Commercial success looms for nanotubes transformed into polyelectrolyte salts

Microwave cooking for soluble CNTs

The industrial processing of carbon nanotubes (CNTs) could become much easier with the development of a quick and simple way to make them highly soluble.

Normal single-wall CNTs are effectively insoluble, forming huge clumps that sink. US researchers have worked on increasing this solubility by attaching various different water-soluble compounds, including fluorine, aryl radicals and sugars, to the tubes. Unfortunately, none of these mechanisms has increased solubility much, and they usually involve time-consuming reaction processes.

Chemists at the New Jersey Institute of Technology, led by Somenath Mitra, have now used microwaves to create CNTs that are up to 125 times more soluble than forerunners. Their method involves adding CNTs to a mixture of nitric acid and sulfuric acid and then heating it in a microwave for just three minutes. The chemists found that the resulting CNTs could dissolve in water at concentrations as high as 10mg/mL, compared with only around 0.08mg/mL for most other methods.

Detailed studies of the CNTs showed that they now contained carboxylated and acid sulfonated groups on their surface, transforming them into polyelectrolyte salts that readily dissolved in polar solvents such as water. The transformed CNTs were still able to conduct electricity at similar levels to normal CNTs.

Mitra's team is now exploring practical applications for these soluble CNTs, including nanocomposites, organic solar cells and thin films. The researchers have formed a company called Nanopulse to commercialise them. 'We are [also] using microwaves to alter nanotubes in several different ways, including attaching different functional groups, polymers and ceramic composites,' Mitra told *Chemistry World*. *Jon Evans*

Microwaves can be used to alter nanotubes

Reference
Y Wang *et al*, *J. Am. Chem. Soc.*, 2006, **128**, 95

Rubber-supported electronic materials keep working when bent out of shape

Applications stretch out for wavy silicon

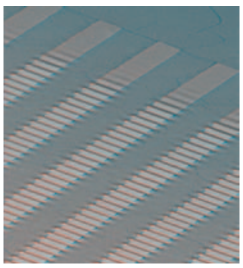
Artificial muscles and electronic skins for space bubbles will be easier to make now that materials scientists in the US have made stretchable and bendable silicon electronic devices.

John Rogers and colleagues at the University of Illinois made single-crystal silicon into wavy ribbons. The wavy geometry meant that when the silicon was supported on a rubber substrate, it could be stretched by altering the wave amplitude, rather than changing the silicon interatomic spacings.

Rogers' team made diodes and transistors with their wavy, stretchy silicon and found that the electrical properties stayed constant as the devices were stretched or compressed.

'Stretchability is a much more difficult, but much more desirable, mechanical characteristic to achieve, compared to simple bendability,' Rogers told *Chemistry World*. Stretchy devices will make monitoring the structural health of curved surfaces, like aeroplane wings, easier, said Rogers. Equally, they could be used as sensor skins for use in biological systems like artificial muscles, or even as inflatable habitats for manned space exploration, he said.

The group will now try to make other stretchy electronic materials, such as gallium arsenide, indium phosphide and gallium nitride. 'We are also developing methods to make full scale integrated circuits into stretchable, wavy geometries,' said Rogers.
Katharine Sanderson



Sensor skins, artificial muscles and aircraft monitoring on the cards for stretchable silicon

Reference
D-Y Khang *et al*, *Science*, 2006, **311**, 208