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Large Scale Directed Assembly of SWNTs and Nanoparticles for Electronics and Biotechnology

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The transfer of nano-science accomplishments into technology is severely hindered by a lack of understanding of barriers to nanoscale manufacturing. 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 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 pattern conducting polymers and that the patterned polymer can be transferred onto a second polymer substrate. Recently, a fast and highly scalable process for fabricating interconnects from CMOS and other types of interconnects has been developed using metallic nanoparticles. The particles are precisely assembled into the vias from the suspension and then fused in a room temperature process creating nanoscale interconnect. The center has many applications where the technology has been demonstrated. For example, the nonvolatile memory switches using (SWNTs) or molecules assembled on a wafer level. A new biosensor chip (0.02 mm^2) capable of detecting multiple biomarkers simultaneously and can be in vitro and in vivo with a detection limit that's 200 times lower than current technology. 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.