

Block Copolymer Thin Films: Patterns and Patterning

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Block copolymers spontaneously self-assemble into “microdomain” structures: simple repeating patterns with a size scale controlled by the polymer molecular weight (typically 10-100 nm, so “nanodomains” might be a better term). Similar patterns are obtained when these block copolymers are deposited in layers a single nanodomain thick. Such thin films make excellent contact masks for patterning, and we have used them as templates to fabricate dense arrays of 20 nm metal or semiconductor particles (dots) or lines (wires). For applications where these nanoscopic entities are to be individually addressed, controlling the long-range order and orientation is a key problem, since the nanodomains naturally form a polygrain structure in both thin films and bulk, with a grain size which is typically microns at most. We have developed both scanning electron microscope (SEM) and *in-situ* atomic force microscope (AFM) methods to study the grain growth and alignment processes in these films. By sequentially imaging the same region of a film by AFM, “movies” of microdomain motion are obtained which directly reveal the mechanisms of defect annihilation in these thin film masks. Moreover, we have recently demonstrated that shear can align the nanodomains in these films over centimeter-square areas, producing truly long-range orientational order.