VIACARBON 'Carbon Nanotubes for Interconnects and Switches'

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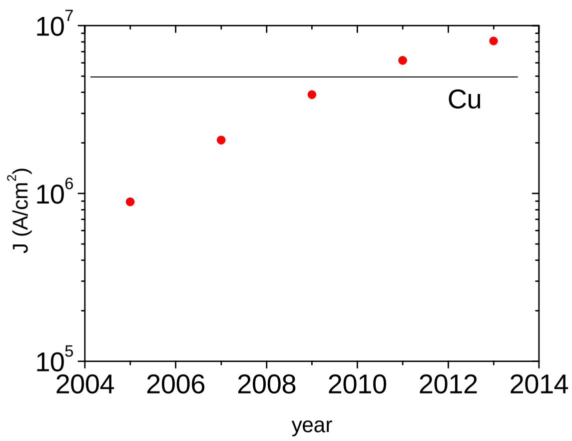
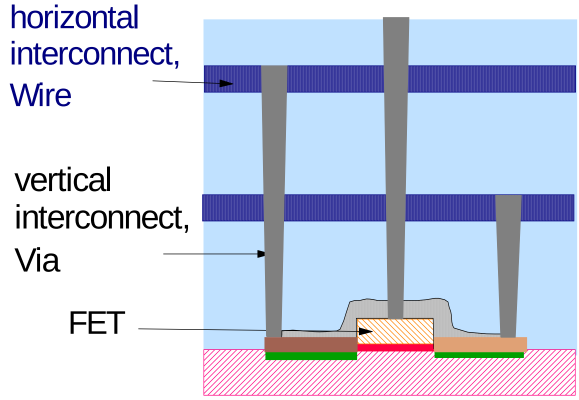
Participant no.	Participant organisation name	Part. short name	Country
1 (Coordinator)	Cambridge University	UCAM	UK
2	CEA	CEA	F
3	Ecole Polytechnique Federale Lausanne	EPFL	CH
4	Intel	Intel	IRL

VIACARBON aims to develop carbon nanotubes for vertical and horizontal interconnects for CMOS nodes of 22 nm and beyond, and for NEMS RF switches.

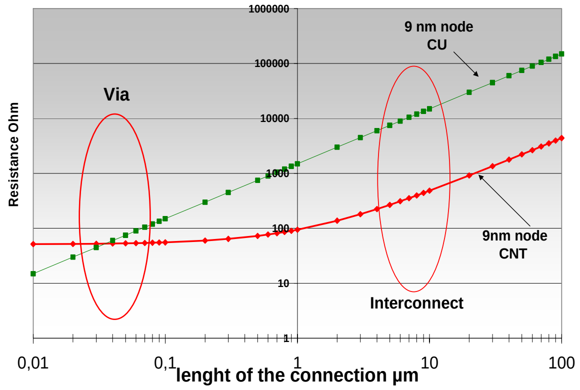
The ITRS roadmap requires that the current density in interconnects at the 222 nm node exceeds 5.10^6 A/cm^2, the maximum current carrying capacity for Cu. Only carbon nanotubes (CNTs) can carry such high current densities, without failing due to electromigration. However, interconnects must also have a low resistance, at least as low as that of copper. As CNTs are one-dimensional conductors, each conduction channel inserts a minimum quantum resistance of 6 kΩ. This series resistance can only be reduced by laying many nanotubes or nanotube walls in parallel. Either contact must be made with all nanotube walls, or we must grow single wall nanotubes (SWNTs) with extremely high densities.



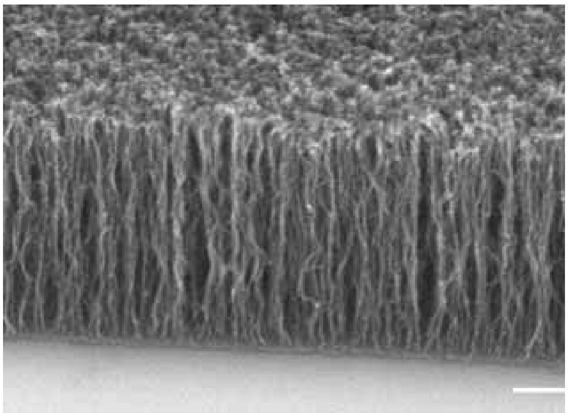


We aim to develop industry-compatible processes for vertical interconnects and for horizontal interconnects. The project aims to grow single wall nanotube mats with a density of over 10^{13} cm^{-2}, by careful optimisation of the CVD growth catalyst. We will measure the semiconducting to metallic component of the nanotubes by Raman spectroscopy. Processes will be developed for low resistivity top contacts. The horizontal contacts will be grown in a trench.

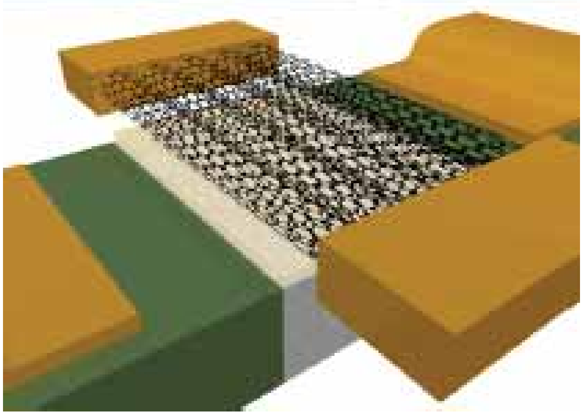
A second aspect is to fabricate arrays of NEMs as RF switches to support new device functions in the interconnect layer: for re-configurable interconnects, banks of programmable passives and power switches.



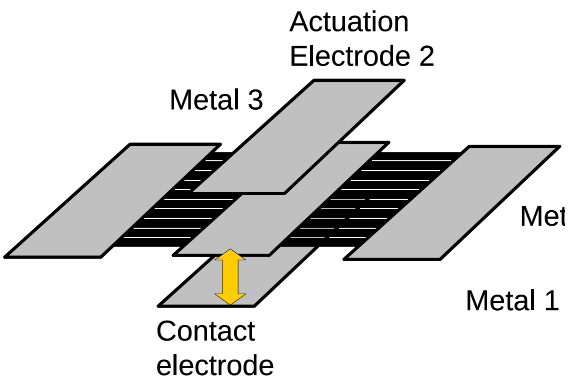
Resistivities of nanotubes as interconnects.



SWNT mat grown by Cambridge



Schematic of NEMS array



Schematic of horizontal nanotube NEMS electrodes and operating principle

The four partners have the necessary expertise. Cambridge in nanotube growth and characterisation; CEA (Leti and Liten) in nanotube growth and processing EPFL in NEMS, modelling and nanotube growth; and Intel in processing and as an end-user.