NANO HIGHLIGHT
Assembly of Nanostructures by Robotic Manipulation and Sintering

NSF NIRT Grant DMI-02-09678

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Assembly of components, or bulding blocks, into more complex structures is a primary goal of robotics at all scales. It involves positioning the required components, joining them, positioning the resulting subassemblies, joining them with other subassemblies, and so forth, in a hierarchical manner. Previous work at USC's Laboratory for Molecular Robotics (LMR) has shown how to position nanoscale components by pushing them on a surface with the tip of an Atomic Force Microscope (AFM). The AFM tip is analogous to a mobile robot that senses its environment by touching it, constructs a map, and navigates using this map in conjunction with dead reckoning and sensory data. LMR research has demonstrated joining of positioned components by gluing them chemically, for example, joining gold nanoparticles by using di-thiols, which are chemical substances that have sulfur end groups and attach covalently to gold. We also have demonstrated in past work that arbitrary structures can be built on a surface by manipulating gold nanoparticles and connecting them by electroless deposition of additional gold.

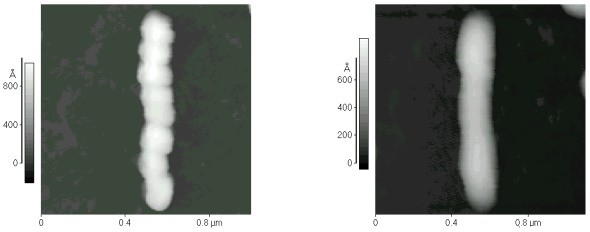

Fig. 1: Latex nanoparticles with diameters ~ 100 nm arranged in a linear array by manipulation with an Atomic Force Microscope (left) and the "wire" that results from sintering the previous structure (right).

Now we have been able to join latex nanoparticles simply by heating (sintering) them. The figures show a wire and a round structure built in this manner. The latex particles have diameters of ~ 100 nm. The figures show the initial structures built by nanomanipulation with an AFM, and the results of sintering them. Note that sintering has a smoothing effect which may be desirable for some applications. Sintering is likely to be applicable to a variety of nanoscale materials besides latex, although this has not been experimentally demonstrated yet. In summary, we have developed another promising tool in the nanomanufacturing arsenal. This new nanoassembly process may be useful in a variety of applications that range from wiring electronic components to building three-dimensional structures by Layered Nanofabrication, a technique also developed at LMR.

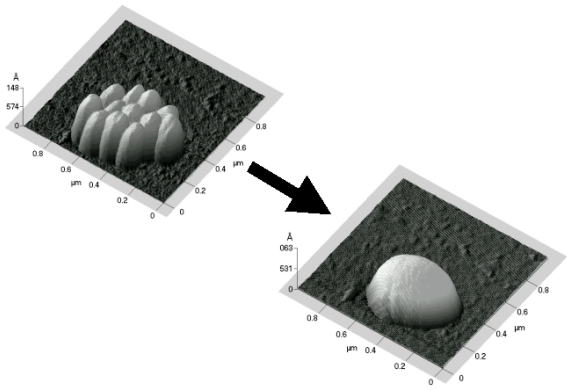

Fig. 2: A round structure built of latex nanoparticles with diameters ~ 100 nm by using nanomanipulation with an Atomic Force Microscope (left) and the structure that results from sintering it (right).

Reference: E. Harel, S. E. Meltzer, A. A. G. Requicha, M. E. Thompson and B. E. Koel, "Fabrication of latex nanostructures by nanomanipulation and thermal processing", *Nanoletters*, accepted for publication.