Recent Dorn Lectures

2014 "Tunable and Quantum Plasmonic Materials"
Harry A. Atwater, California Institute of Technology

2013 "A New Tri-Beam Tomography System: How Much Information is Enough?"
Tresa M. Pollock, University of California, Santa Barbara

2012 "Nanoengineered Materials: Opportunities and Challenges"
Pulickel M. Ajayan, Rice University

2010 "Strength, Adhesion, Sound, and Survival: A Tour of Size Effects
Eduard Arzt, Liebniz Institute for New Materials and Saarland University, Germany

2009 "Designing Optical Materials from the Top Down: Sculpting Photonic Materials at the Scale of Wavelengths"
Evelyn Hu, Harvard University

2008 "Facing our Energy Challenges in a New Era of Science"
Patricia Dehmer, US Department of Energy

2007 "Carbon Nanomaterials for Electronics"
John Rogers, University of Illinois at Urbana-Champaign

2006 "Nanoparticle-Assisted Fun with Phospholipid Vesicles and Other Novel Colloidal Particles"
Steve Granick, University of Illinois at Urbana-Champaign

2005 "Small But Not Too Small: Recrystallization Modeling at the Microstructural Scale"
Elizabeth Holm, Sandia National Laboratories

2004 "Engineering Ferroelectrics Using Strain"
Darrell Schlom, Pennsylvania State University

2003 "The Role of Quantum Mechanics in Virtual Aluminum Castings"
Christopher Wolverton, Ford Research Laboratory

2001 "Carbon Nanotubes: Electrical Properties and Devices"
Phaedon Avouris, IBM Research Division

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2015 John E. Dorn Memorial Lecture

Sponsored by the Department of Materials Science and Engineering

"Solid State Ionics: From Defects to Devices"

Presented by
John A. Kilner
Imperial College of London

Tuesday, April 28, 2015
Lecture 4 p.m.
L361, Technological Institute
2145 Sheridan Road, Evanston

Reception to follow in the atrium,
William A. and Gayle Cook Hall
2220 Campus Drive

John E. Dorn (1909–71) was the most distinguished and well-known metallurgical alumnus of Northwestern University. In the late 1950s he helped his alma mater, which then had a very small materials science department, to receive Department of Defense funding to host one the nation's first three Materials Research Centers. Both the center and the department were launched on a path to their present world-renowned stature.

Dorn was particularly famous for his work on the high-temperature creep of metals. He and his best-known student, Oleg Sherby, who went on to become a professor at Stanford University, established that the activation energy of high-temperature creep is the same as that of self-diffusion. Sherby was the first Dorn lecturer in 1974.

A Chicago native, Dorn received both BS (1931) and MS (1932) degrees in chemistry from Northwestern and a PhD (1936) in physical chemistry from the University of Minnesota. After a two-year postdoctoral fellowship at Battelle Memorial Institute in Columbus, Ohio, he became a faculty member at the University of California, Berkeley, where he spent the rest of his career in physical metallurgy, a field that attracted many chemistry-trained scientists at the time. He was known as an outstanding teacher as well as research scientist.

Dorn authored or coauthored 180 research papers. His honors included the ASTM Charles Dudley Medal (1958), the ASM Howe Medal (1959), the ASTM Gillette Lectureship (1962), and the ASM Albert Easton White Distinguished Teacher Award (1964). He was elected a medallion member of the Honeur Société Francaise de Metallurgie in 1968. He received an honorary PhD from Northwestern in 1971.

Solid State Ionics: From Defects to Devices

In 1834 Michael Faraday first observed the conduction of electricity in ionic crystals by experimenting with Ag_2S, long before an understanding had been gained of the laws of thermodynamics or the regular arrangement of atoms in the solid state. Much later the transport of ionic species in the solid state was shown to rely upon the presence of point defects in the crystal lattice. This has been well understood since the work of Wagner, Schottky and Frenkel in the early part of the 20th century, when the foundations of solid state ionics were first laid down. Today solid state ionics covers a wide range of materials from ionically conducting polymers to oxide ceramic conductors that show both ionic and electronic conductivity.

The application of these fascinating materials has been widespread. The major applications have been found in electrochemical energy storage and conversion, particularly for clean energy systems. Perhaps the most well known example is the Li ion battery found in the majority of portable electronic devices. Other examples include: gas sensors, gas separation membranes, fuel cells, electrolysers and photochromic devices.

In this presentation we will explore the development and application of oxide ceramics that show fast ion conduction; looking at the very special crystal and defect structures necessary to promote this phenomenon. We will then examine specific devices and show the difficulty of turning the useful property of ion conduction into a practical device

John A. Kilner gained his PhD from Birmingham University in the UK and joined Imperial College London in 1979 as a Wolfson Research Fellow. In 1995 he was appointed Professor of Materials Science and in 2006, BCH Steele Professor of Energy Materials. He also holds appointments at CIC Energigune in Vitoria, Spain where he heads the ceramic electrolyte group, and he is a Principal Investigator at International Institute for Carbon Neutral Research (I^2CNER) in Kyushu, Japan.

John has over 30 years experience in the measurement of mass transport and surface properties of ceramic materials for Solid Oxide Fuel Cells (SOFCs), Solid Oxide Electrolysers (SOEC's), Ceramic Oxygen Generators (COGs) and solid state Li batteries. He is a co-founder of the AIM listed company Ceres Power Ltd, winner of the European Fuel Cell Forum Schönbein gold medal, the Verulam medal of the IOMMM, and the recipient of the 2005 Royal Society Armourers and Braziers award. In 2012 he lead an international team from the UK, Spain, the US and Japan, that won the International Union of Materials Research Societies Somiya Award for international collaboration.