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Ultrathin Carbon Earns Nobel

U.K.-Based Scientists Honored for Work on Graphene, Seen as Silicon Replacement

By GAUTAM NAIK

Reuters

Russian-born scientist Andre Geim in Manchester, England.

LONDON—Two Russian-born scientists will share the Nobel Prize in physics for their work on a material that has the potential to one day replace silicon as the base material for modern electronics.

The Royal Swedish Academy of Sciences awarded the $1.5 million physics prize to Andre Geim, 51 years old, and Konstantin Novoselov, 36, for "groundbreaking experiments" on a new form of carbon known as graphene.

The scientists began their careers as physicists in Russia, and now work at the University of Manchester in Britain. Dr. Novoselov is one of the youngest Nobelists ever.

Their road to the physics prize began humbly—with a bit of Scotch tape and the graphite found in everyday pencils.

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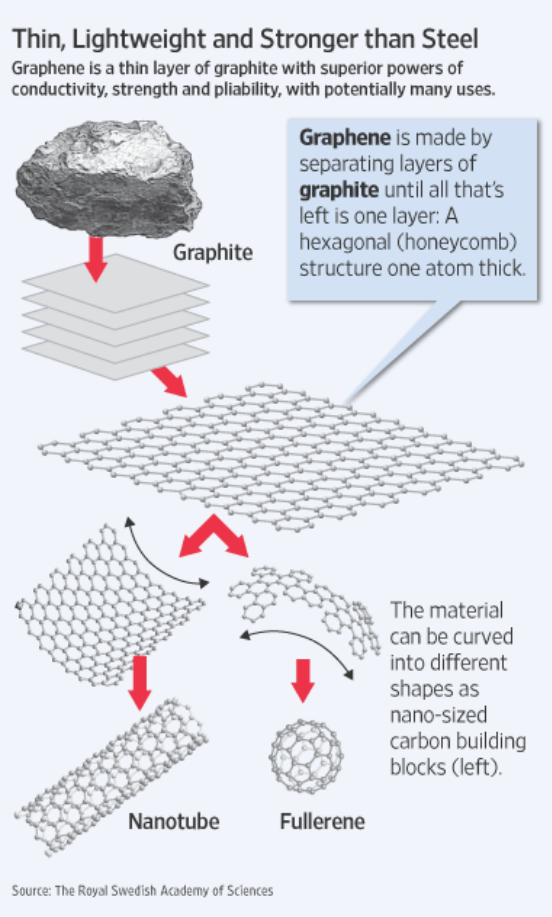
Several years ago, while investigating the electrical properties of graphite, the Russian scientists needed thin pieces of the material. When filing down a piece of graphite didn't do the trick, they tried peeling off extremely thin layers using Scotch tape. It worked, so they kept peeling until they got to a material that was just one atom thick.



"Six or seven years ago, we stumbled on this new class of materials," said Dr. Geim in a phone interview. "You can't imagine anything thinner than one atom. We found its properties to be amazing—very different from any other standard three-dimensional material."

Graphene is believed to be the thinnest and strongest material in the world, more than one hundred times as strong as the strongest steel. It is virtually transparent, extremely dense, and impermeable to gases and liquids. "It's stiffer than a diamond. At the same time, you can stretch it like rubber," said Dr. Geim.

In describing the science behind graphene, the Nobel committee on its website noted that a one-square-meter graphene hammock would be nearly invisible and also able to bear the weight of a four-kilogram (8.8 pound) cat. The hammock itself would weigh less than a single cat whisker.

Graphene also happens to be the best known conductor of heat and electricity. Experiments have suggested that electrons travel about 100 times faster in graphene than they do in silicon at room temperature.

According to Dr. Geim, that could make it an ideal candidate as a material for high-speed transistors used in cellular phones, for electrodes used in DNA sequencing machines, and other electronic devices.

The Nobel Prize in physics goes to two Russian-born scientists for their portrayal of a new form of carbon. Video courtesy of Reuters.

Scores of scientific teams are already trying to harness the properties of the new nano-material. In February, researchers at International Business Machines Corp. published a paper in the journal Science demonstrating a radio-frequency graphene transistor.

In June, Japanese and Korean scientists unveiled the first touch screen made from graphene. Vorbeck Materials Corp., of Jessup, Md., makes a conductive ink for printed electronics whose main ingredient is graphene.

Silicon transformed electronics and computing by allowing transistors to increase

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in speed while shrinking in size. But silicon and other existing transistor materials are believed to be approaching the smallest size at which they can be effective. Graphene has been tapped as the candidate that might replace silicon, though not any time soon.

"This won't happen in the next 20 years," said Dr. Geim. "Making integrated circuits from graphene is still far beyond the horizon."

Graphene was studied theoretically before 2004. But few researchers believed that it was possible to isolate stable sheets of the material. Drs. Geim and Novoselov pulled off the trick and published their results in the journal Science in late 2004.

In its citation, the Swedish academy said the duo achieved their result "at a time when many believed it was impossible for such thin crystalline materials to be stable."

Dr. Geim has Dutch nationality, and Dr. Novoselov is a British and Russian national. The pair has worked together for years, sometimes on unusual experiments. Several years ago, Dr. Geim used magnetism to levitate a living frog. Along with Dr. Novoselov, he also invented super-sticky "gecko tape," based on the biological principle that allows a gecko to scale a vertical wall or rest upside down on a ceiling.

Dr. Geim said he had been working at home on Tuesday morning when a representative from the Swedish academy called with the news. He hopes to sidestep the Nobel Prize publicity as much as possible in order to keep his focus on the unusual properties of graphene.

"I plan to keep muddling through—as usual," said Dr. Geim.

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