

Introduction (Round 0)

1.1 Name of Developer	Kantesh Balani
1.2 Name of your Institute	Indian Institute of Technology Kanpur
1.3 Name of Participating Institute	Indian Institute of Technology Kanpur
1.4 Application Type	Participating Institute
2.1 Lab Name and ID	Electron Microscopy For Beginners 175
2.2 Name of Discipline	Materials Science Engineering
2.3 Target Group	UG,PG

2.4 University

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2.5 Name of Experiments

SNo.	Experiment ID	Experiment Name
1	1438	Basics of Scanning Electron Microscopy: Secondary Electron and BSE imaging mode
2	1439	Feature Size measurement: Porosity, Grain, and Reinforcement
3	1440	Effect of Beam voltage on conducting and insulating samples
4	1441	Elemental mapping: Spot, Line and Area Analysis
5	1442	Basic operations of Transmission Electron Microscope (Imaging and Diffraction Pattern)
6	1443	Bright Field Imaging and Dark Field Imaging
7	1444	Electron Diffraction for various materials
8	1445	Indexing of Diffraction Patterns (Ring Pattern & Spot Pattern)
9	1446	Sample Preparation for TEM analysis (Bulk metal, Powder sample, Brittle material)
10	1447	Cross-sectional Sample Preparation

3.1 Intention of Virtualization

Scanning electron microscope is utilized for topographical evaluation mainly of rough surfaces. Though it requires a conducting coating, insulating samples can be observed via depositing a conductive coating of gold or carbon. On one hand where secondary electron imaging mode can provide fine features, the BSE (back-scattered electron) imaging mode can provide compositional contrast. The elemental mapping facility can present the distribution of elements in that mix of microstructure.

Transmission electron microscope is one of the potential characterization tool for microstructural analysis. Because of the complexity in operation and higher cost of the machine, TEM is not easily available for learning and research purpose. The goal of developing virtual experiment is to provide basic knowledge about the TEM and its operation. This will facilitate the students/users to acquire the feeling of handling microscope. The provisions of playing with various control and its effect on the imaging and diffraction pattern will be provided.

3.2 How will the student get the feel of lab?

It is intended to mimic the actual instrument using animation. Through this the students will virtually get the hands on experience of handling the machine.

3.3 Will you be using animations?

Yes

4.1 Frontend Technology (UI/UX)

i. PHP ii. CSS iii. HTML iv. Flash Player

4.2 Backend Technology

i. MySQL ii. JavaScript iii. PHP

4.3 Miscellaneous Technology

N/A

5.1 Learning Objective and Component

- To understand basic operation of SEM
- To observe the imaging modes of Secondary electron for topographical features and back-scattered electron imaging for compositional contrast
- Get a feel of characterizing the feature size
- To understand the basic operation of the TEM

Loading sample, searching and selecting region of interest, Magnifying the features, Purpose of tilting and optimizing the contrast, setting for bright field imaging, setting for diffraction pattern

- Purpose of bright field imaging, purpose of dark field imaging, weak beam imaging

5.2 Student ability to perform in real lab

Student should be able to perform the experiment first with training, then with minimal assistance.

5.3 Outcome through Simulator

- Understanding the basic Imaging and diffraction concepts.
- Analyzing the results
- Learning of sample preparation for TEM analysis

5.4 References

1. K. C. Thompson-Russel, J. W. Edington, Practical Electron Microscopy in Materials Science, Macmillan Philips Technical Library, 1977
2. David B. Williams, Barry Carter, Transmission Electron Microscopy: A Textbook for Materials Science, Springer Science, 2009
3. J. Thomas, T. Gemming, Analytical Transmission Electron Microscopy: An Introduction for Operators, Springer Science, 2014