Advances in *In-Situ* Microscopy: Addressing *In-Situ* TEM Challenges Using Integrated Hardware and Software

Sponsored by Gatan Inc, JEOL, Oxford and DENS Solutions

8:00 am - 5:00 pm, Wednesday, October 4, 2017
Drexel University: Bossone Research Center, 3140 Market St, Philadelphia, PA 19104

Cost: Complimentary to all confirmed registrants.

Registration: Please register by October 2, 2017:
http://www.gatan.com/company/events/advances-situ-microscopy-workshop

Workshop Schedule

***(All Talks Held in Mitchell Auditorium, 1st Floor of Bossone Research Center)*:**

8:00-9:00 am: Welcome and registration (breakfast will be served)

9:00-9:30 am: **Mitra Taheri,** Drexel University - *Direct Detection Electron Energy Loss Spectroscopy; Opportunities and Challenges for In-Situ Microscopy*

9:30-10:00 am: **Ben Miller,** Gatan - *Addressing in-situ TEM challenges using integrated hardware and software*

10:00-10:30 am: **Renu Sharma**, National Institutes of Standards & Technology - *Hybrid transmission electron microscope: An integrated platform for in situ imaging and spectroscopies*

10:30-10:45 am: Coffee Break

10:45-11:15 am: **Phil Batson**, Rutgers University - *Phonon Spectroscopy and Mapping in Nanostructures*

11:15-11:45 am: **Lena Kourkoutis**, Cornell University - *New frontiers in cryo-electron microscopy: From Probing Low Temperature Electronic Phases to Processes at Liquid/Solid Interfaces*

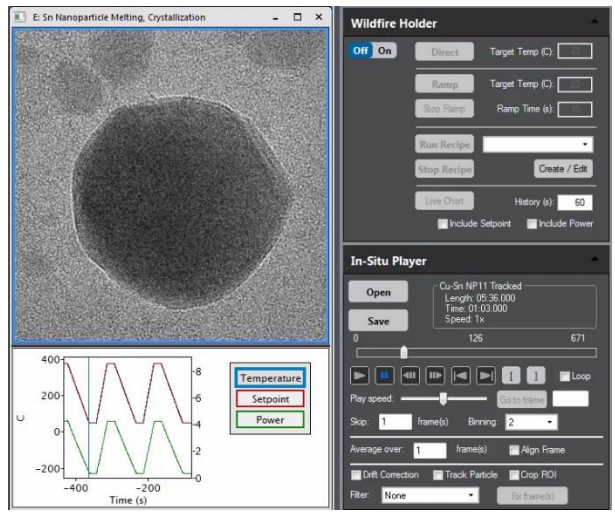
11:45-12:15 pm: **Robert Klie**, University of Illinois-Chicago - *In-Situ EELS Characterization at High Spatial Resolution: 2D Materials Based Liquid-Cell Microscopy*

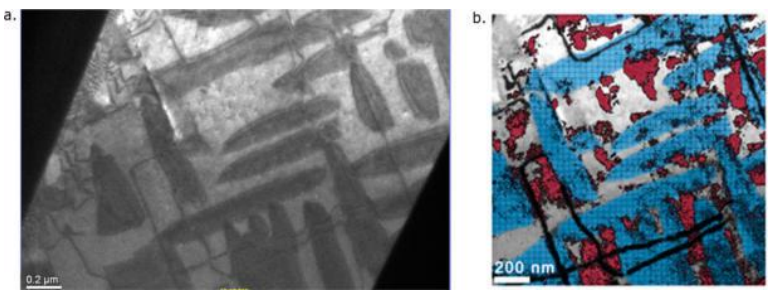
12:15-1:00 pm: Lunch (provided)

(Demonstrations Held in the Centralized Research Facilities, 1st Floor of Bossone Research Center)

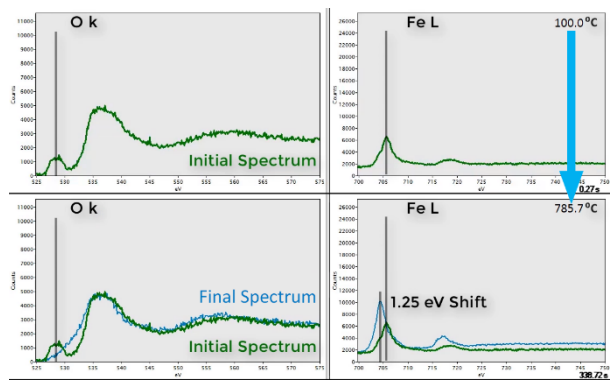
1:00-5:00 pm: Hands-on JEOL JEM 2100F STEM demonstrations of in situ experiments coupled with Direct Detection EELS using a GIF Quantum and K2® IS direct detection camera), DENSsolutions Lightning biasing & heating *in-situ* holder, and *In-Situ* Explorer software.

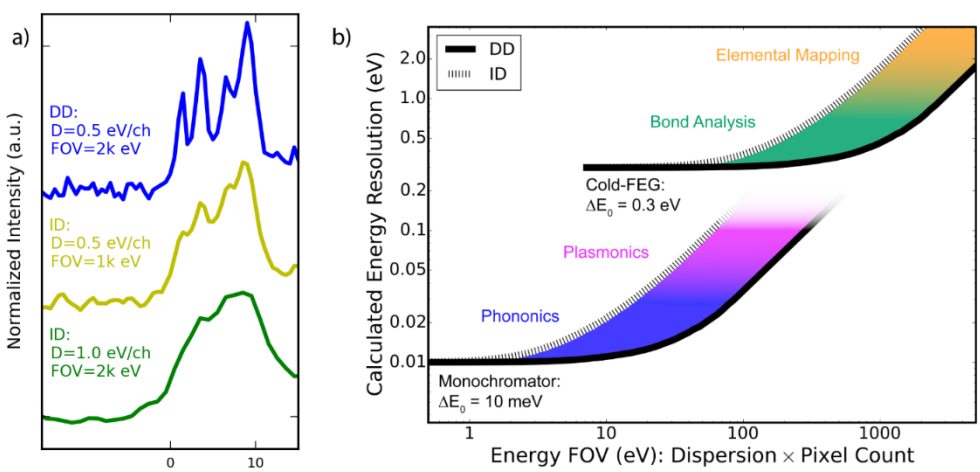
Temperature induced transitions in both complex oxide materials and 2-dimentional MXene will be studied. Chemical and electronic transitions will be measured with DD EELS and correlated with the sample IV behavior.





Example of in situ TEM performed by the Taheri group at Drexel University. In a) the ferroelectric domain structure of a $BiFeO_3$ sample is shown. In b) the blue cross-hatched regions indicate the locations of the original ferroelectric domains, while the red areas represent sites of domain nucleation after application of 210 V/cm. Winkler et al., *Nano Lett.* 2014, **14**, 3617-3622





Demonstration of the improved energy resolution and energy field of view offered by direct detection EELS. DD stands for direct detection, and ID stand for indirect detection, i.e. a conventional scintillator-CCD detector. In a) the Ti L edge of a $SrTiO_3$ sample is shown. In b) the energy resolution versus energy field of view is shown for both a DD sensor and an ID sensor. Areas of combined resolution and field of view offered with DD but not ID are colorized. Various EELS applications are listed according to their respective energy scales. Hart et al., Scientific Reports, 2017, **7**, article number: 8243