MSE 7000+ Introduction to "in-situ TEM"
Spring 2020

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Objectives:

Transmission Electron Microscope (TEM) as a Lab
= how to turn the microscope into an *in-situ* experimental laboratory while maintaining high resolution TEM imaging and spectroscopy capabilities. [1]

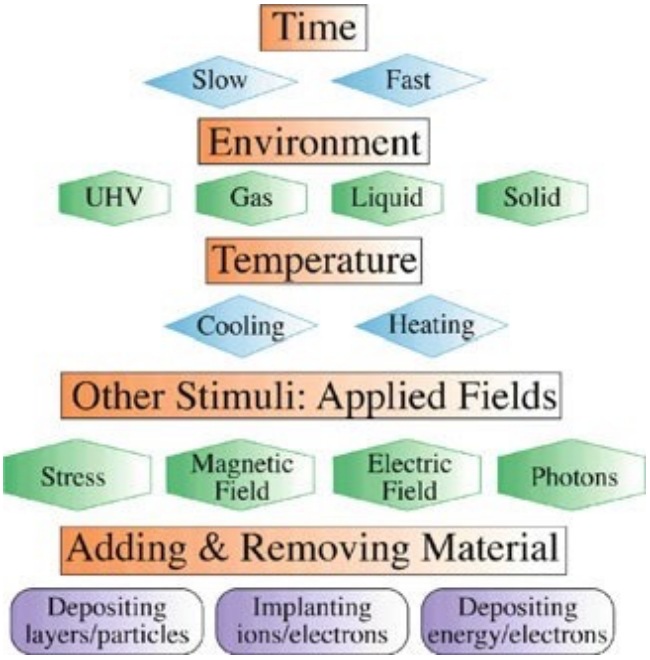

Figure taken from [1]

- Develop the ability to utilize state-of-the-art materials characterization techniques to tackle complex problems in materials science.
- Introduce and develop an understanding of advanced topics in *in-situ* characterization, with an emphasis on *in-situ* scanning / transmission electron microscopy (S/TEM), such as *in-situ* mechanical testing, heating & cooling, biasing, gas & liquid cell.
- Topics covered will include: introduction of the concept of structure-property-function in materials; introduction of S/TEM imaging and data acquisition; time resolution; electron beam – sample interaction effects; technical solutions to introduce in-situ stimuli, incl. pros & cons; in-situ vs operando; application in energy materials, functional materials, metals, soft materials, catalysis, corrosion, etc.

Prerequisites: Graduate standing in MSE/WE,
passed MSE 6741 or 7855, or permission by instructor.

Course material: Required textbooks are available through the OSU library online services. Further reading materials and lecture notes will be available on CanvasCarmen.

Reference Books:

1. David B. Williams, C. Barry Carter, *Transmission Electron Microscopy – Diffraction, Imaging, and Spectroscopy*, Springer 2016
   PDF version is available through the OSU library online services
   https://link-springer-com.proxy.lib.ohio-state.edu/book/10.1007/978-3-319-26651-0
2. Gerhard Dehm, James M. Howe, and Josef Zweck, eds. *In-situ electron microscopy: applications in physics, chemistry and materials science*. John Wiley & Sons, 2012.
3. Florian Banhart. *In-situ electron microscopy at high resolution*. World Scientific, 2008.
4. Thomas W. Hansen, and Jakob B. Wagner. Controlled atmosphere transmission electron microscopy. Principles and Practice. Springer 2016
   PDF version is available through the OSU library online services
   https://link-springer-com.proxy.lib.ohio-state.edu/book/10.1007/978-3-319-22988-1

Grading: Grading is based on:

- Two sets of homework, at least one homework includes presentation on one research example related to the course topic (each 33.3%)
- Final letter grades will be determined also based on student's contribution to in-class discussions (33.4%).

Tentative Schedule

Classes will take place

- in the second half of SP20 (7-week schedule, 7wk2)
- on Wednesday, 3:00 – 4:30pm (1 credit)
- in the CEMAS lecture theater