ORGANIC DIVISION SEMINAR

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WTHR 104

Materials and Measurements for Printed and Flexible Electronics

Dean DeLongchamp, Ph.D.

Leader, Polymers Processing Group

National Institute of Standards and Technology

Since the discovery of semiconducting organic molecules in the 70's, they have enabled many new flexible electronics devices including transistors, solar cells, and displays. I will discuss the fundamentals of this technology and the important properties of materials that drive these exciting new applications. I will draw examples from the manufacturing of organic photovoltaics (OPV), a promising technology for low-cost solar cells. We have developed synchrotron-based X-ray scattering and a variety of benchtop spectroscopic methods to follow the structure evolution of these and other functional films as a printed ink dries. The measurements reveal the mechanisms by which the molecular design, formulation, and processing choices influence the nanoscale structure of the films.

The quest for structure-property relationships in OPV and other organic semiconductors has driven enormous advances in soft matter characterization over the past decade. Despite all the progress, surprisingly little consensus has been reached on what aspects of organic semiconductor film structure actually matter. Although order and orientation must matter, at what length scales are they relevant? I will discuss how a molecular-scale picture – the most difficult to obtain, particular in soft materials - may ultimately be required. We have recently made progress in developing new measurements that combine principles of spectroscopy, inelastic small-angle scattering, real-space imaging, and molecular simulation, which may at last provide a useful molecular scale structure measurement for soft materials and complex fluids.

Dean M. DeLongchamp leads the Polymers Process Group in the Materials Science and Engineering Division at the National Institute of Standards and Technology (NIST). His current research is focused on understanding the relationship between the nanoscale structure at soft matter interfaces and the function of advanced materials, using advanced measurement methods such as soft x-ray spectroscopy and X-ray scattering. He received a B. S. in Chemical Engineering from the Georgia Institute of Technology in 1998, a M.S.C.E.P. from MIT in 2000, and a Ph. D. in Chemical Engineering from MIT in 2003.