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Magnetic Fields and Soft Matter - Functional Materials by Directed Self Assembly of Block Copolymer, Nanowire and Surfactant Mesophases

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2:15 p.m.
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The ability to transform matter that displays novel physics and properties into useful materials and devices is indivisibly linked to the ability to reliably control structure on length scales of interest. While this has been well advanced in hard materials, by contrast, the generation of self-assembled soft matter with arbitrary orientations on length scales beyond 1 mm remains surprisingly challenging. An important goal in this context is the development of approaches that enable reliable control of morphology in thin films of microphase separated block copolymers (BCPs) and polymer nanocomposites. For a broad spectrum of applications ranging from separations membranes to photovoltaics, the need in particular is for control over the out-of-plane ordering of the system, such as in the production of vertically aligned nanostructures. Under appropriate conditions, magnetic fields offer a simple route to directing self-assembly of purely diamagnetic soft matter systems over large length scales in the above described manner. Here I discuss the interaction of magnetic fields with various soft mesophases and the conditions which enable effective alignment. Key points are addressed including degeneracy of alignment and overcoming interfacial effects. The role of magnetic fields on order-disorder transitions in block copolymers is examined using novel in-situ scattering studies of systems under high fields. Examples of functional material systems for energy generation and water purification are highlighted.