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"Controlled Selfassembly of New Block Copolymers for Nanolithography and Metallic Nanostructure Fabrication"

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Abstract

Bottom-up pattern formation at the nanoscale regime has been the focus of enormous research efforts for the past few decades. In particular, the directed self-assembly (DSA) of block copolymers (BCPs) has shown great promise for sub-20 nm lithography due to advantages including high resolution, scalability, cost-effectiveness, and compatibility with conventional fabrication processes for integrated circuits. A major barrier towards the widespread use of the DSA technique has been a trade-off among the desirable properties of resulting self-assembled patterns: high resolution, long-range ordering, low defect density, high etch selectivity, orientation control, and easy pattern-transfer onto a substrate. In addition, most conventional DSA techniques involve multi-step fabrication processes, which yield low throughput of the patterning process.[1]

In this paper, we report a new acrylamide-based hard-soft hybrid BCP that can generate high-quality lithographic patterns satisfying the above mentioned criteria and have additional potential as a scaffold for metallic nanostructures. PDOPAM-PMMA BCPs were synthesized from newly designed crystalline p-dodecylphenylacrylamide (DOPAM) and methyl methacrylate monomers via RAFT polymerization. The key features of our BCPs are as follows: Simple solvent annealing of the BCPs on a substrate generated nano-lithographic patterns with long-range ordering and minimal defect density. The nanoscale features were readily transferred to an underlying material owing to high etch selectivity between PDOPAM and PMMA under UV radiation and high RIE resistance of PDOPAM. The patterned BCPs were also used as a scaffold for reliable incorporation of various inorganic components to form diverse metallic nanostructures including Ag for the first time. These findings suggest that this new BCP is a universal and practical candidate for successful implementation of sub-20 nm DSA processes.[2]

References

1. C. M. Bates, T. Seshimo, M. J. Maher, et al., Science, Vol. 338, pp. 775-779, 2012.

2. J.G. Lee, Y.S Kim, S.H. Han, K.M. Kim, Y-K. Han, Adv. Mater., Vol. 26, pp. 2894-2900. 2014.