Improved Process for Fabricating Carbon Nanotube Probes

Ames Research Center, Moffett Field, California

An improved process has been developed for the efficient fabrication of carbon nanotube probes for use in atomic-force microscopes (AFMs) and nanomanipulators. Relative to prior nanotube tip production processes, this process offers advantages in alignment of the nanotube on the cantilever and stability of the nanotube's attachment. A procedure has also been developed at Ames that effectively sharpens the multiwalled nanotube, which improves the resolution of the multiwalled nanotube probes and, combined with the greater stability of multiwalled nanotube probes, increases the effective resolution of these probes, making them comparable in resolution to single-walled carbon nanotube probes. The robust attachment derived from this improved fabrication method and the natural strength and resiliency of the nanotube itself produces an AFM probe with an extremely long imaging lifetime. In a longevity test, a nanotube tip imaged a silicon nitride surface for 15 hours without measurable loss of resolution. In contrast, the resolution of conventional silicon probes noticeably begins to degrade within minutes. These carbon nanotube probes have many possible applications in the semiconductor industry, particularly as devices are approaching the nanometer scale and new atomic layer deposition techniques necessitate a higher resolution characterization technique. Previously at Ames, the use of nanotube probes has been demonstrated for imaging photoresist patterns with high aspect ratio. In addition, these tips have been used to analyze Mars simulant dust grains, extremophile protein crystals, and DNA structure. This NASA technology is being commercialized through Convergent Science and Technology Inc. (www.con-sci-tech.com).

This work was done by R. Stevens, C. Nguyen, A. Cassell, L. Delzeit, M. Meyyappan, and Jie Han of **Ames Research Center**. *Further information is contained in a TSP (see page 1).*

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