



KNOWLEDGE INCUBATION FOR TEQIP, IIT KANPUR

TEQIP Workshop on Microstructure Engineering via Heat Treatments

October 19-21, 2015

The three day workshop on Microstructure Engineering via Heat Treatments held at IIT Kanpur aimed at introducing the concept of microstructure starting with basic concepts of crystal structure and phase transformation. Bulk and surface heat treatments were covered in detail. Characterization of the microstructure was explained using microscopy techniques and hardness test. Concurrently with the theory classes, lab sessions were organized to keep in view the practical aspects of characterization and heat treatment. Scholars from academia, industry and research organizations were expected to benefit equally from the workshop.

The objectives of the workshop were:

- 1) To introduce the fundamental concepts applied in designing various heat treatments of steels and Aluminium alloys.
- 2) To introduce the basic characterization techniques used to analyse heat treated components.
- 3) To impart hands on experience in metallographic sample preparation as well as live demonstration of some heat treatment processes and characterization of heat treated components.

TOPICS DISCUSSED

- Overview of the course structure
- Structure of Materials (Crystal Structure and Microstructure)
- Phase Diagram
- Iron-Carbide Phase Diagram and Steel Microstructure

- Phase transformations and Microstructures (developed by Annealing, Normalizing and Hardening)
- Practical aspects of Optical and Scanning Electron Microscopy
- Hardenability (Jominy End Quench test) & Heat Treatments of Tool Steels
- Surface Hardening of Steels (Carburizing, Induction, Nitriding)
- Heat Treatments of Cast Irons
- Heat Treatments of Al Alloys

➤ **Lab sessions**

- Characterization of Heat Treated Components (Macro-hardness, micro-hardness)
- Annealing, Normalizing and Hardening Demo
- Hands-on Metallography
- Jominy End Quench test Demo
- Age Hardening Demo
- Characterization of Case Depth

LIST OF SPEAKERS

- Dr. AnandhSubramaniam
- Dr. ShashankShekhar
- Dr. Kaustubh Kulkarni
- Dr. Nilesh Prakash Gurao
- Dr. KallolMondal
- Dr. Anish Upadhyaya

PARTICIPATING INSTITUTES

Institute	Number of Participants
IFTM University	2
V.S.S university of tech. Burla, Sambalpur	3
MNNIT Allahabad	6
HBTI Kanpur	3

National Institute of Technology Raipur	4
National Institute of Technology Kurukshetra	2
NIT, Durgapur	1
MJP Rohilkhad University, Bareilly	1
VNIT Nagpur	1
G.B.P.U.A.T Pantnagar	4
Siemens Ltd. Aurangabad	2
Total	29

WORKSHOP SCHEDULE

October 19, 2015

Time	Event
8:30 – 9:00 AM	Registration
9:00 – 9:20 AM	Overview of the course structure <i>Prof. Anish Upadhyaya</i>
9:20 – 10:20 AM	Structure of Materials (Crystal Structure and Microstructure) <i>Prof. Anandh Subramaniam</i>
10:20 – 10:40 AM	High Tea
10:40 – 11:30 AM	Phase Diagrams <i>Prof. Anandh Subramaniam</i>
11:30 – 12:30 PM	Iron-Carbide Phase Diagram and Steel Microstructure <i>Prof. Shashank Shekhar</i>
12:30 – 2:30 PM	Lunch Break
2:30 – 3:30 PM	Lab : Characterization of Heat Treated Components (Macro-hardness, micro-hardness)
3:30 – 4:00 PM	Coffee Break
4:00 – 6:00 PM	Lab : Annealing, Normalizing and Hardening Demo

October 20, 2015

Time	Event
9:30 – 10:20 AM	Phase transformations and Microstructures (developed by Annealing, Normalizing and Hardening) <i>Prof. Nilesh Prakash Gurao</i>
10:20 – 11:10 AM	Practical aspects of Optical and Scanning Electron Microscopy <i>Prof. Shashank Shekhar</i>
11:10 – 11:30 AM	Coffee Break
11:30 – 12:30 PM	Hardenability (Jominy End Quench test) & Heat Treatments of Tool Steels <i>Prof. Kallol Mondal</i>
12:30 – 2:30 PM	Lunch Break

2:30 – 3:30 PM	Lab: Hands-on Metallography
3:30 – 4:00 PM	Coffee Break
4:00 – 6:00 PM	Lab: Jominy End Quench test Demo
7:30 PM Onwards	Workshop Dinner

October 21, 2015

Time	Event
9:30 – 10:20 AM	Surface Hardening of Steels (Carburizing, Induction, Nitriding) <i>Prof. Kaustubh Kulkarni</i>
10:20 – 11:10 AM	Heat treatment of Cast Iron <i>Prof. Kallol Mondal</i>
11:10 – 11:30 AM	Coffee Break
11:30 – 12:30 PM	Heat treatments of Al Alloys <i>Prof. Kaustubh Kulkarni</i>
12:30 – 2:30 PM	Lunch Break
2:30 – 3:30 PM	Lab: Age Hardening Demo
3:30 – 4:00 PM	Coffee Break
4:00 – 5:00 PM	Lab: Characterization of Case Depth

Summary of Faculty Feedback

Workshop

Questions	Excellent	Good	Ordinary
Clarity of communication about workshop	06	01	00
Organization of the sessions	05	02	00
Quality of lectures	06	01	00
Quality of posters	02	03	00
Effectiveness of discussions	06	01	00
Effectiveness of learning experience	05	01	00
	Appropriate	Short	long
Duration of workshop	00	06	00
	Definitely	Maybe	No
Would you like to have more such sessions?	07	00	00
Would you like e-lectures by experts on special	05	01	00

Suggest specific topic that you would like additional expert lectures on	<ul style="list-style-type: none"> • Mathematical modelling applications in metallurgy and process metallurgy. • Phase diagrams • Micro-structure property relationship • Heat treatment • Mechanical behaviour of materials. • Micro-structure engineering via mechanical testing • Electron microscopy
Additional Suggestions	<ul style="list-style-type: none"> • Copy of presentations should be provided in the form of CD to participants. • There should be some arrangement to visit famous places of the city just to have outing and have idea of the city. Most of the participant travelled from far places to attend the workshop. • More advanced laboratory classes are required. • Total duration of workshop may be extended for one week. • Conduct some knowledgeable programs where exchange of knowledge can occur between faculty members with industrial as well as with the researchers and scientists.

Teaching

Which subjects do you teach?	<ul style="list-style-type: none"> • X- ray diffraction • Metallurgical thermodynamics and Kinetics • Testing of materials • Process metallurgy • Material Science & Material Engineering • Advanced manufacturing process • Physical metallurgy • Heat treatments and Phase transformations • Manufacturing Engineering • Vibration, CAD, FEM & dynamics of M/c
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What is average student to teacher ratio in your institute?	<ul style="list-style-type: none"> • 1:20 • 1:40 • 1:30 • As per AICTE rules 			
Questions	YES		NO	
Do you have additional support for teaching (tutors, graders, teaching Assistants, etc)?	02		05	
Do you give class projects for UG classes?	07		00	
Do you give class projects for PG classes?	04		03	
Do you have sufficient resources for laboratory courses?	00		07	
	Sufficient		Inadequate	
Is the library/journal/e-connection support adequate?	03		04	
	Definitely	May be	No	
Would you like to have common (TEQIP) repository of course material?	04	02	01	
Would you like to visit IITK to participate in and develop course material (existing or new)	06	01	00	
Would you like to participate in creation of the repository material (course files/lab.	05	02	00	
	e-courses	Workshops	Content	none
How can IITK effectively help you prepare for	05	06	03	00
How can TEQIP help improve your teaching?	<ul style="list-style-type: none"> • It can help in deeper our basic concepts by various experts having deep knowledge of the field. • Interaction with professor in workshop and research collaborations. • Through e-connection support and journals. • Extending lab facilities providing study materials. • By giving sufficient knowledge in our research and teaching area by conducting such type of workshops and short term courses. 			

Research

Questions	Definitely	Maybe	No
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Would you like to visit an IIT for a visiting-faculty/ post-doctoral fellow, if offered (via-TEQIP)?	05	02	00
Would you like to share/use research infrastructure at IITK, if made available?	07	00	00
Would you like to conduct collaborative research with IITK?	06	01	00
Would you like lectures by experts (Indian and international) on niche research areas/topics?	07	00	00
Do you want special-topic conferences?	04	03	00
How can TEQIP help improve your research?	<ul style="list-style-type: none"> • It can help us in faculty exchange programs by providing funding as well as research facilities. • Collaborative research work allowing testing facilities and joint supervision of M. Tech students. • By giving opportunity to pursue our research through different programs. • Through experimental work. • Most of the institutes have no infrastructure for doing researches, this certainly helps to motivate candidate to see the lab facility and well organized lectures by experts. 		

Summary of Student Feedback

Workshop

<i>Questions</i>	<i>Excellent</i>	<i>Good</i>	<i>Ordinary</i>
Clarity of communication about workshop	13	03	00
Organization of the sessions	11	05	00
Quality of lectures	16	00	00
Quality of posters	07	06	01
Effectiveness of discussions	11	05	00
Effectiveness of learning experience	12	04	00
	<i>Appropriate</i>	<i>Short</i>	<i>Long</i>
Duration of workshop	06	09	00
	<i>Definitely</i>	<i>Maybe</i>	<i>No</i>
Would you like to have more such sessions?	15	00	01

Would you like e-lectures by experts on special topics?	15	01	00
Suggest specific topic that you would like additional expert lectures on	<ul style="list-style-type: none"> • Mechanical metallurgy and deformation behaviour • Heat treatment of cast iron • Sintering, Powder characterization • TTT, CCT -diagram • Ferrite Nano particles • Welding • SG cast iron and its formation • Material characterization techniques • Computational fluid dynamics • Effect of micro-structure on the tribological behaviour of metals • XRD- Analysis, optical micrography 		
Additional Suggestions	<ul style="list-style-type: none"> • Additional practical work shall be required. • Duration of lectures to be long to address all subjects. • Workshop may be scheduled for one week. • Effect of welding heat treatment changes the microstructure. • Must organize such type of workshops but total duration should be atleast 7 days. • Provide some modelling workshop on ANSYS. • For such short duration workshops, it may be carried out in phase- 1 & 2 and so on. • Would like to have more such sessions. Workshop should be held for at least 1 week. 		

Learning

Questions	Yes	No
Do you get enough class projects?	14	02
Is the learning adequate?	15	01
Do you have sufficient resources for laboratory courses?	13	03

What is your area of specialization	<ul style="list-style-type: none"> • Material science • Production Engineering • Powder Metallurgy • Nano Composite • Ferrous process metallurgy • Mechanical engineering • Micro-manufacturing • SG cast iron • Metallurgy and Material Engg. <ul style="list-style-type: none"> • Machining 		
	Sufficient		Inadequate
Is the library/journal support/e-connection adequate?	13		01
	Definitely	Maybe	No
Would you like to have common (TEQIP) repository of course	14	01	00
Would you like to visit IITK to attend specialized courses?	15	01	00
Would you like MOOCS/e-resources based courses?	13	03	00
How can TEQIP help improve your learning?	<ul style="list-style-type: none"> • Conducting more workshop(hands on practice). • By providing a digital copy of the seminar to recall the contents covered. • By providing such type of excellent experimental knowledge and good interactions with experts. • It is improving our learning by best facility available and exposure to the international quality research. • In this workshop co-ordinator conducted hands on practice for us. This is very good practice for us likewise in future add more experimental things. Hands on learning provide better learning. • Just by increasing the duration of the course. • By interaction with professor from reputed institutions. • By providing video, lectures of professors. 		

Research

<i>Questions</i>	<i>Definitely</i>	<i>Maybe</i>	<i>No</i>
Would you like to visit an IIT for a short visit /internship/post- doctoral stint ,if offered (via TEQIP)?	15	01	00
Would you like to share/use research infra- structure at IITK, if made available?	13	03	00
Would you like to conduct collaborative research with IITK faculty?	14	02	00
Would you like lectures by experts (Indian and international) on niche research areas/topics?	13	03	00
Do you want special-topic conferences?	13	02	01
How can TEQIP help improve your research?	<ul style="list-style-type: none"> • By interaction with expert it helps to clarify and some experimental techniques which is possible to learn only from experts. • By allowing access to equipment available at IITK. • Providing the necessary arrangements to do research work. • By continuing these types of interaction. • Providing facility of equipment, machinery on economical basis. • TEQIP can provide us more and more workshop and other educational conferences on different topics at different IITs and NITs. • By providing a session having description of available facilities for research work. • By providing some modelling workshop. • By arranging the workshop and expert talk. • Providing facility for the use of laboratory of IIT Kanpur. 		

OUTCOME

The workshop on **Microstructure Engineering via Heat Treatments** was envisaged to introduce faculty member, students and participants from industries to the inter-relation between structure and processing of various materials, particularly, ferrous alloys and Al-alloys. With this in mind, the organisers used the expertise and resources available at IIT Kanpur and put together a course structure which introduced the participants to the various fundamentals of metallurgy and the knowledge related to heat treatment was disseminated. In order to provide participants with a better feel of the subject, laboratory component was also included.

The participants were very interactive and raised many pertinent questions during lecture and follow-up discussion. The initial feedback from the participants has been very encouraging. Participants greatly appreciated the workshop contents and strongly advocated for a longer workshop on this theme so as to have detailed coverage on many of the topics. Participants also appreciated the presence of laboratory component, which gave them a hands-on experience of various aspects which were discussed in lectures. Some of the participants had visits to the labs of faculty involved to initiate future academic interactions.

Overall, the workshop successfully achieved the objective with which it was held. It is hoped that there will be several follow up activities at various participating institutes and industries related to heat treatment and microstructure engineering.