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Prepatterning of Substrates via Diblock Copolymer Lithography

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Porous materials have attracted increasing interest particularly in nanotechnology. Examples are their application as templates for the synthesis of one-dimensional nanostructures, and as highly selective membranes for separation applications[1]. Prerequisites for this are a uniform pore size distribution, a regular arrangement of the pores, and the possibility to prepare laterally extended, continuous porous films. A simple and versatile method to prepare such porous structures characterized by lattice constants of a few tens of nanometers is based on self-assembly of diblock copolymers[2]. Compared to electron beam lithography, this approach allows the patterning of large areas (up to several cm^2) at considerably lower cost. Further benefits are the easy tailoring of the lattice constant by properly adjusting the molecular weight of the used block-copolymer and its self-healing behaviour. Thin films of poly(styrene-b-methyl methacrylate) on various substrates consisting of cylindrical domains of the minor phase MMA normal to the film plane were prepared by spin-casting and annealing under inert atmosphere. After exposing to UV light followed by rinsing in acetic acid an ordered holey film of polystyrene was obtained and used for lithography[3]. We employed reactive ion etching (RIE) to transfer the pattern into the underlying substrates. To enhance the etch contrast, the major phase consisting of the styrene blocks may be stained with ruthenium tetroxide. The thus patterned substrates can be further processed to obtain extended, highly ordered porous materials with pores having high aspect ratios. Such porous materials may be used as nanosieves, high temperature-resistant lithographic masks for the growth of nanowires or for subsequent electro-chemical etching processes.

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