Soft-Matter Hierarchical Assemblies for Nanopatterning Applications

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Macromolecular self-assembly has evolved to become an important and valuable tool for bottom-up patterning and fabrication at the nanometer scale. From block copolymer lithography to functional polymer brushes, to nanocrystal superlattices to biomolecular assemblies, bottom-up patterning is reaching an unprecedent level of control over complex patterns at the nanoscale with an increasing degree of precision. There is no question that the lithographic landscape has been transformed in the past few years with the introduction of extreme ultraviolet (EUV) lithography and the maturity of multiple patterning techniques. At dimensions below 10 nm, emphasis has shifted away from resolution to precision, highlighting the importance of the tight uniformity achieved by self-assembling hierarchical systems and the exquisite precision afforded by biomolecular assemblies. Moreover, an opportunity may be opening for new, higher complexity, information-rich architectures where hybrid nanoparticle-(bio)molecule assemblies may shine. With features defined at the molecular level and the potential to modular and hierarchical structures, the thermodynamics and kinetic landscape of these self-assembling systems offers a path to unique 2D and 3D architectures. In this talk I will review the current state of bottom-up patterning by hierarchical soft matter and I will discuss research plans at The Molecular Foundry related to molecular-scale assembly.