SCHOOL OF PHYSICS

UNIVERSITY OF NEW SOUTH WALES

COLLOQUIUM

3-4 p.m., Wednesday, 17 February, 2010

PLEASE NOTE CHANGE OF TIME AND DAY

School of Physics Common Room Room 64, Old Main Building

Professor David Muller

School of Applied and Engineering Physics, Cornell University, USA

"Atomic-Resolution and 3-Dimensional Imaging of the Physical and Electronic Structure of Nano-Devices"

Atomic-resolution spectroscopic imaging in a new generation of electron microscopes is now capable of unraveling bonding details at buried interfaces and clusters, providing both physical and electronic structure information [1]. In some cases the sensitivity and resolution extends to imaging single dopant atoms or vacancies in their native environments. The thousand-fold increase in electron energy loss spectroscopy (EELS) mapping speeds over conventional microscopes allows us to collect data from millions of spectra, generating statistically meaningful maps of heterogeneous populations – such as the facet-dependent leaching in fuel-cell catalysts nanoparticles. In addition, transition radiation generated by the relativistic electron microscope beam also allows the optical modes of photonic structures to be mapped at nanometer resolution. The detection and control of interface defects using EELS, closely-coupled with atomically-precise growth methods, has enabled the realization of interface-stabilized states unreachable in their bulk counterparts, including an oxidation-resistant 2D metal [2]; a 2D superconductor between two band insulators [3]; and, by eliminating extended 2D defects, ferromagnetic tunnel junctions a few unit cells thick.

The audience is invited to meet the speaker beforehand at 2:45 p.m. over coffee and biscuits in the Common Room.

[1] D. A. Muller, L. F. Kourkoutis, M. Murfitt, J. H. Song, H. Y. Hwang, J. Silcox, N. Dellby, O. L. Krivanek, *Science* 319**,** 1073 (2008).

[2] A. Ohtomo, D. A. Muller, J. L. Grazul, and H. Y. Hwang, "Artificial Charge-Modulation in Atomic-scale Perovskite Titanate Superlattices" *Nature* **419**, 378 (2002).

[3] N. Reyren, S. Thiel, A. D. Caviglia, L. F. Kourkoutis, G. Hammerl, C. Richter, C. W. Schneider, T. Kopp, A. S. Ruetschi, D. Jaccard, M. Gabay, D. A. Muller, J. M. Triscone, and J. Mannhart, "Superconducting interfaces between insulating oxides" *Science* **317** (5842), 1196 (2007).

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