • Physical metallurgy • XRD, SEM, TEM • Biomedical engineering. • Condensed Matter Physics. • Composites • Corrosion on A.S.S • Thermal spray coating • Chemical engineering. • Electrochemical Engineering • Chemical Engineering (Chemical Process Design) • Surface Engineering	
	Sufficient	**inadequate**
Is the library/journal support/e-connection adequate?	12	01

	Definitely	**Maybe**	**No**
Would you like to have common (TEQIP) repository of	16	00	00
Would you like to visit IITK to attend specialized	15	01	00
Would you like MOOCS/e-resources based courses?	12	04	00

How can TEQIP help improve your learning?	• More sessions like this should be conducted in near future. • Got a conceptual knowledge of characterization techniques. • Organize more courses such like that. • Learning basics. • By organizing lectures and internship. • TEQIP sponsored internship may help to learn better. • By e-learning material and workshops on different topics. • By interacting with professors. • By providing the equipment available for research. • Interacting with professors and other institute colleague. • By organizing such internship • Organizing such courses. • Basic concept. • By increasing the laboratory instruments and it should be accessible for all.

RESEARCH

Questions	**Definitely**	**Maybe**	**No**
Would you like to visit an IIT for a short visit /internship/post-doctoral stint ,if offered(via TEQIP)?	11	01	00
Would you like to share/use research infra-structure at IITK, if made available?	11	01	00
Would you like to conduct collaborative research with IITK faculty?	11	01	00
Would you like lectures by experts (Indian and international) on niche research areas/topics?	11	01	00
Do you want special-topic conferences?	10	01	01

How can TEQIP help improve your research?	• By giving basic idea of XRD, SEM, TEM. • By providing lectures in current technology and future aspects. • TEQIP sponsored internship with IIT experts on some specific technique or research interest would certainly help. • By sharing lab facility at IITK. • By providing the equipment facilities and experts lectures and workshops. • By providing opportunity, fund and leave from college. • Online forum

OUTCOME

This workshop was very successful in terms of participation and feedbacks from participants were very encouraging too. It brought together participants from Industry, academia and research labs to form networks among themselves, discuss their area of expertise and help each other to expand their knowledge.

- The course provided the participants theoretical background and a hands-on experience to data collection and data analysis, complemented by lectures and lab sessions.
- It helped participants to acquire a basic theoretical background for the characterization techniques, particularly those of advances in analysis as well as technology.
- It helped them better understand the practical aspects of characterization methods and how useful they are.
- For researcher and teachers, the course provided an appreciation of the link between the theoretical principles and practical applications with a modern perspective.