Directed Nanoscale Assembly for Electronics, Optics, and Biomedical Applications

Significant investment and progress have been made in nanotechnology over the last decade, but the integration of new nanomaterials and processes into products remains disappointingly slow. Many contemporary nanoscale devices do not as yet incorporate actual nanomaterials (nanotubes, nanoparticles (NPs), graphene, etc.), thus failing to realize the much-anticipated benefits to be gained from harnessing their unique properties. Bottom-up directed assembly has been considered as one of the best approaches for integrating nanomaterials at high rates. However, repeatable, highly controllable and scalable directed assembly at the nanoscale is still one of the major challenges impeding the realization of this technique in product applications.

In this seminar, the recent work on electric field and fluidic directed assembly of micron, nano and molecular scale materials will be presented. In comparison with numerical simulations and experimental observations, the driving forces at the nano and micro scale regime will be discussed. Based on the control of assembly parameters and the driving forces, a highly repeatable and reliable assembly of nanoscale materials will be demonstrated. In addition, a newly developed ambient temperature and pressure nanoscale directed assembly-based printing process will be presented. This process is capable of printing materials made from metals, semiconductors and insulators (organic or inorganic) into 2-D and 3-D nanostructures down to 25nm. Applications of the produced nanostructures in electronics, optics and nanobiotechnology will also be shown.