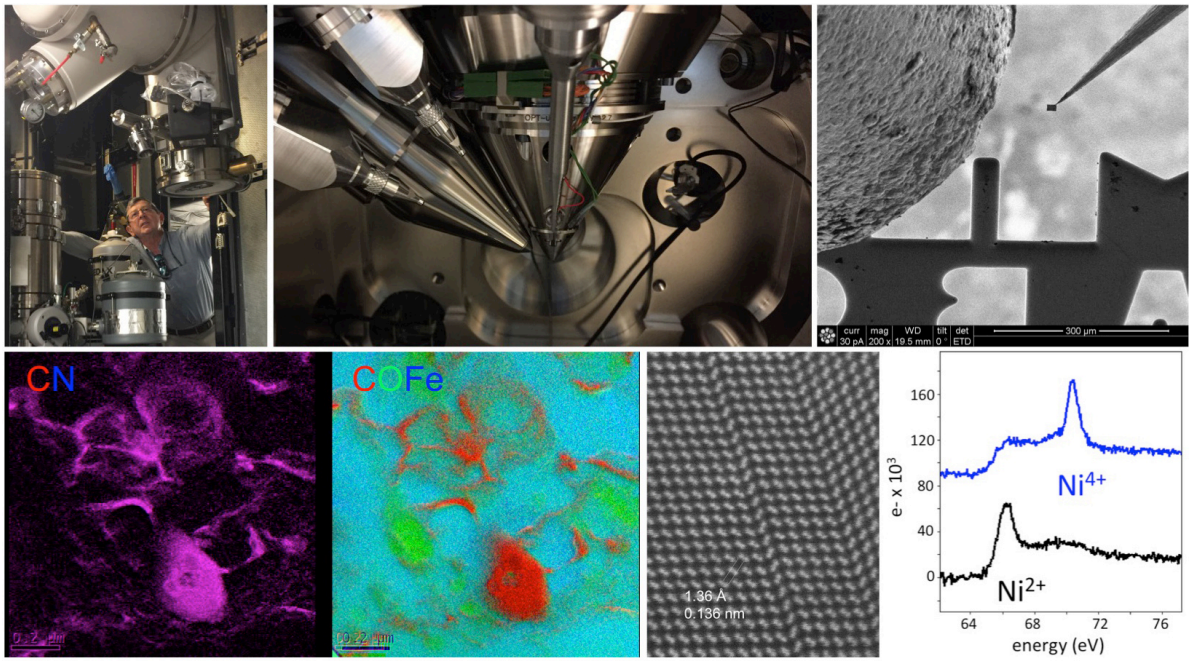
ERTH 711 Fall 2020 CRN 79313

Electron & Ion Microscopy



CRN: 79313 (3 credits)

Class meets: T/Th 10:30 – 11:45 AM for lectures via Zoom
Once-weekly time blocks will be set up for lab work in lieu of lectures several weeks during the semester (to be determined by students' schedules)
Given the current coronavirus pandemic situation, most labs will be via Zoom + (hopefully) some in-person labs with limited number of people present.

Necessary Background: Physics and Chemistry. Contact instructor, if you have questions.

Instructor: Dr. Hope Ishii
Contact Info: POST 509B, **ishii3@hawaii.edu**, 956-7755
Advanced Electron Microscopy Center: POST 08

With co-instructors Dr. John Bradley and Dr. Kenta Ohtaki

Description: Skills in electron and ion microscopy are highly sought-after. This course is intended to introduce graduate students to the state-of-the-art instruments in the Advanced Electron Microscopy Center (AEMC), located in the basement of the POST building. Students will learn how the dual-beam Focused Ion Beam – Scanning Electron Microscope (FIB-SEM) and Transmission Electron Microscope (TEM) function and the kinds of research and engineering that can be performed using them. Laboratory periods will allow students to observe and operate the instruments. There will be some theoretical background, but the course will emphasize the practical aspects of the instrumentation, data and analysis. Depending on enrollment, student-provided samples may be used for FIB and TEM work. Enrollment in this course is encouraged for students planning on using the AEMC instruments in their thesis work.

For information on the FIB and TEM instruments, see the AEMC website:
http://www.soest.hawaii.edu/AEMC/

Course Goals:
Students can expect to emerge with an understanding of how FIB and/or TEM may be useful in their current or future research and their advantages and limitations.

Example Topics (content and order will depend on student backgrounds and interests):

- Sample requirements and preparation
- Representativeness of samples
- Electron-solid interactions
- Ion-solid interactions
- Components of the dual-beam FIB and TEM
- Monochromator and aberration correctors on the UH TEM
- Gas injection system chemistries and considerations
- Imaging modes in the FIB
- Imaging modes in the TEM
- Energy-dispersive spectroscopy
- Electron energy loss spectroscopy
- Energy filtered imaging
- Electron diffraction

Assessment and Grading
Attendance is mandatory. Grading is based on

A) Engagement and participation in class sessions. (10%)
B) Short quizzes or homework assignments that will cover theoretical foundations and practical aspects learned during the course. (20%)
C) Demonstrate proficiency in applying course concepts during FIB and/or TEM work on actual samples in the lab. Depending on enrollment and interests, this work may be done in groups. (30%) ***Note that this may end up being via Zoom.***
D) A concise written report that includes a description of the science question and hypothesis addressed, the relevant instruments and analytical conditions used for sample analysis, evaluation and interpretation of the data acquired, and conclusions and/or future work needed. Each student needs to turn in their own report written in their own words. (40%)

Student Learning Objectives:
Technical knowledge: You will emerge with an understanding of the basics of operation of SEM, FIB and TEM and the physics of electron and ion interactions with solids, useful in sample preparation, characterization and engineering.
Scientific method: You will apply the scientific method in constructing a hypothesis and testing it in the lab. You will interpret your data and draw conclusions.
Communication: You will communicate your findings in a short report.
Employability: You will increase your knowledge and skills on practical sample characterization instruments of use in many research and industrial settings.

Resources

Disability Access:

The Earth Science Department will make every effort to assist those with disability and related access needs. For confidential services, please contact the Office for Students with Disabilities (known as "Kokua") located in the Queen Lili'uokalani Center for Student Services (Room 013): 956-7511, kokua@hawaii.edu, www.hawaii.edu/kokua

Title IX Resources:

The University of Hawaii is committed to providing a learning, working and living environment that promotes personal integrity, civility, and mutual respect and is free of all forms of sex discrimination and gender-based violence, including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence, and stalking. If you or someone you know is experiencing any of these, the University has staff and resources to support and assist you. Staff can also direct you to community resources. Here are some options:

- **As members of the University faculty, your instructors are required to immediately report any incident of potential sex discrimination or gender-based violence to the campus Title IX Coordinator.** Although the Title IX Coordinator and your instructors cannot guarantee confidentiality, you will still have options about how your case will be handled. Our goal is to make sure you are aware of the range of options available to you and have access to the resources and support you need.
- If you wish to remain **ANONYMOUS**, speak with someone **CONFIDENTIALLY**, or would like to receive information in a **CONFIDENTIAL** setting, use the confidential resources available here:
  http://www.manoa.hawaii.edu/titleix/resources.html#confidential
- If you wish to **REPORT** an incident of sex discrimination or gender-based violence including sexual assault, sexual harassment, gender-based discrimination, domestic violence or stalking as well as receive information and support, contact: **Dee Uwono**, Title IX Coordinator, Hawai'i Hall 124, t9uhm@hawaii.edu, (808) 956-2299