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Devices for Electronic, Optical and Energy Applications via Additive Driven Self-Assembly and Nanoimprint Lithography: Towards Solution-Based Nanomanufacturing

James Watkins

Professor
Department of Polymer Science and Engineering,
University of Massachusetts Amherst, Amherst, MA

ABSTRACT:

Fabrication of advanced devices via solution-based processing requires the rapid and scalable creation of high integration density, nanoscale features in organic, hybrid and inorganic materials. Our approaches include nanoparticle driven self-assembly to produce periodic, well-ordered polymer/nanoparticle hybrid materials with domain sizes ranging from less than 10 nm to more than 125 nm and nanoimprint lithography for device scale patterning at length scales greater than 50 nm using nanoparticle/ polymer hybrid inks. We have also developed a new process that allows direct printing of patterned crystalline metal oxide films and composites with feature sizes of less than 100 nm. This approach is an attractive alternative to conventional subtractive processing using Si wafer-based platforms and can enable large area production of fully printed devices. Applications in flexible electronics, light and energy management, and sensors and will be discussed.

BIOGRAPHY:

James Watkins is Professor of Polymer Science and Engineering and Director of the Center for Hierarchical Manufacturing, a National Science Foundation Nanoscale Science and Engineering Center (NSEC) at the University of Massachusetts, Amherst. Professor Watkins received his B.S. and M.S. degrees in Chemical Engineering from the Johns Hopkins University and his Ph.D. in Polymer Science and Engineering from the University of Massachusetts. He joined the Chemical Engineering faculty at UMass in 1996 and the Polymer Science and Engineering faculty in 2005. He is the recipient of a Camille Dreyfus Teacher-Scholar Award and a David and Lucile Packard Foundation Fellowship for Science and Engineering and is a Fellow of the American Physical Society.