Electronic and Optical Devices via Additive Driven Self-Assembly and Nanoimprint Lithography: Towards Solution-Based Roll-to-Roll Nanomanufacturing

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We are pursuing a strategy for nanoscale device fabrication that includes nanoparticle driven self-assembly to produce well-ordered polymer/nanoparticle hybrid materials with domain sizes of ranging from 10 to 100 nm that can serve as active device layers and roll-to-roll (R2R) nanoimprint lithography for device scale patterning at length scales greater than 50 nm. We also employ highly filled nanoparticle/polymer hybrids for applications that require tailored dielectric constant or refractive index. Finally, we have developed a new process that allows direct printing of patterned crystalline metal oxide films and composites with feature sizes of less than 100 nm. This approach is an attractive alternative to conventional subtractive processing using Si wafer-based platforms. These solution based processing schemes provide routes for continuous production of materials and devices with high throughput and relatively low cost. Application examples including flexible electronics, lighting, and large area films for light and energy management will be discussed.