MONASH University
Centre for Electron Microscopy

SEMINAR

In-Situ (S)TEM/DTEM: From High Spatial Resolution to High Temporal Resolution

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11am – 12noon
Science Lecture Theatre S10, Building 25

Abstract

The last few years have seen a paradigm change in (scanning) transmission electron microscopy ((S)TEM) with unprecedented improvements in spatial, spectroscopic and temporal resolution being realized by aberration correctors, monochromators and pulsed photoemission sources. Spatial resolution now extends to the sub-angstrom level, spectroscopic resolution into the sub-100meV regime and temporal resolution for single shot imaging is now on the nanosecond timescale (stroboscopic imaging extends this even further to femtoseconds). The challenge now in performing experiments in an (S)TEM is to implement the in-situ capabilities that will allow both engineering and biological systems to be studied under realistic environmental conditions. Performing experiments using in-situ stages or full environmental microscopes presents numerous challenges to the traditional means of analyzing samples in an electron microscope – we are now dealing with the variability of dynamic process rather than a more straightforward static structure. In this presentation, I will discuss the recent developments in the design and implementation of in-situ stages being pursued at the Pacific Northwest National laboratory (PNNL). Examples of the use of these capabilities for the direct imaging of oxidation and reduction in metals, ceramics and catalytic systems and to identify the fundamental processes involved in nucleation and growth of nanostructures from solution will be presented. As the in-situ stages have been designed to be incorporated into both high spatial resolution aberration corrected (S)TEM as well as into high temporal resolution Dynamic TEM (DTEM), the potential for future experiments to study dynamics, including those in live biological structures, will also be discussed.

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BIOGRAPHY FOR DR NIGEL D. BROWNING

Nigel Browning is currently a Laboratory Fellow and Chief Scientist for Chemical Imaging at Pacific Northwest National Laboratory (PNNL) – having joined PNNL in September 2011. He received his undergraduate degree in Physics from the University of Reading, U. K. and his Ph. D. in Physics from the University of Cambridge, U. K. After completing his Ph. D. in 1992, he joined the Solid State Division at Oak Ridge National Laboratory (ORNL) as a postdoctoral research associate before taking a faculty position in the Department of Physics at the University of Illinois at Chicago (UIC) in 1995. In 2002, he moved to the Department of Chemical Engineering and Materials Science at the University of California-Davis (UCD) and also held a joint appointment in the National Center for Electron Microscopy (NCEM) at Lawrence Berkeley National Laboratory (LBNL). In 2005 he moved the joint appointment from LBNL to Lawrence Livermore National Laboratory (LLNL) to become project leader for the Dynamic Transmission Electron Microscope (DTEM). In 2009, he also joined the Department of Molecular and Cellular Biology at UCD to focus on the development of the DTEM to study live biological structures. He has over 20 years of experience in the development of new methods in electron microscopy for high spatial, temporal and spectroscopic resolution analysis of engineering and biological structures. His research has been supported by DOE, NSF, NIH, DOD and by industry, leading to research projects for over 30 graduate students and 29 postdoctoral research fellows. He is a Fellow of the American Association for the Advancement of Science (AAAS) and the Microscopy Society of America (MSA). He received the Burton Award from the Microscopy Society of America in 2002 and the Coble Award from the American Ceramic Society in 2003 for the development of atomic resolution methods in scanning transmission electron microscopy (STEM). With his collaborators at LLNL he also received R&D 100 and Nano 50 Awards in 2008, and a Microscopy Today Innovation Award in 2010 for the development of the dynamic transmission electron microscope (DTEM). He has over 350 publications and has given over 200 invited presentations on the development and application of advanced TEM methods.