Morris E. Fine

Morris E. Fine, Walter P. Murphy and Technological Institute Professor Emeritus of Materials Science and Engineering, is a pioneer in teaching the unifying concepts underlying all classes of materials: metals, ceramics, polymers, biomaterials, and electronic materials. He is a founder of Northwestern's materials science and engineering department, the first of its kind in the world. His research career at Northwestern has spanned a broad range of topics, from physical chemistry to mechanical behavior, and includes studies on metals and alloys, ceramics, and composite materials.

Fine received his PhD in physical metallurgy from the University of Minnesota in 1943. After working on the Manhattan Project in Chicago and Los Alamos, he worked for Bell Labs until 1954, when he came to Northwestern.

A member of the National Academy of Engineering and the American Academy of Arts and Sciences, Fine is a fellow of the Minerals, Metals, and Materials Society, ASM International, the American Ceramic Society, and the American Physical Society. He is an honorary member of the American Institute of Mining, Metallurgical, and Petroleum Engineers and the Japan Institute of Metals.

Fine continues to publish and has more than 300 papers to his credit. He has received numerous awards, most recently the TMS 2009 Application to Practice Award for research that led to a new steel with better corrosion resistance, toughness, and welding properties. More than 500 tons of this steel were used for a bridge in Lake Villa, Illinois, that opened in 2006.

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Fifth annual

Morris E. Fine Lecture

Sponsored by the Department of Materials Science and Engineering

"Nanoparticle Structure Using Coherent X-ray Diffraction"

Presented by

Ian Robinson
Professor, London Centre for Nanotechnology, University College London
Diamond Fellow, Research Complex at Harwell

Tuesday, November 19, 2013
Lecture 4 p.m.
Technological Institute, Room L211
2145 Sheridan Road, Evanston
Reception to follow in the atrium, William A. and Gayle Cook Hall

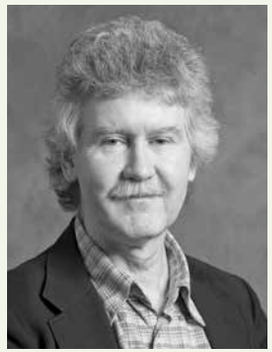
Robert R. McCormick School of
Engineering and Applied Science
Northwestern University

“Nanoparticle Structure Using Coherent X-ray Diffraction”

This lecture will examine the physical reason 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 an 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.

Ian Robinson

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.