MONASH University
Centre for Electron Microscopy

MICROSCOPY NETWORK VICTORIA

SEMINAR

"Imaging and spectroscopy of interfaces and nanoscale materials"

Professor Gianluigi Botton

Dept of Materials Science and Engineering,
Canadian Centre for Electron Microscopy- Brockhouse Institute for Materials Research,
McMaster University, Canada

Thursday 16 February, 2012
11am – 12noon
Science Lecture Theatre S11, Building 25

Abstract

The design of new materials with increasingly smaller features and with new properties requires detailed understanding of their structure with better resolution. Modern electron microscopes provide unprecendented spatial and energy resolution so that better insight on the chemical composition, chemical state and structure of materials can be provided.

In this presentation, we will show several examples related to the study of optical and structural properties of materials with reduced dimensions (thin films, nanowires and nanoparticles) to demonstrate the application of electron microscopy and electron energy loss spectroscopy to better understand the properties of these materials. As a first example, we will present a study of the nature of defects in III-V films grown on Si, where we have been able to identify the origins of the antiphase boundaries, locally measure the strain around these defects and identify new types of defect structures extremely detrimental to the electronic properties[1]. We will then provide some examples of studies of alloy nanoparticles used for fuel cell applications where we demonstrate the detection of ordered phases and core-shell structures with enhanced CO tolerance, by providing spectroscopic and imaging information with high-resolution methods. In the second part of the talk, we will present the application of electron energy loss spectroscopy with high energy and spatial resoluiton in two electron energy loss domains. The first demonstration will be related to the detection of plasmon resonances in the infrared part of the electromagnetic spectrum with a energy resolution below 0.1eV in nanophotonic structures such as nanorods [2] and nanoparticles of diverse shapes. We subsequently discuss the application of atomic-resolved chemical analysis in the first instance to study the termination of surfaces of oxide substrates used for the growth of ferroelectric materials BLTO and then for the study of interfaces in LCMO/YBCO. These results demonstrate that it is possible to identify the termination and map not only valence state but also the site (octahedral and tetrahedral) in complex oxides. Additional examples will highlight the application of microscopy techniques to the analysis of clusters of rare earth atoms inplanted in Si and deduce the interaction between vacancies and the dopants. These examples demonstrate structural and chemical information can be obtained down to the Ångstrom level and even in the third dimension[5-6]. Recent applications in the study of properties and structure of laser and LED nanowires may be presented [7,8, 9].

[1] S. Hosseini et al., *Applied Physics Letters* 98, 082113 (2011).
[2] D. Rossouw, et al., *Nano Letters* 11, 1499-1504 (2011).
[3] G.A. Botton, et al. *Ultramicroscopy*, 110, 926- 934, (2010).
[4] S. Lazar, et al., *Microscopy and Microanalysis*, 16, 416-424, (2010).
[5] F. Nan, et al., *Chemcatchem*, 3, 999-1003, (2011).
[6] M. Couillard, et al., *Physical Review Letters*, 107, 186104, (2011).
[7] K. Cui, et al., *J. Applied Physics*, 109, 124311 (2011).
[8] H.P.T. Nguyen et al., *Nano Letters*, 11, 1919–1924, (2011),
[9] K. Cui et al, Nanotechnology, 23, (2012) in press

Convenor: Professor Joanne Etheridge
Email: mcem@monash.edu
Tel: 9905 5563

Visitors are most welcome: Please note that there is a designated Visitors Car Park (S2) clearly ground-marked by white paint and tickets, at a cost of $3.50/hour for up to 3 hours, available from a dispensing machine. This high-rise car park is located on the following Clayton Campus Map, Ref. E3.

Printable version of the Clayton campus map (pdf 833 kb) (Please right click to open link)