Probing Size-Dependent Mechanical Properties of Metallic Nanostructures and Biomaterials – *In Situ* Nanomechanical Characterization

**Dr. Yang LU**
Department of Materials Science and Engineering, Massachusetts Institute of Technology, USA

**Date:** 30 July, 2012 (Monday)
**Time:** 4:00 pm (Tea Reception at 3:45 pm)
**Venue:** B6605 (CSE Conference Room)

**Abstract**
Mechanical properties of materials deviate largely from their bulk counterparts when characteristic dimensions become sufficiently small. Size-dependent mechanical behavior of metallic materials and biological materials at micro- and nano-scales have recently generated great interests because of their importance on assembly, performance, and reliability of functional nanoelectronics devices and nano-electro-mechanical systems (NEMS), as well as tissue engineering scaffolds. Hence, by design and development of a series of in situ nanomechanical testing platforms, which enable both electron microscopy (SEM/TEM) and/or atomic force microscopy (AFM) imaging of samples' structure evolution as well as real-time measurement of their mechanical properties at unprecedented high resolution, we were able to characterize individual metallic nanowires and Ubx protein fibers with a wide range of diameters, from nano to micro, and made significant progresses toward deeper understanding of their size-dependent mechanical properties and deformation mechanisms. In particular, we successfully performed the first quantitative in situ TEM characterization of "ultrathin metallic nanowires" a new kind of 1-D nanomaterials with diameters down to sub-10 nanometers, and
observed interesting new properties which were never expected at larger length scales, including the "cold welding" and "brittle fracture" of ultrathin gold nanowires. These discoveries may open new paths for researchers looking at next-generation nanoscale electronics. Finally, ongoing research on in situ nanomechanics study of nanotwinned copper, bones and red blood cells will be briefly talked about and discussed with their potential applications in advanced materials processing/design and disease diagnostics/treatment.

About the Speaker

Dr. Yang Lu received his Ph.D. degree in Materials Science from Rice University, Houston, TX, USA, with the highest student honor "Franz R. & Frances Brotzen Fellowship" award in the Department of Mechanical Engineering and Materials Science. Before joining Rice, he earned his B.S. degree in Physics from Nanjing University, Nanjing, China, and M.S. degree in Materials Engineering from New Mexico Tech, Socorro, NM, USA, respectively. He is currently a postdoctoral associate in the Department of Materials Science and Engineering at MIT.

Dr. Lu's research interests focus on "nanomechanics and biomechanics", with particular emphasis on in situ nanomechanical characterization of metallic nanostructures and biological systems as well as their potential applications in nanofabrication, nanoelectronics and nano-electromechanical systems (NEMS), energy harvesting/storage, nuclear safety, disease diagnostics/treatment, cell/tissue engineering, and bio-inspired materials design. He has published more than 15 papers in a number of top journals, including "Nature Nanotechnology", "Advanced Functional Materials" and "ACS Nano", and serves as a reviewer for multiple international journals such as "Journal of Materials Research", "Materials Science and Engineering: A", "Experimental Mechanics", and "International Journal of Damage Mechanics".

Enquiry: 3442 8420

All are welcome!

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