Directly-Photodefinable Guiding Layers: Enabling Simple 3-Step DSA Processes for Lithographic Patterning

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Directed self-assembly (DSA) is a candidate alternative lithography route for large area fabrication of future sub-30 nm lithographic patterns. Current methods for patterning the guiding layers for block copolymer DSA include chemoepitaxial and graphoepitaxial routes. However, current methods and processes for producing either type of guiding layer involve a large number of complex steps. For example, preparing guiding layer for chemoepitaxial DSA of a model block copolymer PS-b-PMMA includes fabrication of a substrate that is neutral to the block copolymer, coating and patterning a resist layer that would provide commensurate patterns to the periodicity of the block copolymer and decorating the exposed regions to be preferential to PMMA. A series of chemically amplified photoresist-like functionalized polyphenols that can be utilized as photo-definable guiding layers for PS-b-PMMA have been designed, synthesized and screened. By implementing such a photodefinable material, it will be shown that a conventional chemo-epitaxial guiding process can be converted into a much simpler 3-step DSA (coating, exposing and baking) process that reduced process cost, time, and lessens the potential for defects. In this work, it will also be shown that graphoepitaxial and chemoepitaxial effects can be comboined and controlled in the same photodefinable material. Demonstrations of the alignment of PS-b-PMMA using such photodefinable guiding layers will be shown.