Uses of carbon nanotubes

Carbon nanotubes are still an exciting technology in 2009, but back in 1991 they were still very new and excitement was running at fever pitch. Every engineer was buzzing with ideas of how they could change the world. Here are my inputs at the time:

Uses of carbon nanotubes

I D Pearson, Cybernetics, 6/12/91

Concept

5 uses of cylindrical carbon molecules

Problems

Limited bandwidth of optical fibre
Chip interconnect problems
Micromotor mechanism shortage
Chip cooling mechanism shortage

BT Opportunities

High order space division multiplexing
Chip interconnect solution
Microjets
Chip cooling
Micromagnets

Summary

A new form of carbon has been discovered, which is a cylindrical variation of the fullerene form of carbon, made of hexagonal carbon molecules built into tubes. The diameter of these tubes is around 5nm. Currently, experimental lengths are in the micrometres, but there is speculation that they may lead to quantum pipes, which could be used to guide electrons. It is likely that the material will be a superconductor, like its 'buckyball' form. There are various opportunities which spring from this new form if it becomes manageable.

High Order Space Division Multiplex

If it is possible to make long strands of the material, there is a possibility that cables could hold very large numbers of these 'quantum pipes', giving high order space division multiplexing. (It may not be practical to actually build such a cable, but a 0.5mm cable would hold up to 10 billion of them. If each of these could operate at 64 kbit/s this gives a total cable capacity of 6.4×10^{14}, comparable with optical fibre. At 2Mbit/s each, we would have 2×10^{16} bit/s capacity.)
There may also be some application in current carrying. (These uses are hinted at in New Scientist, 16/11/91, which also suggests that it may yield materials stronger than carbon fibre)

On Chip Interconnect

It may offer a solution to on-chip interconnects (or other short distance transport) where metallic conductors are inappropriate. Given their very small diameter, this may assist with miniaturization.

Micro 'ion drive'

It should be possible to accelerate electrons along the tubes so they could be used as a very small 'ion drive' type motor, or jets, using the reaction from electron acceleration to propel the tube and whatever it is attached to.

On chip cooling

Using exactly the same principle, they may be useful for on chip cooling, by circulating air around chips.

Micromotors

As well as the ion drive version, a whole range of application in motors spring from the characteristics of this material.

In the fullerene and cylindrical forms, the carbon can be used as a container for other atoms. In the spherical form, it is already realised that atoms of many elements can be 'shrink wrapped' in carbon. This will yield many uses in the next few years. If several iron atoms are enclosed in a carbon tube, this could be made into a very small micromagnet, without the problems of the iron interacting with its environment. This would be much better than coating iron with other materials, which would generally be much more bulky. Having obtained these small magnets, and using them as a core, and using other carbon cylinders as the wires, very small step motors could be produced, in which the wires may be superconducting, with resulting low power wastage and low heat production. Possibly the forces obtainable from such devices would be very much better than electrostatic motors. These should be very chemically stable, since there are no spare bonds in the molecules. It is idle speculation at the moment, but it may prove possible to produce a shuttle device, in which carbon molecule containers are passed up and down a larger tube of carbon, using magnetic propulsion. This may have some use but I can't think what.

There are many other possibilities for this material and also the more spherical fullerene version. The above is a small sample. It is certainly worth looking at in more detail.