Carbon nanotubes in space

Scientists in South Korea have shown that carbon nanotube field-effect transistors (FETs) could operate effectively in space, and are not unduly affected by radiation.

The research, carried out by Takhee Lee and colleagues at the Gwangju Institute of Science and Technology, studied the effects of proton irradiation on the electrical properties of carbon nanotube-based network FETs.

They found no big changes, even after prolonged exposure to proton beams with energies and fluxes found in space.

Testing the radiation hardness of carbon nanotubes was never the original aim of the research, according to Lee: 'My intention was to find a way of converting metallic carbon nanotubes into semiconducting nanotubes by breaking their surface symmetry with highly energetic particles.'

The results of the study, published in the journal *Nanotechnology*, show that carbon nanotubes may be suitable for use in situations where traditional silicon-based devices are damaged by ionising radiation.

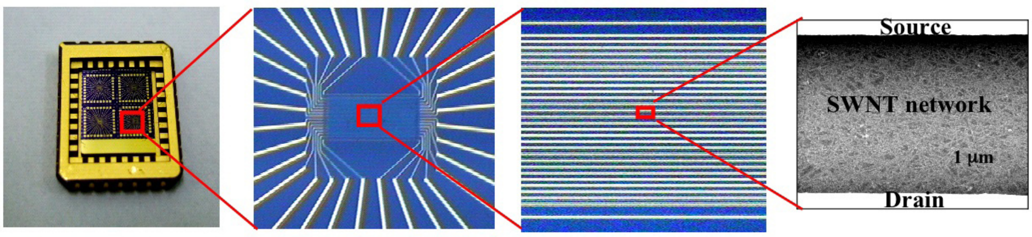
Shielding sensitive electronics against radiation is costly as it involves increasing the weight and size of satellite systems, so there is a pressing need for radiation-hardened electronic materials in space applications.

While other studies have focused on structural changes in bulk materials following charged particle irradiation, the authors took it a step further and looked at the effects of proton irradiation on real electronic devices based on single walled carbon nanotubes.

They found that carbon nanotube-based FETs maintained their electrical properties under exposure to protons with an energy range of 10–35 MeV and integrated flux of 1010–1012 cm-2, which is representative of the geospace environment.

Lee is convinced that carbon nanotubes will in the future be used extensively in space applications, but for now he intends to study in detail the effect of different types of radiation on not only carbon nanotubes, but also other types of nanomaterials such as wires and rods.

Images of carbon nanotube-based network-FETs, with increasing magnification.



Source: "Radiation hardness of the electrical properties of carbon nanotube network field effect transistors under high-energy proton irradiation", Woong-Ki Hong et al., Nanotechnology, 2006

Living cells inspire nanotech building blocks

Living creatures make use of a biological process in which cell membranes are formed from lipid-based molecules, which have both hydrophilic and hydrophobic ends.

These so-called amphiphilic molecules self-assemble into sheets, forming a bilayer – or micelle – with the molecules packed into high density arrays.

Eugene Zubarev and his colleagues at Rice University in Texas, US, realised that by attaching a nanoparticle to a junction point of an amphiphile, it is possible to mimic the biological process, and assemble billions of nanoparticles into one-dimensional structures that are water-soluble.

In this way, the researchers believe, it should be possible to create a wide variety of useful materials, including powerful anti-cancer drugs and more efficient catalysts for use in chemical engineering.

The researchers took V-shaped amphiphiles of polystyrene-b-poly (ethylene oxide), and attached two-nanometre diameter gold particles at the focus of the V. With micelle formation, the researchers found they could create tightly packed cylinders of gold nanoparticles measuring 18nm across.

As well as cylinders, micelles can form into vesicles and spheres. By varying the length of the polystyrene arm of the molecules, the size of the gold particles and the solvents used, Zubarev was able to create well-defined nanostructures with a specific size and shape.

As for the inspiration behind this work, Zubarev says: 'The pioneering work by Chad Mirkin and, later, by Vincent Rotello had a significant impact, because they showed that organic molecules can in principle be used as a means to induce, and control, the formation of inorganic nanoparticle superstructures.'

Rotello adds: 'One of the keys to increasing the range of structures we can generate with this strategy is to expand the range of shapes and sizes of our available building blocks.'

The research is reported in the Journal of the *American Chemical Society.*

Click here for Eugene Zubarev's homepage