

MSE 2021: Materials Characterization

Credit hours and contact hours: 3-0-3-4

Instructor: Hamid Garmestani

Textbook: No textbook used. Class notes used.

Specific course information

Catalog description: The fundamentals of basic microstructural and compositional materials characterization techniques are presented with an emphasis on tools using electromagnetic radiation and electrons as stimuli.

Prerequisites: MSE 2001 – Principles & Applications of Engineering Materials

Course: Required

Specific goals for the course

Outcomes of instruction:

Outcome 1: The student will develop an understanding on the principles and operation of X-ray Diffraction

- 1.1 Describe x-ray diffraction in crystalline materials.
- 1.2. Describe structure factor for single and binary systems.
- 1.3. Describe reciprocal Lattice parameter analysis.
- 1.4. Describe particle size and strain measurement using x-ray techniques.

Outcome 2: Understand the basics and operation of light and electron interaction with materials to get an image in different scales

- 2.1. Describe electron beam /materials interaction to form an image.
- 2.2. Describe x-ray microanalysis.
- 2.3. Acquire experimental data in a team of 4-5 from x-ray diffraction, optical and electron microscopy and prepare reports.
- 2.4. Perform statistical analysis of the experimental data acquired.

Student Outcomes:

- (1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

- (6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

Topics covered:

1. Properties of Photons and Electrons
2. Atomic Structure
3. Optical Microscopy
4. Quantitative Stereology
5. Scanning Electron Microscopy -
6. Sample preparation techniques, thin film deposition, and resolution
7. X-ray microanalysis
8. Microstructure and Crystallography
9. X-ray Diffraction

Correlation between Outcomes of Instruction and Student Outcomes:

Outcomes of Instruction	Student Outcomes						
	1	2	3	4	5	6	7
1.1 Describe x-ray diffraction in crystalline materials.	X					X	
1.2. Describe structure factor for single and binary systems.	X					X	
1.3. Describe reciprocal Lattice parameter analysis.	X					X	
1.4. Describe particle size and strain measurement using x-ray techniques.	X					X	
2.1. Describe electron beam /materials interaction to form an image.	X					X	
2.2. Describe x-ray microanalysis.	X					X	
2.3. Acquire experimental data in a team of 4-5 from x-ray diffraction, optical and electron microscopy and prepare reports.	X					X	
2.4. Perform statistical analysis of the experimental data acquired.	X					X	

School of Materials Science and Engineering Student Outcomes:

- (1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- (2) An ability to apply engineering design to produce solutions that meet specified needs with consideration for public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- (3) An ability to communicate effectively with a range of audiences.
- (4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

- (5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
- (6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
- (7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.