

WORKSHOP #10

Advanced Electron Microscopy for Functional Nanomaterials

Organizers: Sooyeon Hwang (CFN), Meng Li (CFN), Judy Yang (CFN), Yimei Zhu (CMPMS), Shize Yang (Yale University)

The development of transmission electron microscopy (TEM) and scanning TEM (STEM) has significantly advanced our understanding of nanomaterials. TEM/STEM's ability to perform multiscale characterization enables the simultaneous exploration of structural, chemical, and electronic changes in nanomaterials or nanodevices at the atomic level. In addition, in situ/operando observations and data analysis using AI/ML further enhance contribution of advanced electron microscopy to cutting-edge nanoscience research. Recent advancements in aberration correction, monochromation, high-speed and high-sensitivity detectors, along with high energy resolution spectrometers, provide an unparalleled opportunity for conducting multiscale characterization, even for electron beam-sensitive materials within the TEM/STEM. This breakthrough allows for the direct determination of the chemistry and structure of crystals, interfaces, and defects at the atomic scale across various nanomaterials, unveiling novel discoveries in nanoscience.

This workshop serves as a platform for the exchange of knowledge and ideas related to the latest developments in STEM, in situ/operando TEM/STEM, and spectroscopy as well as new methods for accelerating data analysis. The main emphasis is on the applications of electron microscopy in elucidating the intricate details of functional nanomaterials. The workshop aims to showcase the current and upcoming capabilities and resources of CFN, with a specific focus on Nion HERMES, which is expected to be operational during the users' meeting. In essence, this workshop will underscore the importance of electron microscopy in catalyzing scientific breakthroughs.

Start Time (ET)	Title	Speaker (Affiliation)
9:00-9:10	Welcome	
9:10-9:50	New Horizons in STEM	Murray Gibson (FAMU-FSU)
9:50-10:20	The Impact of Aberration-correction on Materials Science	Andrew Lupini (Oak Ridge National Lab)
10:20-10:30	Break	
10:30-11:00	In situ cryogenic transmission electron microscopy for quantum materials	Myung-Geun (MG) Han (BNL)
11:00-11:30	In-situ 4D-STEM observation of the dynamics of planar defects	Yang Yang (Penn State)
11:30-12:00	High-throughput nanoparticle mass measurement using quantitative STEM	Stephen House (Sandia National Lab)
12:00-1:00	Break	
1:00-1:30	In situ study of electrified interface dynamics via electrochemical liquid cell TEM	Haimei Zheng (Lawrence Berkeley National Lab)
1:30-2:00	Applications of Aberration-Corrected Electron-Beam Lithography	Fernando Camino (BNL)
2:00-2:30	Progress in ultra-high energy-resolution EELS in the EM, and in atomic-resolution SE imaging	Benjamin Plotkin-Swing (Bruker, former Nion)
2:30-3:00	Seeing Atomic-Level Surface Dynamics on Metal and Oxide Nanoparticles through In Situ TEM and Artificial Intelligence	Peter Crozier (Arizona State University)

3:00-3:10	Break	
3:10-3:40	Atomic Engineering: engineering atoms at room temperature	Cong Su (Yale University)
3:40-4:10	Quantitative electron-beam matter interaction via in situ sub-atomic precision targeting	Julian Klein (MIT)
4:10-4:30	Improvement of Oxygen Reduction Performance in Alkaline Media by Gas-Etching	Lihua Zhang (BNL)
4:30-5:00	Decoding structure-spectrum relationships in x-ray absorption spectra with physically organized latent spaces	Deyu Lu (BNL)
5:00	Closing	