Materials Science & Engineering Seminar Series

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presents

New Frontiers in Cryo-electron Microscopy: From Probing Low Temperature Electronic Phases to Processes at Liquid/Solid Interfaces

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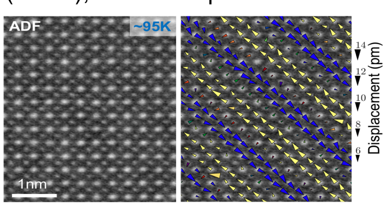
ABSTRACT: Scanning transmission electron microscopy techniques have enables direct visualization and quantification of the structure, chemistry and bonding of interfaces, reconstructions, and defects. So far, most efforts in the physical sciences have focused on room temperature measurements where atomic resolution spectroscopic mapping has almost become routine. In this talk, I will demonstrate the benefits of cryogenic STEM for understanding low temperature electronic phases as well as complex processes at liquid/solid interfaces.

For crystalline solids, our cryogenic STEM techniques have enabled direct mapping of the nature and evolution of charge order in strongly correlated systems such as layered transition-metal dichalcogenides and colossal magnetoresistive manganites. While bulk measurements have previously shown complex interactions between charge order and electronic phases, our real space measurements provide the microscopic picture and underscore the importance of lattice locking in charge ordered manganites. More broadly, cryogenic STEM can now be used to investigate and quantify the role of the lattice in a variety of low temperature electronic phases.

I will also discuss our approach to study two processes at the anode-electrolyte interface in lithium metal batteries (LMBs), uneven deposition of lithium metal leading to dendrite growth and the breakdown of electrolyte to form a "solid-electrolyte interphase" (SEI) layer, processes which result in capacity fade and safety hazards. By combining cryo-electron microscopy with cryo-FIB lift out, we provide nanoscale compositional information about intact SEI layers in cycled LMBs and track local bonding states at interfaces, leading to new insights into SEI and dendrite formation.



BIOGRAPHY: Lena F. Kourkoutis is an Assistant Professor of Applied and Engineering Physics and James C. and Rebecca Q. Morgan Sesquicentennial Faculty Fellow at Cornell University. Her electron microscopy group focuses on understanding and controlling nanostructured materials, from complex oxides to materials for energy storage to biomaterials. They use advanced electron microscopes to study these systems atom-by-atom and develop new cryogenic techniques to gain access to low temperature electronic states as well as to study processes at liquid/solid interfaces.

Kourkoutis received her undergraduate degree in Physics from the University of Rostock, Germany in 2003, and then moved to Ithaca where she was awarded a Ph.D. in 2009. As a Humboldt Research Fellow, she spent 2011-2012 in the Molecular Structural Biology Group at the Max Planck Institute of Biochemistry in Martinsried, Germany. She returned to Cornell University in 2012 and joined the Cornell Faculty in 2013. Kourkoutis is recipient of a 2014 Packard Fellowship for Science and Engineering, a 2016 Presidential Early Career Award for Scientists and Engineers, presented by President Barack Obama, a 2017 NSF CAREER award, and the 2018 Burton Metal by the Microscopy Society of America. She is also a Kavli Fellow of the National Academy of Sciences.

Doherty Hall 2210, 11:30AM
Friday, November 2, 2018