



Nanostructured polymer composites for electronics and sensor applications

Wednesday November 10, 2010, Babbio 122, 10am

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Nanostructured composites based on polymer matrix and carbon nanotubes (CNT), metallic nanoparticles and polymer core-shell latex systems will play a critical role in emerging field of molecular and printed electronics. Structure-properties relationships for such polymeric nanocomposites with metallic or semiconducting behavior are studied with several modes of atomic force microscopy (AFM), namely, traditional topography imaging and ultrasonic force microscopy (UFM), helium ion microscopy (HIM), Raman spectroscopy, and surface conductivity characterization. Nonlinear current-voltage (I-V) characteristics are found in all systems where polar polymer films such as poly(vinylidene fluoride) (PVDF) or polyurethane (PU) are surface-modified with a conductive (like polyaniline (PANI) or semiconductor (polythiophene) layers. The phenomenon is related to a local electrical field produced by polarization of ferroelectric domains of PU or PVDF matrices under application of the external field. We demonstrate that nanostructured PVDF-based core-shell systems offer an interesting universal platform for development of nanostructured multifunctional materials. They can be used for preparation of conducting and semiconducting polymer films having promising electrical and photovoltaic properties. The same approach can be also used for development of active components for chemical sensors with enhanced sensitivity to some analytes (like ammonia). Understanding of structure-properties relationships for polymer-based nanocomposites is crucially important for development of advanced all-plastic electronic devices, organic photovoltaics and sensors.

Valery Bliznyuk received a Ph.D. degree in Polymer Science from the Institute of Macromolecular Chemistry of National Academy of Sciences, Kiev, Ukraine (1985), and Doctor of Science (D.Sc.) degree in Polymer Chemistry in the field of nanostructured organic materials from Kiev State University (2004). He held research positions in Ukraine (Institute of Macromolecular Chemistry and Institute of Semiconductor Physics), Germany (Alexander von Humboldt Foundation Fellow, University of Mainz), England (University of Cambridge and University of Oxford), and the USA (Western Michigan University, and University of California at Santa Cruz). He is an Associate Professor at the Department of Materials Science and Engineering since 2001. Dr. Bliznyuk has a broad expertise in preparation and characterization of nanostructured organic and advanced polymer materials; he is an author of more than 100 peer-reviewed publications. His recent publications address surface structure and properties of polymers, electro-optics and photovoltaics of advanced polymer materials, structure and electrical properties of nanocomposites based on polyaniline and carbon nanotubes, and self-assembly in polymer and inorganic systems.

**Co-sponsored by the Department of Electrical and
Computer Engineering**

