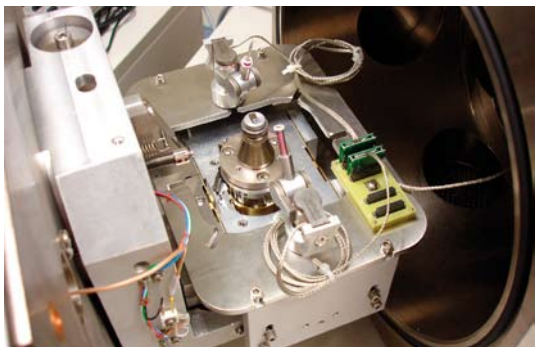
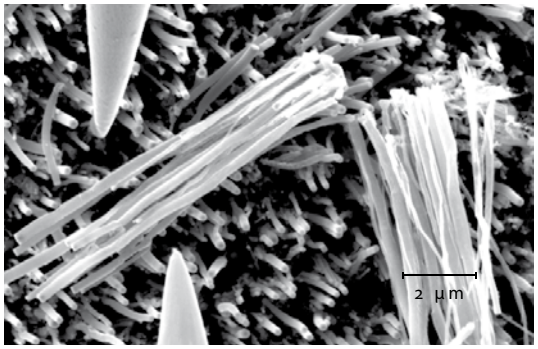
Carbon nanotube manipulation made simple

One of the most fascinating experiments in recent nanotechnology research is the manipulation and characterization of single carbon nanotubes. We recently demonstrated our micromanipulator to be a most versatile and efficient tool for this task.

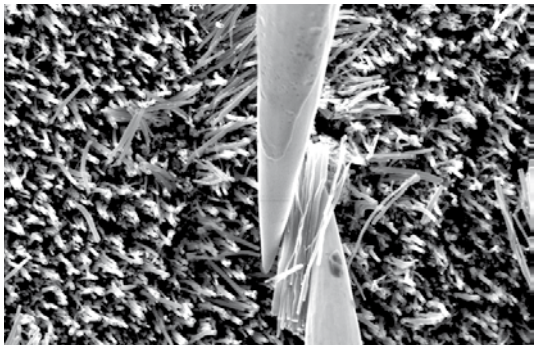
Two MM3A-EM micromanipulators were installed in Dr. Wong's lab - the Department of Electrical and Computer Engineering at the National University of Singapore.



SEM/FIB installation: two MM3A-EM micromanipulators



Two bunches of nanotubes lying on a carpet of nanotubes



One bunch of nanotubes was lifted using two tungsten tips

MM3A-EM micromanipulator (actual size)

The sample was prepared so that two bunches of nanotubes were lying on the surface like two packges of noodles on grass. The task was to separate a single nanotube from one of the bunches.

Two tungsten probe tips were moved to the region of interest and used to grip one of the bunches. Precise control of the probe tips and direct visual feedback of the applied forces made working with the CNT's like using chopsticks.

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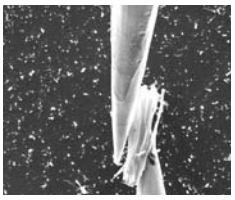
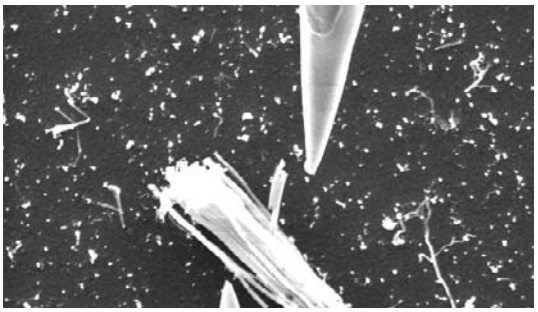
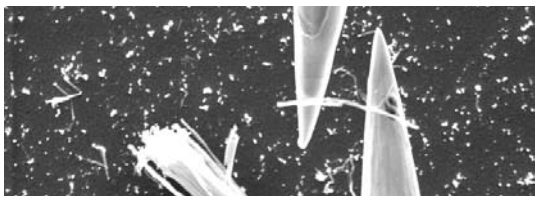
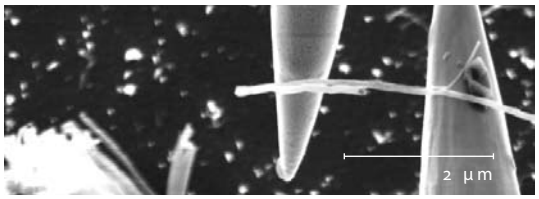


The bunch was separated from the underlying surface by lowering the SEM stage. It was then brought to the designated position by moving the SEM stage and released.

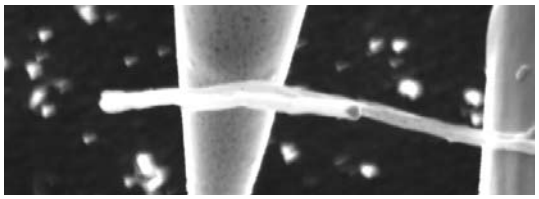




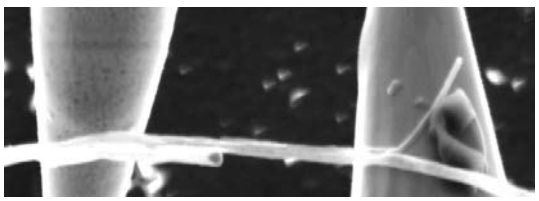
A single nanotube was then separated from the bunch.



An electrical measurement was performed and subsequently the nanotube was found to be 'welded' to the probe tips.



This connection was so strong that it was possible to bend the nanotube in three planes of movement using a force of several micronewtons without breaking it.



Further information

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