

FOCUS ION BEAM FABRICATION OF SCANNING TIPS WITH INDIVIDUAL CARBON NANOTUBE

Guangyu Chai and Lee Chow

Department of Physics, University of Central Florida
Orlando, FL 32816

Focus ion beam technology is based on the application of the field emission ion sources called liquid metal ion sources, which can produce an extremely narrow beam of ions that can be focused to <10 nm with a current density in the focused spot as high as $10\text{A}/\text{cm}^2$.^{1,2} The two main features of the FIB tool that are most important are the capability to remove material from the sample by sputtering (micro-machining) and to add materials to the sample by ion induced reactions (deposition) at sub-micron dimensions.³ FIB technology is extremely useful for the semiconductor industry, and is also increasingly used in materials research in industry and academia.

In our laboratory, nanotube containing carbon fibers have been synthesized with conventional chemical vapor deposition method.^{4,5} The single multiwall CNT sticks out as a tip of the carbon fiber. In order to pick up the individual CNT field emitters, focus ion beam (FIB) technique is applied for cutting and adhering the samples. The carbon fiber with nanotube tip was first adhered on a micro-manipulator with the FIB depositing function. Afterwards, by applying the FIB milling function, the fiber was cut from the base. This enables us to handle the individual CNT tips conveniently. By the same method, we can attach the nanotube tip on conventional AFM tips. Fig.1 shows the SEM image of carbon fiber with nanotube tip. Fig.2 illustrates the FIB image of welding CNT sample on AFM tip. Atomic force microscopy with nanotube tips allows imaging of relatively deep features of the sample surface at near nanometer resolution. Fig.3 shows the AFM scanning image with CNT tip. FIB is proven to be appropriate and powerful for the nano-fabrication.

Reference

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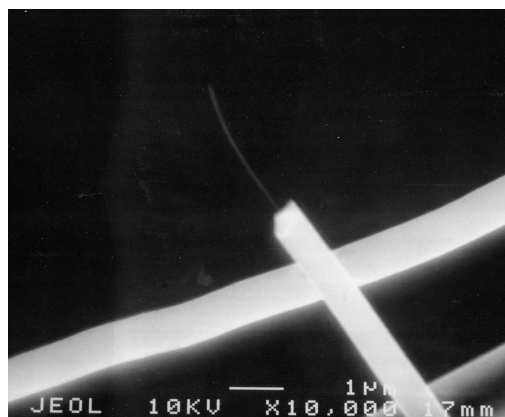


Fig.1 SEM image of CNT tip

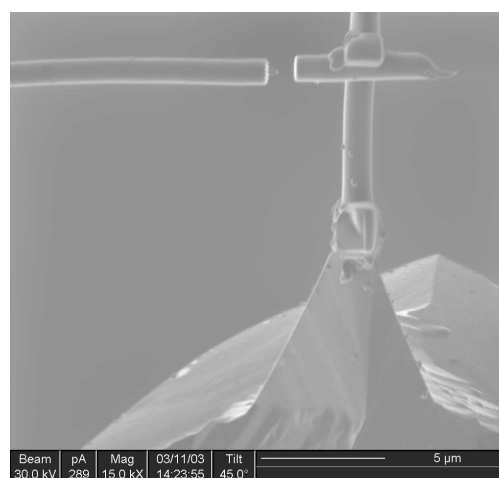


Fig.2 FIB image of welding CNT sample on traditional AFM tip

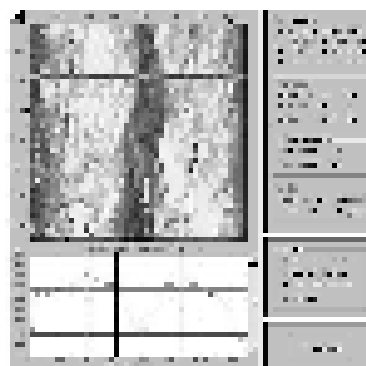


Fig.3 AFM image with CNT tip