Seeing into Materials through Aberration Corrected Scanning Transmission Electron Microscopy

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Frontiers in Chemical Imaging
Seminar Series

Presented by

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Abstract

The successful correction of lens aberrations has greatly advanced the ability of the scanning transmission electron microscope (STEM) to provide direct, real space imaging at atomic resolution. Very complementary to reciprocal space methods, it is especially advantageous for aperiodic systems, nanostructures, interfaces and point defects.

Al-Co-Ni decagonal quasicrystals provide an excellent illustration of both the benefit of aberration correction in allowing light atom columns to be seen clearly, and the power of the direct image to reveal broken symmetry within the 2-nm clusters, the origin of the quasiperiodic real space tiling.

Interfaces in complex oxide heterostructures show many surprising properties, and real space images combined with density functional calculations can reveal their origin. Aberration corrected STEM images can provide (projected) atomic coordinates with precision of a few pm. Examples will be shown of $BiFeO_3$, mapping polarization, lattice parameter and octahedral rotations across interfaces unit cell by unit cell, and the origin of colossal ionic conductivity in $SrTiO_3/Y_2O_3$-stabilized ZrO_2 superlattices.

Nanocrystals exhibit structures and properties with no relation to the bulk, for example the white-light emission from nanosized CdSe. Real space imaging combined with density functional calculations has unraveled the origin of such surprising properties.

Finally, the direct imaging and identification of point defect configurations in monolayer BN and graphene will be presented. Such point defects create localized plasmon resonances with sub-nm localization.

Bio

Stephen J. Pennycook is a Corporate Fellow in the Materials Science and Technology Division at Oak Ridge National Laboratory and leads the Scanning Transmission Electron Microscopy Group. He also holds the positions of Professor in the Dept. of Materials Science and Engineering, University of Tennessee and Adjoint Professor in the Dept. of Physics and Astronomy, Vanderbilt University. For the development and application of Z-contrast scanning transmission electron microscopy, he received an R&D 100 Award in 1990, the Microbeam Analysis Society Heinrich Award in 1992, the Materials Research Society Medal in 1992, the Institute of Physics Thomas J. Young Medal and Award in 2001 and the Materials Research Society Innovation in Characterization Award in 2012.

Dr. Pennycook is a Fellow of the American Physical Society, the American Association for the Advancement of Science, the Microscopy Society of America, the Institute of Physics and the Materials Research Society. His research interests focus on the development of *Z*-contrast scanning transmission electron microscopy and electron energy loss spectroscopy with sub-Angstrom resolution, and applications to materials science, catalysis and nanoscience. He has 38 books and book chapters, 400 publications in refereed journals and has given over 200 invited presentations.

Friday

May 4, 2012

9:30 am

EMSL Auditorium

More Info:
http://stem.ornl.gov/

Host: Chongmin Wang - 371-6268
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