2012-2013

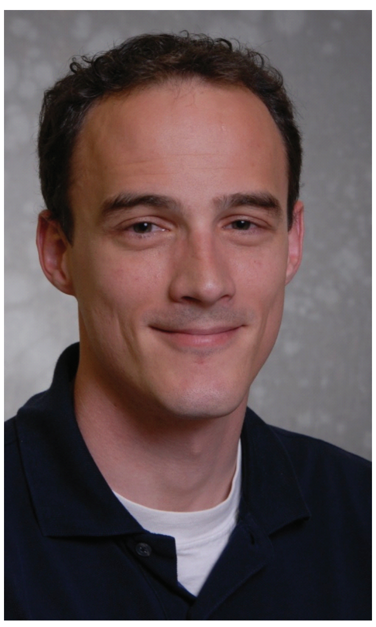
Graduate Seminar Series

The Department of Mechanical Engineering – Engineering Mechanics

Proudly Presents

Dr. Robert F. Klie

University of Illinois at Chicago



Dr. Robert F. Klie is a widely recognized expert in Z-contrast imaging, electron energy-loss spectroscopy (EELS) and in-situ experiments. Dr. Klie is an Associate Professor in the Physics Department at the University of Illinois at Chicago, where he has pioneered the in-situ heating and cooling experiments using atomic Z-contrast imaging and EELS of oxide grain boundaries, heterogeneous catalysts, as well as semiconductor thin-films. Dr. Klie has authored over 80 papers in peer-reviewed journals, which have been cited over 1400 times since 1998, and has an *h*-index of 20. As a scientist, Dr. Klie has over 10 years of experience in academic and industrial research, including his current appointment at UIC and previously Brookhaven National Laboratory. Recently, Dr. Klie was the PI on a grant to purchase an aberration-corrected scanning transmission electron microscope (STEM), which has been installed at UIC last year. Currently, the JEOL JEM-ARM200CF is the highest resolution 200 kV STEM in the United States which allows for in-situ experiments, and provides 68 pm spatial, as well as 0.35 eV energy resolution.

Thursday, Nov. 1, 2012 4:00 – 5:00 p.m. Room 112, ME-EM Bldg.

Chemical analysis with sub-Å resolution: The power and challenges of aberration-corrected scanning transmission electron microscopy

The last few years have seen a paradigm change in (scanning) transmission electron microscopy, (S)TEM, with unprecedented improvements in both spatial and spectroscopic resolution being realized by aberration correctors, cold-field emission guns and monochromators. The spatial resolution now extends to the sub-angstrom level, while the spectroscopic resolution has reached the sub-100 meV regime. In-situ stages have further extended the temperature range where atomic-resolution can be achieved between 10 K and 1,000 K. These instrumentation developments have brought notable successes in materials analysis, in particular for interfacial, catalysis and thin-film studies. However, they have also challenged the established experimental protocols and our fundamental understanding of both imaging and spectroscopy in the STEM. In this presentation, examples of where the new instrumentation has been successfully used to address materials physics issues in nanoscale systems will be described, including magnetic transitions in oxide thin films, *pn*-junctions in semiconductor nanowires, and promoter diffusion in heterogeneous nano-catalysts. Furthermore, the challenges associated with operating these new STEMs for reliable quantitative imaging and spectroscopy will be discussed. Finally, I will present a perspective on the future developments in STEM analysis.

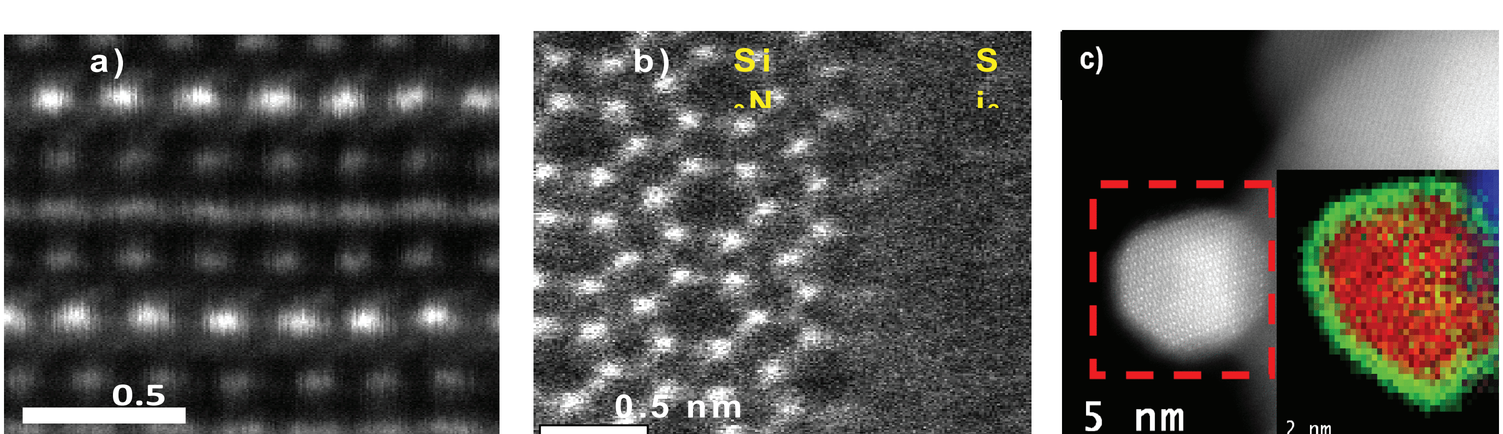


Figure 1: Aberration corrected Z-contrast images of a) thermoelectric $Ca_3Co_4O_9$ [100], b) Si_3N_4/SiO_2 interfaces, and c) Mn-promoted Co Fischer-Tropsch catalysts on TiO_2 (Mn – green, Co – red, Ti – blue).

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