

Synthesis and In Situ Mechanical Characterization of Semiconductor Nanowires for Energy Applications

Steve Boles, PhD

Department of Electrical Engineering
Hong Kong Polytechnic University, Hong Kong

Friday, December 2, 2016

3710 GITC

1:00 to 2:00pm

Abstract:

Silicon has become one of the most promising candidates to replace carbon as the anodic material in lithium-ion batteries due to its high theoretical capacity and relatively low cost. However, this high capacity is coupled with volume changes of up to 300% upon alloying with lithium. The intense expansion subsequently induces large mechanical stresses on the material which have been shown to have a significant impact on the functionality and reliability of silicon as an anode material. Here we present results from *in situ* scanning electron microscopy investigations into the mechanical integrity of silicon nanowires before and after alloying and de-alloying with lithium. Additionally, the constant charging and discharging nature of battery electrodes implies inherent time constraints on the various physical processes occurring during within the host material. Thus, we also explore time-dependent deformation mechanisms in fully-lithiated silicon nanowires using creep-based *in situ* mechanical testing methods. Measurements of the wire size and microstructure can be used to gain insight into the atomic diffusion pathways which govern the creep behavior in these lithium-silicon alloy materials. Implications regarding the implementation, design and construction of silicon-based electrode materials will be discussed. Additionally, the same synthesis and testing methods can be applied to other classes of semiconductor nanowires which show very promising results for the future of smart materials for energy applications.

About the Speaker:

Dr. Boles currently holds the position of Assistant Professor in the Department of Electrical Engineering at the Hong Kong Polytechnic University. He obtained his B.S. in Materials Science and Engineering from Carnegie Mellon University in 2004. From 2002 to 2005, he was a member of the technical staff at Lumileds Lighting in San Jose, CA. He conducted his Ph.D. research at the Massachusetts Institute of Technology in the Department of Materials Science and Engineering. Following his graduation in 2010, he was awarded the Alexander von Humboldt Fellowship to conduct his postdoctoral research at the Institute for Applied Materials at the Karlsruhe Institute of Technology in Karlsruhe, Germany. In 2014 he joined PolyU as part of strategic effort to enhance the field of materials science in the electrical engineering department.

For more information contact Prof. Siva Nadimpalli, siva.p.nadimpalli@njit.edu or Prof. Shawn Chester, shawn.a.chester@njit.edu.