Nano

The Next Big Thing

STORY BY MICHAEL FRANCO
ILLUSTRATIONS BY RANDY LYHUS

First there was plain old small. The Japanese perfected that with the transistor radio, then the Walkman. Then we had mini – Alex Issigonis shrunk the car down to city-friendly proportions. Next came micro, as Gordon Moore introduced the microprocessor and founded Intel on the strength of it. Now we have gone even smaller: nano.

Derived from the Greek word for "dwarf," nano refers to all things that exist at the sub-microscopic level. The usual measure of length at this level is the nanometre, which is one one-millionth of a millimetre. If you shrunk human beings down to this size, you could line up every single person on the planet from one side of an average bedroom to the other – with plenty of space left over. While things at the nanoscale are tiny indeed, many expect the work being done in this field will have a gargantuan impact on society.

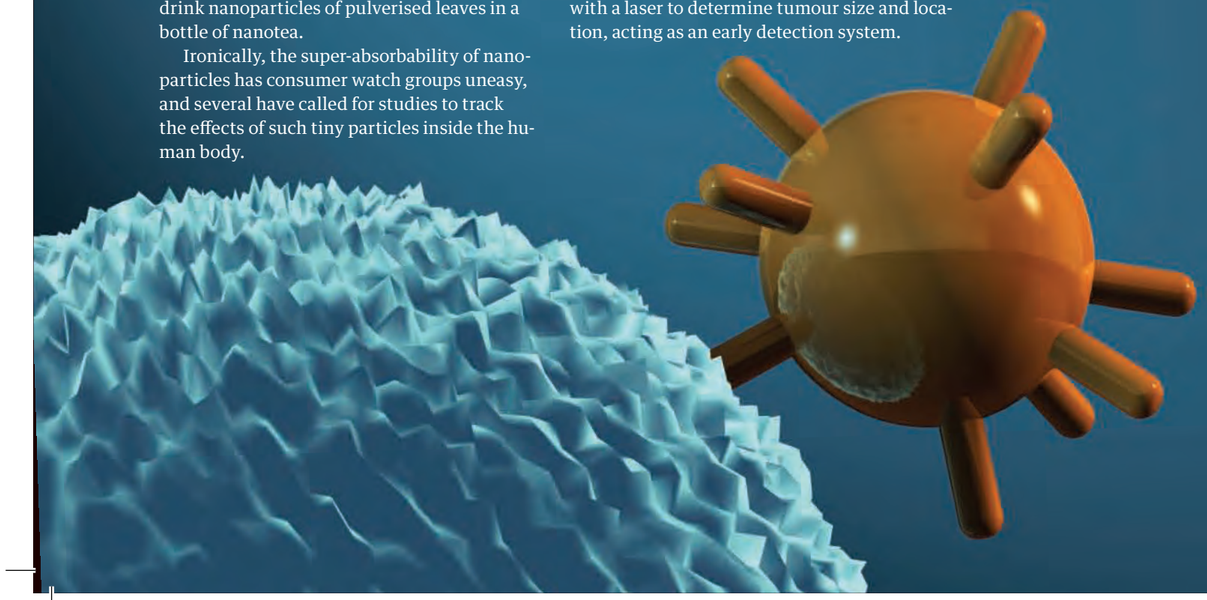
Scientists predict it could have as much of an impact as the industrial revolution did. You could almost say small size matters big.

NANOPARTICLES

Because nanoparticles – defined as having at least one dimension of less than 10 nanometres – can enter and be absorbed by the body extremely effectively, these particles are appearing in a whole host of consumer goods. This includes hairsprays, bug repellents, moisturisers, sunscreens and deodorants. And thanks to a company in China, you can even drink nanoparticles of pulverised leaves in a bottle of nanotea.

Ironically, the super-absorbability of nanoparticles has consumer watch groups uneasy, and several have called for studies to track the effects of such tiny particles inside the human body.

Sometimes though, the theoretical risks of nanoparticles are outweighed by the tangible benefits. That's certainly the case at the Emory-Georgia Tech Nanotechnology Center in the United States where scientists have linked gold nanoparticles to antibodies which are drawn to cancer cells. Once inside the rogue cells, the golden hitchhikers can be beamed with a laser to determine tumour size and location, acting as an early detection system.



Hopes are high that **nanoparticles** can play a significant role in the fight against cancer.

NANOFIBRES

Nanofibres are defined as fibres with diameters less than 100 nanometres, roughly 1,000 times thinner than a human hair.

These liliputian filaments have already woven themselves into our lives in the form of substances like Nano Tex, used by clothing manufacturer Eddie Bauer to keep shirts and trousers stain resistant. Researchers at Ohio State University in the United States have discovered that by treating nanofibres with certain chemicals, they can alter their properties to attract or repel various substances like oil. Coating a sheet of glass with such dirt-repelling fibres, which are invisible to the human eye, could mean never having to wash windows again.

Nanofibre bandages that heal wounds faster and fight infection better than traditional wraps have been through clinical trials and may be on the market later this year.

And most significantly, professor Samuel Stump of Northwestern University in the US state of Illinois has just developed a method of restoring the mobility of paralysed mice.

The process involves Stump injecting the mice with a liquid that assembles itself into a nanofibre scaffold along which nerves can grow to repair damaged spinal cords.

Nanofibres have great medical potential. They can be injected to form scaffolds along which nerves can grow and regenerate damaged neural networks.

BUCKYBALLS

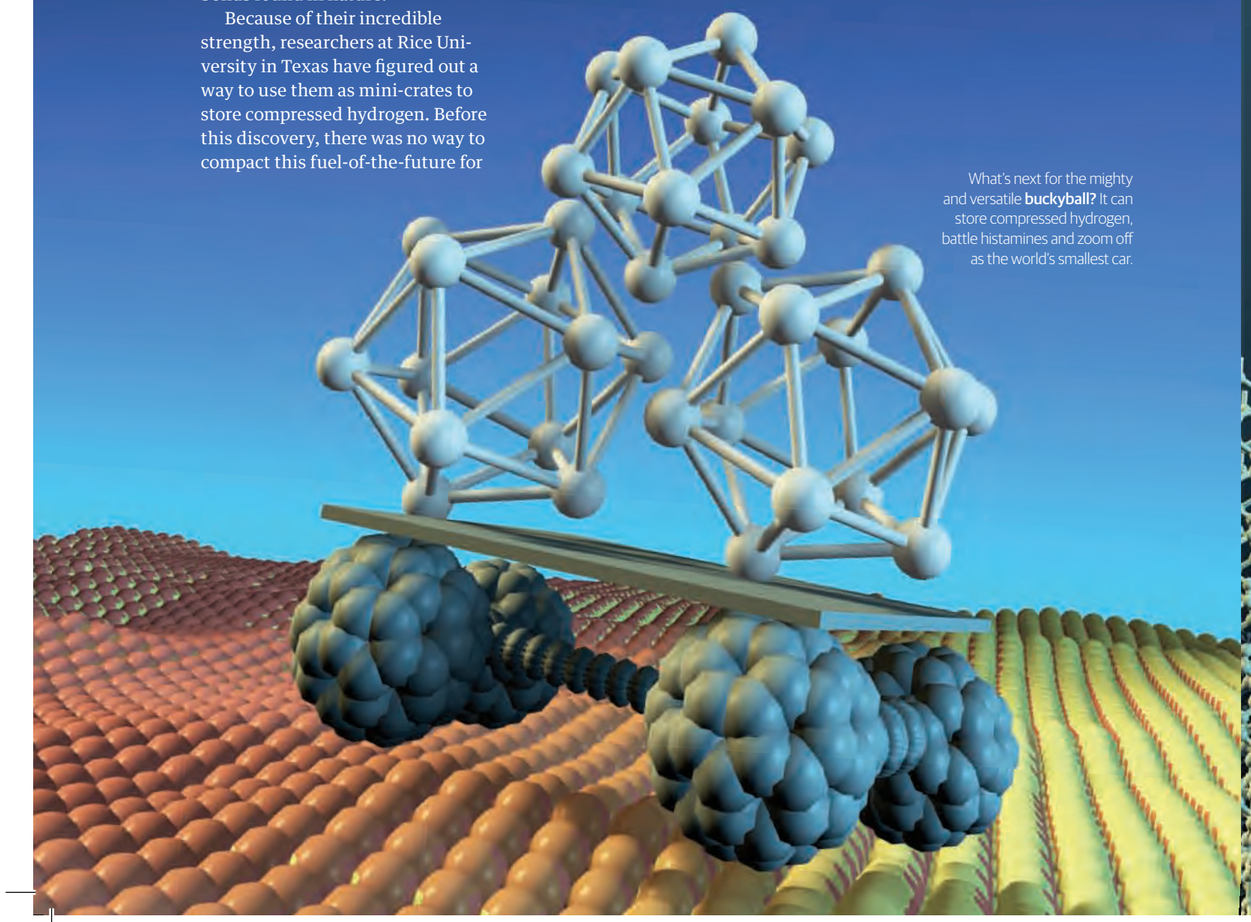
If you've ever seen a dome-shaped house, then you have some idea of what a buckyball looks like. These tiny particles are named after the inventor of the geodesic dome home – architect and engineer R. Buckminster Fuller – and are also remarkably similar to traditionally-stitched footballs. Just like their inflated cousins, buckyballs can bounce and spin. But crush one under extreme pressure, and it snaps back into shape when the pressure eases.

What makes buckyballs so tough? The lines that make up their cage-like structures consist of carbon bonds – the strongest molecular bonds found in nature.

Because of their incredible strength, researchers at Rice University in Texas have figured out a way to use them as mini-crates to store compressed hydrogen. Before this discovery, there was no way to compact this fuel-of-the-future for efficient storage in a car's fuel tank.

Medically, buckyballs are being studied for their sneeze-stifling abilities because they can prevent certain cells from releasing histamine into the body. They're also great free radical sponges and may some day work to soak up these cancer-causing substances in our blood streams.

In a truly futuristic development, buckyballs have been used as the wheels of the world's smallest car which measures just 3x4 nanometres. The hope is that one day small vehicles like this could work as pick-up trucks delivering atoms around molecular-sized nanofactories.



What's next for the mighty and versatile **buckyball?** It can store compressed hydrogen, battle histamines and zoom off as the world's smallest car.

CARBON NANOTUBES

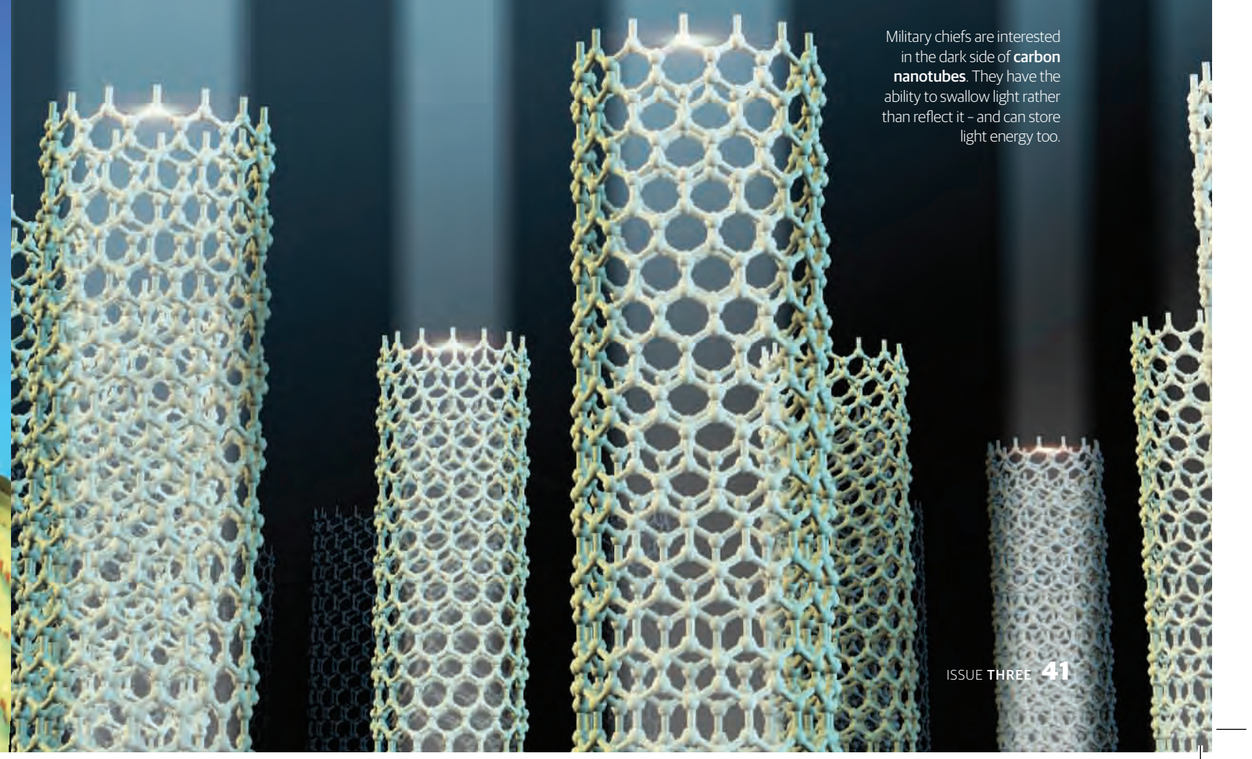
If you held a piece of paper on its edge and tried to balance a teacup on it, the results would be messy, and very ineffective. Roll that paper into a tube, however, and then put the teacup on it. Voila, you have something very light supporting something relatively heavy.

This is the idea behind carbon nanotubes, formed by rolling up a sheet of honeycomb-like carbon molecules. This process creates the strongest substance on earth – tiny tubes that are 100 times stronger than steel, yet an amazing six times lighter.

Researchers at the University of California have also exploited an electricity-producing capability of carbon nanotubes by using them in artificial muscles. These not only generate enough power through their expansion and contraction to actually charge your iPod but can also repair themselves.

Nanotubes can also channel sound frequencies and, in fact, one has been used as the world's smallest radio demodulator, appropriately receiving "Good Vibrations" by The Beach Boys.

Scientists at Rice University in Texas and Rensselaer Polytechnic Institute in New York have even produced a blacker black by stacking carbon nanotubes on end, like bristles on a brush. Because light slips between the tubes and gets swallowed instead of being reflected, the colour appears much darker than any black to date. This material can store energy from light sources like the sun, and militaries worldwide are interested in its ability to make the "cloak" part of "cloak-and-dagger" even more clandestine.



Military chiefs are interested in the dark side of **carbon nanotubes**. They have the ability to swallow light rather than reflect it – and can store light energy too.