



~~Special Polymer Physics Seminar ~~

Professor Christopher K. Ober

Materials Science and Engineering
Cornell University
Ithaca, NY 14853

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301 Steidle Bldg.

The convergence of top down and bottom up patterning applied to microelectronics and the life sciences

While there has been dramatic progress in developing patterning methods that permit sub-50 nm patterning, there remain tremendous challenges in going well below that size. Molecular glasses offer one avenue to formation of small-scale structures. These materials have small molecular dimensions, yet undergo the solubility changes and etch behavior needed in a modern resist. These patternable materials can also be processed in the environmentally friendly solvent supercritical CO₂ to enable orthogonal processing of organic semiconductors. These techniques enable the creation of devices that to date have been impossible to fabricate. Yet molecular glasses like polymer resists have not yet successfully broken the 30 nm barrier. Block copolymers offer a means to resolve this impasse, but like any other resist system they have distinct limitations. We have been investigating a block copolymer, poly(α -methyl styrene)-block-poly(4-hydroxystyrene), due to its potential for patterning by both bottom-up self-assembly and top-down lithography. The polymer self-assembles following conventional rules for microphase formation. The poly(4-hydroxystyrene) block is also capable of undergoing all the photoresist chemistry of advanced photoresists. We have recently shown we can control the self-assembly process can be achieved by solvent annealing, and can be further controlled by choice of solvent. This property enables rapid ordering and microstructure selection under conditions that retain the photochemical photoresist properties of this polymer. We have also shown for the first that that we can selectively pattern more than one microstructure in a single film. Examples of patterned structures used for the study of cell-surface interactions, sensors, light emitting devices and energy harvesting systems will be given.