MATSCEN 2241 Structure and Characterization

Course Description

Atomic structure of materials and its determination using X-ray diffraction techniques. Introduction crystalline defects and microstructure. Characterizing and quantifying materials microstructure using optical and electron microscopy.

Transcript Abbreviation: Struc Char Mater
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Undergrad
Student Ranks: Sophomore
Course Offerings: Spring
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 3.0 hr Lec
Expected out-of-class hours per week: 6.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: Prereq: 2010, Physics 1250 or 1260, and Math 1151 or 1161, and Chemistry 1210 or 1250, and enrollment as Matscen-BS student; or permission of instructor.
Exclusions: Not open to students with credit for BOTH MSE 341 and MSE 342
Cross-Listings:

Course Rationale: Existing course.

The course is required for this unit's degrees, majors, and/or minors: Yes
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: No

Subject/CIP Code: 14.3101
Subsidy Level: Baccalaureate Course

Programs

Abbreviation	Description
MATSCEN	Materials Science and Engineering

General Information

Explore the properties of crystalline defects including dislocations, grain boundaries and interphase boundaries.
Introduce the principal methods for characterizing materials microstructure optical and electron microscopy, and stereological techniques for quantifying microstructural features.

Course Goals

Relationship to MSE Program Outcomes: 1. This course applies basic science and engineering concepts to develop a fundamental understanding of atomic structure, defects and microstructural features in materials.
2. Students are presented with the basic operation and capabilities of the principal characterization methods used in materials science, namely XRD, optical microscopy and SEM.
3. Understand how microstructure and crystalline defects affect the properties of materials, and how these features can be characterizedconcepts that are fundamental for graduate research and employment in the area of materials design.

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Atomic Structure of Materials - Common structures for metals, semiconductors ceramics and polymers - Defining directions and planes - Anisotropy and effect on properties - Point defects - Amorphous materials and examples	9.0							
Introduction to X-Ray and Electron Diffraction - X-ray and electron sources - Braggs law - Atomic scattering factor and structure factor - Phase identification and texture measurement - Electron Back-Scattered Diffraction	6.0							
Dislocations and Interfaces - Basics of dislocation structure - Energy and forces associated with dislocations - Structure and energy of surfaces and grain boundaries - Structure of interphase boundaries - Connections to macroscopic properties	9.0							
Optical and Scanning Electron Microscopy - Instrumentation - Types of signals - Imaging in the OM and the SEM - Resolution, aberrations, depth of field - Comparison of SEM and optical microscopy - Live/remote demo using the Phenom or Quanta	6.0							
Stereology and Quantitative Image Analysis - Need for stereology and quantitative microscopy - Measurement of key microstructural features - Statistics in stereology	6.0							
Energy Dispersive Spectroscopy - Basics, need for compositional analysis - Principles of compositional analysis - Capabilities, limitations - Resolution and uncertainty	3.0							
Spectroscopy Using Photon and Ion Probes - Photon interactions with matter - Raman, IR, UV and Optical Spectroscopy - Ion interactions with matter - Rutherford Backscattering Spectroscopy - Secondary Ion Mass Spectroscopy	3.0							

Grades

Aspect	Percent
Homework and Projects	34%

Aspect	Percent
Mid-term Exam	33%
Final Exam	33%

Representative Textbooks and Other Course Materials

Title	Author
Introduction to Materials Science and Engineering	Callister
Electron Microscopy and Analysis, 3rd ed., 2000	P. J. Goodhew, F. J. Humphreys and R. Beanland
Grade A Notes compilation of several chapters from (X-Ray Diffraction).	Cullity
Grade A Notes compilation of several chapters from (Crystalline Defects).	Hull and Bacon

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
***	a	An ability to apply knowledge of mathematics, science, and engineering.
	b	An ability to design and conduct experiments, as well as to analyze and interpret data.
*	c	An ability to design a system, component, or process to meet desired needs.
*	d	An ability to function on multi-disciplinary teams.
***	e	An ability to identify, formulate, and solve engineering problems.
*	f	An understanding of professional and ethical responsibility.
*	g	An ability to communicate effectively.
	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
*	i	A recognition of the need for, and an ability to engage in life-long learning.
	j	A knowledge of contemporary issues.
**	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Prepared by: Michael Mills