



Transmission Electron Microscopy in Materials Science and Engineering

Fall 2018, Syllabus

Instructor Information

Instructor: Prof. Sadegh Yazdi

Office: RASEI N327B

Office Hours: After class and by appointment

Office Telephone: (303) 492-2611

E-mail: sadegh.yazdi@colorado.edu

Course Description

RASEI (Catalog code TBD)

Course Name: Transmission Electron Microscopy in Materials Science and Engineering

Prerequisite

Open to all graduate and senior undergraduates (permission required, please contact Prof. Yazdi). Experience on electron microscopy recommended but not strictly necessary.

Important Note: For getting the training on Titan Themis, priority will be given to those who have taken “*Transmission Electron Microscopy in Materials Science and Engineering*”. Also this course is a prerequisite for the Titan lab course that will be given in spring 2019.

Textbook

- Williams & Carter, Transmission Electron Microscopy: A Textbook for Materials Science, Second Edition

Student Learning Objectives

Upon completion of this course students will be able to:

- 1) Understand different electron microscopy techniques, the instrumentation required for each technique, and the applications of each technique in materials science
- 2) Understand published electron microscopy papers and interpret electron microscopy data
- 3) Design electron microscopy experiments that answer the materials questions they have in their own research

Students will meet the three objectives listed above through a combination of the following activities in this course:

- Written exam (for evaluating the first learning objective, weight: 30%)
- Oral presentation on an assigned electron microscopy paper (for evaluating the second learning objective, weight: %30)
- Writing a research proposal on characterization of a material of their own choice (must be related to their Ph.D. or M.Sc. research project) using transmission electron microscopy techniques (for evaluating the third learning objective, weight: %40)

Topic Outline/Schedule

Week 1, 2, and 3

Module 1: Basics of Electron Microscopy

- Why transmission electron microscopy?
- Electron-matter interaction
- Instrumentation: Electron Sources, Lenses, Apertures, Detectors, Holders and Vacuum system
- TEM specimen preparation

Week 4 and 5

Module 2: Electron Diffraction

- Electron Diffraction Theory

- Obtaining and indexing Selected Area Diffraction (SAD) patterns
- Kikuchi diffraction
- Convergent Beam Electron Diffraction (CBED) and Nano Beam Electron Diffraction (NBED)

Week 6, 7, and 8

Module 3: Imaging

- High Resolution Transmission Electron Microscopy (HRTEM)
- Electron Holography and Lorentz Microscopy
- High Resolution Scanning Transmission Electron Microscopy

Week 9, 10, and 11

Module 4: Electron Spectroscopy

- Energy Dispersive X-ray Spectroscopy (EDS)
- Electron Energy Loss Spectroscopy (EELS)
- Cathodoluminescence (CL)

Week 12, 13, and 14

Module 5: Other Topics and Applications

- Electron Tomography
- In-situ Electron Microscopy
- Time resolved electron microscopy
- Application examples