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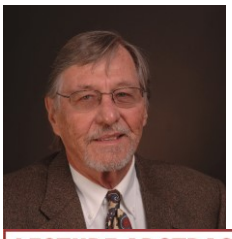
SPEAKER SERIES

PRESENTS

Aberration Corrected and Monochromated STEM/EELS: New Developments in Materials Science Microscopy



Prof. Ray Carpenter
Arizona State University

Friday, Nov. 16, 11:15 am
Melcher Hall - Room 180 (Business School)

LECTURE ABSTRACT

The successful development of aberration correctors for scanning transmission electron microscopes (STEM) has enabled atomic resolution scanning transmission imaging with high current density probes, with the latter facilitating single atom detection by electron energy loss spectroscopy. These developments together with the several detector modes available with STEM such High Angle Annular Dark Field (HAADF) STEM permit both chemically sensitive and spectroscopic imaging of materials with atomic resolution for the first time. In these instruments the energy resolution is typically 0.5 to 1 eV. Addition of an efficient monochromator to these microscopes improves the energy resolution to better than 30 meV (the present limit is 8 meV) and, most importantly, narrows the width of the zero loss peak (ZLP) so that band gaps and phonon excitation peaks can be observed, with atomic spatial resolution.

I will discuss materials application examples of atomic resolution STEM imaging, composition sensitive imaging, and chemical spectrographic imaging, and band gap and phonon nanospectroscopy. Many of these measurements require serial rather than parallel data collection, thus temporal instrument and site stability become critically important. Not surprisingly our original sites proved insufficiently stable to achieve our resolution goals, so we built a new laboratory building for aberration corrected microscopes and it did enable achievement of image and spectroscopy goals. I will also describe unique design features of our high-stability building, monochromator and spectrometer that are essential for achievement of the resolution required for our materials research.

SPEAKER BIOSKETCH

Ray Carpenter completed graduate studies/research in Materials Science under the direction of Professors Earl R. Parker and Ralph R. Hultgren at the University of California at Berkeley for his doctorate. Following graduate school he first joined Stanford Research Institute and then Oak Ridge National Laboratory as senior member of research staff for applications of electron microscopy to phase transformations and radiation effects research. In 1980 he joined the graduate materials science faculty at Arizona State University, as Professor in the Center for Solid State Science and Director of the NSF/ASU Regional Center for Electron Microscopy. He is also a faculty member of the School of Molecular Sciences.

At ASU Prof. Carpenter continued his research on phase transformations and electron microscopy, and established the first graduate classes on transmission electron microscopy for materials science and on phase transformations in materials. Most recently, in the 2010-2020 time frame, he led the effort to establish aberration-corrected electron microscopy at ASU with the initial acquisition of two microscopes and the design and construction of an ultrastable laboratory building for aberration corrected EM. At ASU Prof. Carpenter has served as Director of the Center for Solid State Science and of the interdisciplinary materials graduate program, and as member and chair of the college liberal arts and sciences faculty senate. He has served as President and as Director(physical sciences) of the Microscopy Society of America, and as editor(physical sciences) for the Society research journal. He has also served as deputy editor for Acta Materalia.

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