

~~Special Polymer Physics Seminar ~~

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301 Steidle Bldg.

Design of Electrical Functionality in Polymer-Based Nanocomposites

Polymers offer the advantage of processing flexibility, lightweight, and durability. Other notable features of polymers include their low dielectric constant, low elastic stiffness, and low density, which may result in a high voltage sensitivity (good sensor characteristics) and low acoustic and mechanical impedance (crucial for medical and underwater applications). Shortfalls of current electroactive polymers (EAPs) however include relatively small electromechanical coupling coefficient, high actuation voltage and poor blocked stress. In this presentation, we explore nanocomposite concepts to address these materials limitations and enhance the electroactive response of polymers. By following the nanocomposite route, we can address current state-of-the-art challenges in smart polymers such as high actuation voltage, low dielectric permittivity and low electromechanical coupling coefficients. For example, in the case of carbon nanotube-polyimide systems, we have successfully demonstrated the creation of an electrostrictive response by addition of small quantities of nanotubes. Most importantly, these improvements were achieved at low actuation voltages, and were accompanied by increase in both mechanical and dielectric properties. We are taking a path toward realizing these active nanocomposites by probing the link between control of nanoparticle (NP) distribution and resulting properties and performance of the polymer-based composite. Through controlled dispersion of NPs in polymers, such as graphene platelets, carbon nanofibers, metal oxide nanoparticles and carbon nanotubes, we show that property enhancements are not limited to just mechanical and electrical responses, and that in the case of polar polymers, the NPs interact strongly with the polar functional groups. The direct implication is that presence of NPs enhances the electromechanical response and leads to improved performance of polymeric sensors and actuators.

Brief Biography. Zoubeida Ounaies joined the Pennsylvania State University in January 2011 as an associate professor of Mechanical Engineering. Previous to that, Zoubeida was an associate professor in Aerospace Engineering and Material Science and Engineering at TAMU, where she was the inaugural holder of the Aldridge Career Development Professorship. She has been awarded the NSF CAREER Award (2007), the TEES Select Young Faculty Award (2008) and the Montague Teaching Scholar award (2008). Her research has been supported by NSF, AFOSR, NASA and DARPA.