Mechanical Engineering Department Seminar

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1130 Mechanical Engineering

Bionic Nanomaterials

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The development of a method for interfacing high performance devices with the human body could yield breakthroughs in regenerative medicine, prosthetics, and human-machine interfaces. Yet, most high quality inorganic materials are hard and brittle, and their crystallization generally requires high temperatures for maximally efficient performance. These properties render the corresponding devices incompatible with soft tissue. Nanotechnology provides a route for overcoming these dichotomies, by altering the mechanics of materials while revealing new effects due to size-scaling. In this talk, I will focus on vital areas for biointerfacing nanodevices: 1) graphene nanosensors for ubiquitous detection, and 2) piezoelectric PZT nanoribbons for bioelectromechanical energy harvesting. Our approach involves the following key steps: first, new nanomaterial synthesis or fabrication; second, fundamental studies of novel properties; and finally, interfacing these materials with cells and tissue. I will also present a future vision of bionic systems in which the electronics and biology are seamlessly interwoven in 3D. The novel properties of nanomaterials coupled with “living” platforms may enable exciting avenues in fundamental studies and bioMEMS applications, including the creation of augmented bionic organs.

Bio: Michael McAlpine began his appointment as Assistant Professor of Mechanical and Aerospace Engineering at Princeton University in 2008 and is affiliated with the Department of Chemistry and the Princeton Institute for the Science and Technology of Materials (PRISM). He received a B.S. in Chemistry with honors from Brown University in 2000 and a Ph.D. in Chemistry from Harvard University in 2006. His research has focused on nanotechnology-enabled approaches to biointerfacing materials, for fundamental and applied investigations in the biological and energy sciences. His work has been featured in major media outlets, including Time Magazine and the New York Times. He has received a number of awards, most prominently a TR35 Young Innovator Award, an Air Force Young Investigator Award, an Intelligence Community Young Investigator Award, a DuPont Young Investigator Award, a DARPA Young Faculty Award, an American Asthma Foundation Early Excellence Award, a Graduate Student Mentoring Award, and an invitation to the National Academy of Engineering Frontiers in Engineering Symposium.