Ninth U.S.-Korea Forum on Nanotechnology

Rethinking Manufacturing; Nanomaterials Based Nanomanufacturing for Electronics and Biotechnology Applications

Ahmed Busnaina, W.L. Smith Professor and Director
The NSF Nanoscale Science and Engineering Center for High-rate Nanomanufacturing
Northeastern University, Boston, MA 02115
Email: a.busnaina@neu.edu, URL: www.nano.neu.edu

ABSTRACT

Present fabrication facilities that manufactures nanoscale devices such as consumer electronics costs $5-10 billion. This high cost of entry barrier completely shuts out small and medium sized businesses. Dramatically lowering such barriers would spur innovation and the creation of entirely new industries. A directed assembly based nanomanufacturing factory could be built for as low as $50 million, a fraction of today's cost, making nanotechnology accessible to millions of new innovators and entrepreneurs and unleash a wave of creativity in the same way as the advent of the PC did for computing.

The NSF Center for High-rate Nanomanufacturing (CHN) is developing tools and processes to conduct fast massive directed assembly of nanoscale elements by controlling the forces required to assemble, detach, and transfer nanoelements at high rates and over large areas. The center has developed templates with nanofeatures to direct the assembly of carbon nanotubes (CNTs) and nanoparticles (down to 10 nm) into nanoscale trenches in a short time (in seconds) and over a large area (measured in inches). The center has demonstrated that nanotemplates can be used to assemble naoscale structures (polymers, CNTs and nanoparticles) and transfer them onto a second substrate. Recently, a fast and highly scalable, material-independent, aqueous, room-temperature and pressure manufacturing process of 3-D nanoscale features was developed for fabricating interconnects using nanoparticles.

The center has many applications where the technology has been demonstrated. A nonvolatile memory switches using CNTs or molecules assembled on a wafer level. A new biosensor chip (0.02 mm^2) capable of detecting multiple biomarkers simultaneously and the bio sensor can be in vitro and in vivo with a detection limit that's 200 times lower than current technology. A new autonomous chemical sensor with a low detection limit that's less than 1 mm^3 has been developed. The center has developed the fundamental science and engineering platform necessary to manufacture a wide array of applications ranging from electronics, energy, and materials to biotechnology.