UNIT OPERATIONS FOR NANOMANUFACTURING

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There is a chasm between promising nanotechnological advances in the laboratory and commercial manufacturing. Many techniques have been developed to produce exquisitely controlled nanopatterned surfaces with amazing and potentially valuable properties. These methods, however, are almost always on the laboratory scale producing a few samples of the materials over small areas. To make them viable manufacturing processes, the methods must be scaled up to produce nanopatterned materials at high speeds over large areas, usually with low-defectivity. Currently, scale up is often accomplished by time consuming and expensive trial-and-error approaches. In this talk it is argued that the time has come to identify, model and simulate the unit operations of nanomanufacturing. Such models accelerate the design and optimization of nanomanufacturing processes from predominantly empirical approaches to more reliable and cost-effective ones based on computational simulations. Furthermore, these computational tools will enable greater innovation and early identification of untenable designs, thus mitigating risk. This research will transform manufacturing of nano-enabled devices in areas such as computing, communications, data storage, solid state lighting, energy storage, solar cells, biomedicine, and electronic displays. Examples of the benefits of such computational simulations will be given in the context of UV Imprint Lithography. The beginnings of a list of unit operations for nanopatterning will also be identified.