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NANOCARBON TECHNOLOGY

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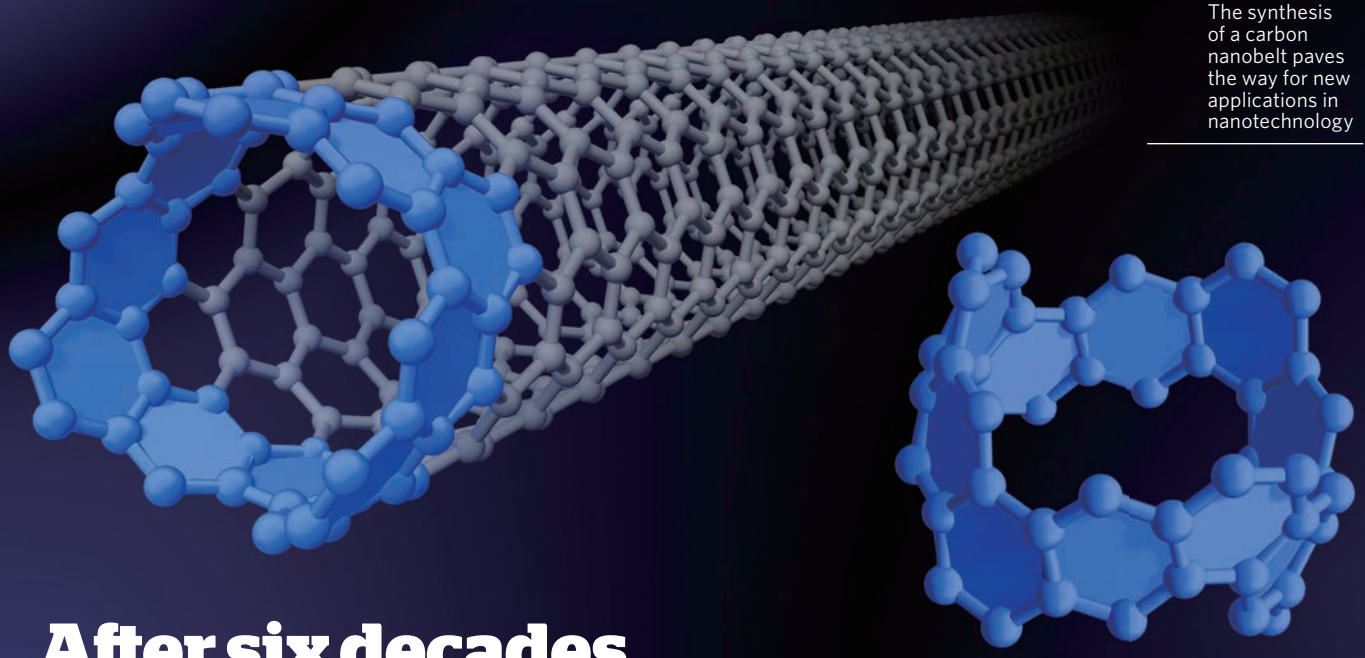

The synthesis of a carbon nanobelt paves the way for new applications in nanotechnology

After six decades of anticipation, the nanobelt has arrived

CHEMISTS HAVE SYNTHESIZED the smallest member of the carbon nanotube family.

In a way, the world of nanocarbons resembles origami — small manipulations can bring changed forms and functions. Graphene, a semi-metallic single layer of carbon atoms, is like a flat sheet of paper. Shape it into a sphere, and it becomes insulating. Wrap it into a tube, and it becomes a semiconductor that is transparent to light below a certain energy level. Twist that tube slightly, and it becomes a metal that absorbs light of all energies.

Unlike paper though, the shape of atomic-scale nanocarbons is extremely difficult to control. Lacking tools to use more direct means, scientists have had to resort to painstaking filtering techniques. To make a nanotube transistor, for example, the required semiconducting nanotubes are typically filtered from a mixture of nanostructures produced at high temperatures.

But despite decades of work, filtering remains highly imperfect. "The key issue in the field remains the preparation of well-defined materials," says Kenichiro Itami, research director of the JST-ERATO Itami Molecular Nanocarbon Project and professor of chemistry at Nagoya University.

CHEMISTS TEND TO BELIEVE THAT BEAUTIFUL STRUCTURES WILL EXHIBIT AMAZING PROPERTIES

An approach enabling more control over the shape would be a chemical synthesis of a single desired structure. Now, after an extraordinary 12 years of effort, a team of researchers led by Itami has succeeded in doing just that with one of the most sought-after nanostructures in the field — the carbon nanobelt.

Chemists have been trying to synthesize the nanobelt for over 60 years. "It's a simple and beautiful structure," says Itami, "and chemists tend to believe that beautiful structures will exhibit amazing properties."

The nanobelt consists of a thin ring of carbon atoms joined in a loop, as if someone had taken a vertical slice from the centre of a nanotube. Crucially, this means that the nanobelt can be used to grow metallic or semiconducting nanotubes with perfect fidelity — no filtration required. "In this regard," Itami says, "carbon nanobelts are the ultimate seed."

Nanobelts may also be useful in nanomachines, single-molecule electronics, photonics, and spin transport. They may even make a perfect nanocar 'tyre'. Being both the newest and the smallest well-defined member of the carbon nanotube family, many new applications may be found, says Itami. "People can't predict how it will change the game."

Scientists around the world will soon get the chance to try. Tokyo Chemical Industry Co., Ltd. (TCI) is collaborating with Nagoya University to efficiently scale up the synthesis of the nanobelt, and aims to make it commercially available within six months. Inquiries, they say, are already coming in. ■

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