Block copolymers have been extensively studied for their ability to self-assemble into microdomain morphologies such as spheres, cylinders, and lamellae, with typical periodicities of 20-100 nm. Similar structures form when block copolymers are deposited as thin films on substrates; these films can serve as excellent templates for nanofabrication, where the block copolymer's nanodomain structure is faithfully reproduced in an inorganic material—but the final array of inorganic objects is, at best, only as good as the structure of the film from which it was derived. Consequently, we have worked intensively to develop methods to manipulate the structure of the films. For example, the polygrain structure which these nanodomains normally form can be transformed to a single-crystal texture, over macroscopic areas, by a simple shearing process. Shear can also realign the domain orientation locally in films with an otherwise macroscopic orientation; create complex orientation patterns on the millimeter scale; and even transform spheres into cylinders. We have employed these thin, substrate-supported block copolymer films to fabricate dense arrays of 20-40 nm metal or semiconductor particles: dots (from sphere-forming block copolymers) or lines (wires, from cylinder-formers), all with a size and spacing set through block copolymer molecular weight. Such shear-aligned thin-film templates can also be stacked to produce square or rectangular grids. As a particular example, we have used this approach on shear-aligned films containing in-plane cylinders to fabricate centimeter-scale arrays of parallel nanowires; due to their fine pitch, such wire grids can polarize an exceptionally broad range of wavelengths extending down into the deep ultraviolet (for 193 nm photolithography), with 90% or better efficiency.

April 4th 2014 11AM–12PM, 104 Boggs