Mechanical Engineering Department Seminar

3:35pm September 18, 2013
1130 Mechanical Engineering

Atomistic Investigation of Nanomaterials – Seeing the Invisible and Bridging Theory and Experiments

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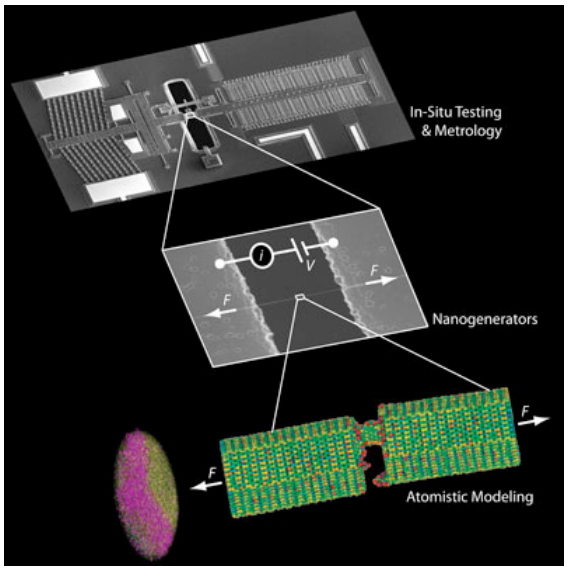
In the past decade, there has been a major thrust to develop novel nanomaterials exhibiting unique mechanical and electro-mechanical (e.g., piezoelectric) properties. These nanomaterials are envisioned as building blocks for the next generation of lightweight materials, electronic and energy harvesting systems. In this context, identification of size dependent mechanical and electrical properties is essential. However, such endeavor has proven challenging from both experimental and modeling perspectives. In this seminar, progress towards accurate identification of such properties will be reviewed. In particular, a MEMS platform for in-situ electron microscopy testing of one dimensional nanostructures will be introduced and used to identify mechanical property size effects in metallic (Ag) and semiconducting (ZnO, GaN) nanowires. Furthermore, the validity of force fields commonly used to model nanomaterials will be examined through one-to-one comparison to experimental findings and quantum mechanical simulations. In the case of semiconducting nanowires, it will be shown that force fields are accurate enough to capture elasticity but that higher order theories are needed to interpret nanowire failure and piezoelectric size effects. Opportunities arising from identified size effects in various applications of interest will be presented.



Bio: Horacio D. Espinosa is the James and Nancy Farley Professor of Manufacturing and Entrepreneurship in the McCormick School of Engineering and Applied Sciences at Northwestern University. He received his Ph.D. in Applied Mechanics from Brown University, in 1992. Professor Espinosa has made contributions in the areas of dynamic failure of advanced materials, micro, and nanomechanics. Professor Espinosa is a foreign member of the *European Academy of Arts and Sciences, the Russian Academy of Engineering*, and Fellow of AAM, ASME, and SEM. He received numerous awards and honors including the Society for Experimental Mechanics LAZAN, HETENYI and SIA NEMAT-NASSER awards. He was the Timoshenko visiting Professor at Stanford University in 2011, President of the Society of Engineering Science in 2012, and was recently appointed to two committees of the *National Academies*, the Panel on Materials Science and Engineering to advise the Army Research Lab, and the U.S. National Committee on Theoretical and Applied Mechanics.