

CNTs vs SiNWs for future electronics

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Since their identification in 1991 by Iijima (1) carbon nanotubes (CNTs) have been touted for use in next generation devices and circuits, including transistors, diodes, sensors, inverters, transparent contacts, vias and interconnects, NEMS etc -see e.g Fig 1 but because of problems with chirality, diameter and positional control they have yet to be utilized commercially.

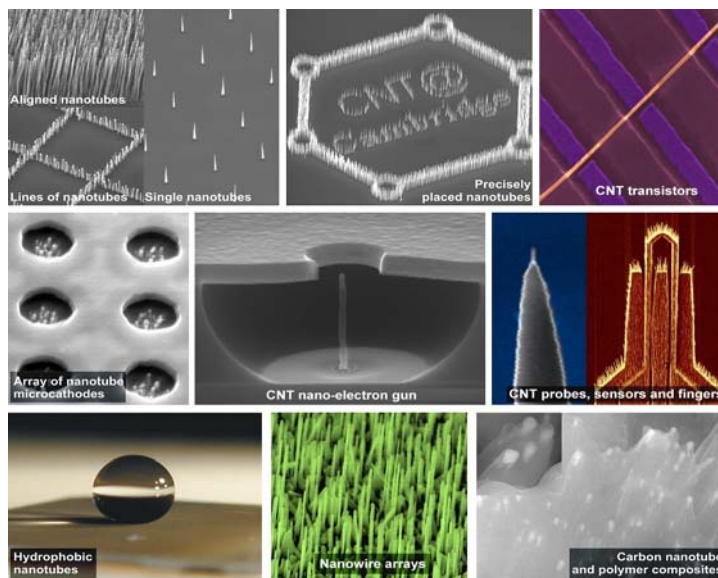


Figure 1 Examples of CNTs and Possible Applications

On the other hand one-dimensional silicon nanowires (SiNWs) (2) may be more attractive, due to the central role of silicon in the semiconductor industry. Also at the nanometer scale Si can become a direct band gap semiconductor due to quantum confinement. This makes SiNWs also very promising for optoelectronics. Unlike nanotubes, which naturally grow as a mixture of metals and semi-conductors, SiNWs are always semiconductors and they can be doped during or after deposition. However there are still problems in reproducibly growing small diameter Si nanowires and interfacing them for contacts/hetero-structures and in also in doping them uniformly. A typical wire grown in our PECVD system is shown below in Figure 2.

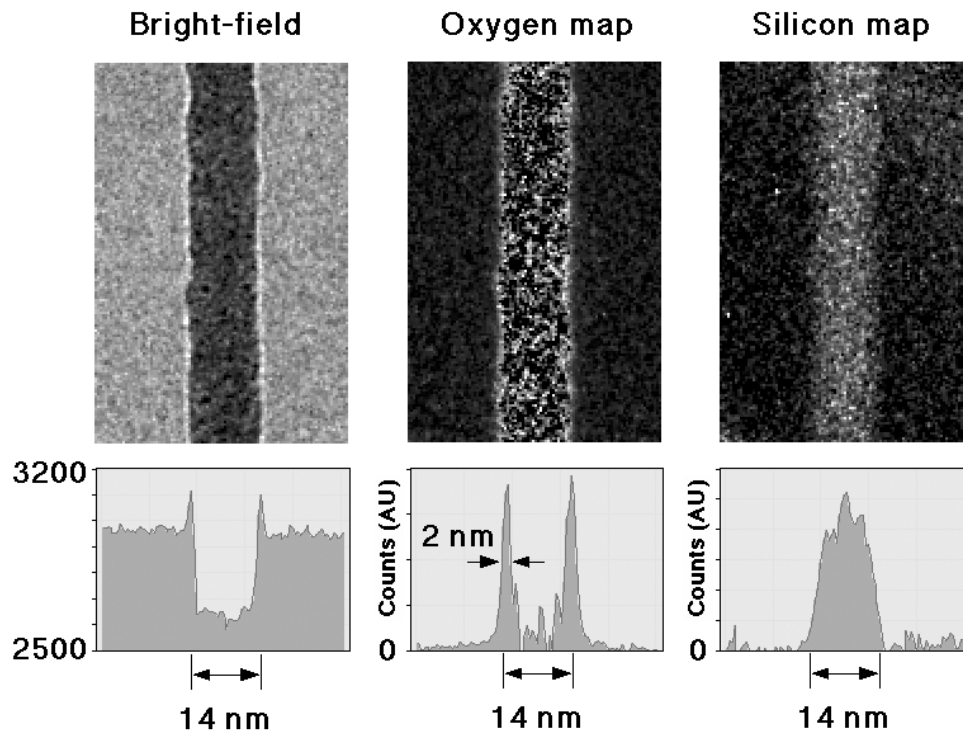


Fig 2. EELS elemental maps of a portion of a 14 nm diameter SiNW. The highly crystalline core is surrounded by a ~ 2 nm thick, native SiO_x sheath (after air exposure)

However we are still investigating ways of producing yet thinner wires with well controlled doping.

In this presentation I will describe the production and potential applications of CNTs in electronic circuits and devices and compare and contrast them with Silicon Nanowires.

References:

- [1] S.Ijima Nature 354, 56, 1991
- [2] S. Hofmann, et al., *J. Appl. Phys.* **94** (2003) 6005.