2011-2012

Graduate Seminar Series

The Department of Mechanical Engineering – Engineering Mechanics

Proudly Presents

Dr. Jianyu Huang, Staff Scientist
Center for Integrated Nanotechnologies
Sandia National Laboratories

Dr. Jianyu Huang is a staff scientist at the Center for Integrated Nanotechnologies at Sandia National Laboratories. He received his Ph. D. from the Institute of Metal Research, Chinese Academy of Sciences in 1996. He then moved to Japan as a COE (Center-of-Excellence) Fellow and a JSPS (Japanese Society for the Promotion of Science) Fellow. From 1999 to 2001, he worked at Los Alamos National Lab. as a postdoc, and from 2002 to 2006, he was a research faculty at the Physics Department of Boston College. He has been working in the area of electron microscopy and its applications in materials science for over 20 years. His current interests focus on in-situ structure and property correlation of carbon nanotubes, nanowires, and graphene by using transmission electron microscopy – scanning probe microscopy platforms. He is also involved in developing micro-electro-mechanical devices to enable in-situ thermal/thermoelectric, and electrochemical (battery) studies. The goal is to understand how the size, defects and surface affect the electron, phonon, ion, and mass transport processes in nanomaterials. He has published in over 170 peer reviewed journal papers, including such distinguished journals as Nature, Science, Physical Review Letters, Nature Nanotechnology, Nature Communications, Nature Methods, PNAS, and Nano Letters. He has given over 70 invited talks in a number of academic conferences, including the Materials Research Society, the Microscopy Society of America, TMS, AVS. Some of his works are featured in New York Times, Nature, Nature Nanotechnology, New Scientists, Chemical Engineering News, EETimes, Science News, Sandia Lab. News.

Thursday, Oct. 6, 2011 | 4:00 – 5:00 p.m. | Room 112, ME-EM Bldg.

Application of In-Situ Electron Microscopy in Nanoscience and Energy Research

To begin with, I will review our recent progress in using TEM-SPM platform to probe the electrical and mechanical properties of individual carbon nanotubes, nanowires and graphene. First, individual multiwall carbon nanotubes are peeled off layer-by-layer by electric breakdown inside the TEM. This provided new insights into the transport property of nanotubes. Second, plastic deformation, such as superplasticity, kink motion, dislocation climb, and vacancy migration, was discovered in nanotubes and graphene. Third, we induced sublimation of suspended few-layer graphene by in-situ Joule-heating inside a TEM. The graphene sublimation fronts consisted of mostly {1100} zigzag edges. Under appropriate conditions, a fractal-like “coastline” morphology was observed.

I’ll conclude by reviewing our recent progress in in-situ studies of lithium ion batteries (LIBs). We created the first nano-battery inside a TEM, allowing for real time atomic scale observations of battery charging and discharging processes. Two types of nano battery cells, one ionic liquid based, and the other all solid based, were created. The former consists of a single nanowire anode, an ionic liquid (IL) electrolyte and a bulk $LiCoO_2$ cathode; the latter uses Li_2O as a solid electrolyte and metal Li as anode. The electrochemical process induced volume changes, phase transformations, and mechanical stress were revealed in real time and at an atomic scale. The results provide understanding of the fundamental science of LIBs, guiding the development of advanced LIBs for plug-in electric vehicle applications

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