



THE 2013 MORRIS E. FINE LECTURE

Ian Robinson

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Diamond Fellow, Research Complex at Harwell

Tuesday, November 19, 2013

Tech L211, 4:00pm

Reception - Cook Hall Atrium, 5:00pm

“Nanoparticle Structure Using Coherent X-ray Diffraction”

This lecture will examine the physical reasons why nanoparticles differ in structure from the bulk. The reason is fundamentally crystallographic. Each unit cell with a crystal is stabilized by those around it; when cells are removed to create a surface, there is a structural response – in a metal this is an inward relaxation, detectable as strain. Where two surfaces meet along the edge of a crystal, the effect is enhanced. Nanocrystals are in a size range that is dominated by the surface and edge properties. This is visualized as the pattern of strain in the crystallographic structure of the particle. Certain simple properties of nanoparticles can be explained through these structural differences. To study these effects, we use coherent x-ray diffraction, a powerful method of measuring the three dimensional structure of nanocrystals. A key experiment will be discussed that uses this method to study the redistribution of strains on the surface of a Au nanocrystal. This pattern is found to change upon application of pressure (or adsorption of a chemical layer). Ultrafast imaging with free-electron laser sources allows visualization of the strain patterns in vibrating crystals. The possible uses of XFELs in materials science will be discussed in conclusion.

Biography: Ian Robinson, professor of physics and astronomy at the London Centre for Nanotechnology of University College London and Diamond Fellow at the Research Complex at Harwell in Oxford, England, also serves as chair of the Science Advisory Council at Stanford University’s Linac Coherent Light Source. While working as a researcher at AT&T Bell Laboratories from 1981 to 1992, he developed the methods for studying surface structure using X-ray diffraction. These methods, based on crystal truncation rods, have become the definitive technique for determining atomic positions at surfaces and interfaces. Such surface methods are still used today at the major synchrotron research facilities, including NSLS (Brookhaven), ESRF (Grenoble), APS-ANL (Argonne), and Diamond Light Source (Harwell).

Robinson’s numerous awards include the Professorial Fellowship of the Biotechnology and Biological Sciences Research Council in the United Kingdom; the Surface Structure Prize of the International Conference on the Structure of Surfaces; the Diamond Light Source Fellowship; the Humboldt Foundation’s Senior Research Fellowship; the Ted Maslen Award of the Society of Crystallographers in Australia and New Zealand; and the American Crystallographic Association’s B. E. Warren Award. He was the editor of the *Journal of Physics: Condensed Matter* and a professor in the physics department at the University of Illinois at Urbana-Champaign from 1992 to 2005.

Robinson received a PhD in biophysics from Harvard University and a master’s degree in natural sciences from Cambridge University. He is the coauthor of three books and has published more than 280 papers in areas that span nanocrystal and nanowire structural analysis, surface structure determination, phase contrast imaging, and X-ray diffraction methods.