Progress in the use of PS-\textit{b}-PMMA block copolymers to Generate 25 nm Diameter Metal Nanopillars

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Block copolymers (BCP) are complex macromolecules consisting of two or more different blocks bound together chemically. BCPs containing immiscible components which microphase separate to produce nanostructures that have a defined shape and size. Presence of chemical bonds between the polymer segments prevents macrophase separation. Thin films of block copolymers have attracted a lot of attention of researchers in recent years because of their ability to make templates that can be used for nanofabrication. The shape of the features depends on the mole fraction of each of the blocks present, while the size of the features is controlled by the molecular weight (N) and segmental interaction parameter, also called the Flory-Huggins parameter ($\chi$). Block copolymer nanolithography has an edge over other methods because the properties of the features can be tuned just by changing the properties of the block copolymers. Block copolymers of polystyrene (PS) and polymethylmethacrylate (PMMA) with PS fraction of $\sim 0.7$ phase separate into cylinders of PMMA incorporated in a continuous phase of PS. PMMA cylinders of approximately 12-30 nm can be fabricated using a block copolymer having molecular weight of 36,000 g/moles. The PMMA portion of the block copolymer can be removed with UV irradiation or rearranged by rinsing with glacial acetic acid. Electrodeposition of e.g. Co/Pt is expected to lead to high density patterned recording media.

Because of difficulties in generating Co/Pt and Fe/Pt nanopillars of the appropriate magnetic properties, we have been exploring a different fabrication strategy. This involves sputter deposition of a continuous film of Co/Pt or Fe/Pt with the desired magnetic properties (11, Out of plain anisotropy) followed by block co-polymer nanolithography as summarized in the processing scheme below. The various images on this poster summarize our progress in generating the block copolymer nanostructure, orienting the nanostructure perpendicularly, opening perpendicular pores, electrodepositing nickel to generate a hard mask and ion milling to transfer the pattern to the underlying media.

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