Hybrid Lithographic Techniques for Rapid Fabrication of Hierarchical Nano/Microstructures
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In order to advance patterning capabilities for future applications, innovative lithographic strategies must be available in a scalable and cost-effective set of techniques. In considering any lithographic technique, there generally exists an inverse correlation between rate and degree of control. For example, the most rapid methods, such as techniques using single or multiple wide area optical exposures or self-assembly can pattern a large area (mm-cm scale) in a single lithographic step. This ability, however, comes at the cost of very limited control over both the naturally occurring and desired defects. In contrast, direct write (DW) techniques, can provide nearly arbitrary control over the patterned structure with the limitation of slow, serial writing. We have explored a variety of strategies to increase the speed and capabilities of DW by combining it with wider area lithographic techniques to create hierarchical structures with fine nanoscale features defined by the large area technique and a superstructure defined by the 2/3D DW. In this way, both periodic and complex predefined structures may be patterned with nearly arbitrary positioning. To best approach these novel technique combinations, we have incorporated both simulations and experiments to determine possible technique combinations and pattern geometries, and further, the properties of the fabricated structures.