Biodata

Siu-Wai Chan

Professor of Materials Science and Metallurgy

Education

Massachusetts Institute of Technology, Sc. D. (Materials Science and Metallurgy) – 1985 Columbia University, B. S. (Materials Science and Metallurgy) – 1980

Professional Activities

Chair Symposium on Nanostructural Materials at 2001 American Ceramic Chair Symposia on High Temperature Superconductors at 1998 & 91 MRS Fall Meetings Chair for various sessions at different MRS Meetings Organizer of Prof. Nowick Symposium 1994 President 1994 & Secretary 1993 of the Materials Science Club Panelist for National Science Foundation's program on Materials Research Science and Engineering Centers Reviewer on Materials Science Projects for NSF and Hong Kong University Research Council Reviewer for Philosophical Mag., Appl. Phys. Lett., J. App. Phys. and J. Mat. Res.

Current Research

Transmission electron microscopy; thin films, grain boundaries and interfaces; high Tc superconductors; electronic ceramics.

The focus of my research is a systematic study of grain boundaries and interfaces relating their geometry, structure, chemistry, and energetics with their electrical properties.

Grain boundaries, despite their importance in technological materials, are among the least understood areas in materials science because of their complexity. There are working devices, for example: high temperature superconducting quantum interference devices (squids) likely to be used in the first magnetic cardiograms, zinc oxide varistors in surge protectors, and positive temperature coefficient (PTC) materials in temperature activated switches. They all use novel eletrical transport properties of grain boundaries. Since five geometric parameters are generally needed to specify a boundary, not all grain boundaries are alike even in the same materials. Therefore, contradicting results involving eletrical measurements on boundaries are not uncommon in the literature. A significant part of our research is to identify boundary types that have similar electrical responses to facilitate the usage of boundaries in devices.

In addition to isolating a particular boundary to observe its structure by high resolution electron microsopy, and relate that to its electrical properties measured, we are also examining an assembly of boundaries and the combined effects on percolation paths and electrical transport. Computational methods in predicting the types of boundaries remained and the general orientation texture after grain growth are being developed.

In an overall theme, our research is aimed at searching for the basic understanding of boundaries and interfaces and applying the knowledge for better engineered electrical properties of materials for applications and new devices.

Honors

Advance Fellow - National Science Foundation
and the University of Washington (2004)
Tan Fellow (2004)
Guggenheim Fellow (2003)
IBM Faculty Award (1998)
Outstanding Woman Scientist Award (1997)
Presidential Faculty Fellow from the White House and the National Science Foundation (1993)
Very Important Parent - Luther Lee Emerson School in Demarest, NJ (1992)
DuPont Faculty Award (1991, 1992)
Sigma Xi (1982)
Tau Beta Pi (1979)
Francis B. F. Rhodes Prize (1980)

Talk Title:

Nano Oxides : Structures, Defects, and Redox activities in catalysts

Siu-Wai Chan 陳 小 惠

Dept. of Appl. Phys. & Appl. Math. Columbia University

We will give an overview of the structure in nano-oxides. The structure of nano ceria will be thoroughly discussed as well as its spontaneous reduction as crystal size decreases even at ambient. Both X-ray diffraction and Raman spectroscopy of different patches of nano-ceria each patch with different crystallite-size show the lattice swells with decreasing crystal-size, at 6nm there is a 0.45% increase in lattice parameter at ambient and with the concomitant reduction of 6% of Cerium cations from 4+ to 3+ as shown by XANES. This investigation is possible because of the mono-dispersed nature of the nano-ceria in each patch. The solubility of zirconia in nano-ceria is larger as the crystallite-size decreases and as the partial pressure of oxygen decreases. In reducing atmosphere, total solid solution in cubic-fluorite structure is formed for whole composition range of binary oxide of cerium and zirconium. Thus the phase diagram for bulk cannot predict the phases one may observed in the nano-oxide. Even pure oxide of zirconium can be prepared in cubic-fluorite structure if the amorphous oxide particles are small and they are annealing in a reducing atmosphere. Nano CuO and Mn3O4 are shown to very different reduction products than their bulk counter-parts. New research area and specialty of research partners will be outlined to attract collaborations across the globe.