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A Simple way to fabricate nano-dot array : self-assembled block-copolymer template

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The nano-lithographic technique using self-assembled polymeric template has lots of advantages over the conventional semiconductor lithographic techniques such as photo-etching or e-beam lithography in the fabrication of nano-dot arrays . The periodicity and size of self-assembled structures of di-block copolymer can be controlled ranging from a few to a hundred nanometers by variation of appropriate polymer chain length and relative composition. A regular array of typical 10nm sized spherical pattern could be easily made over the large surface area in the following way. We prepared well-controlled poly-styrene(PS) and poly-isoprene(PI) block copolymer (weight fraction of PI = 0.16) of poly-dispersity = 1.01 and Mw = 85k by living anionic polymerization. Spin-coated PS-PI block copolymer film is spontaneously ordered after overnight annealing inside the vacuum above their glass transition temperature giving hexagonal-close-packed (hcp) phase with a periodicity of 35nm and sphere size 20nm which is confirmed by TEM. The monolayer film of thickness 60nm was etched selectively via ozonation to make the PI sphere void. We checked their self-assembled phase separation using AFM and obtained the topographic image of the half-etched polymer film. The subsequent reactive ion etching (RIE) enabled us to transfer nano-structured pattern to the given substrate, that is, silicon nitride. To get a higher aspect-ratio, the lift-off poly-imide layer and additional silicon nitride hard mask layer were previously inserted below polymer film. This technique can be applied to various fields, for example, a high-density magnetic storage device, field emission flat panel display and selective media for bio-materials.