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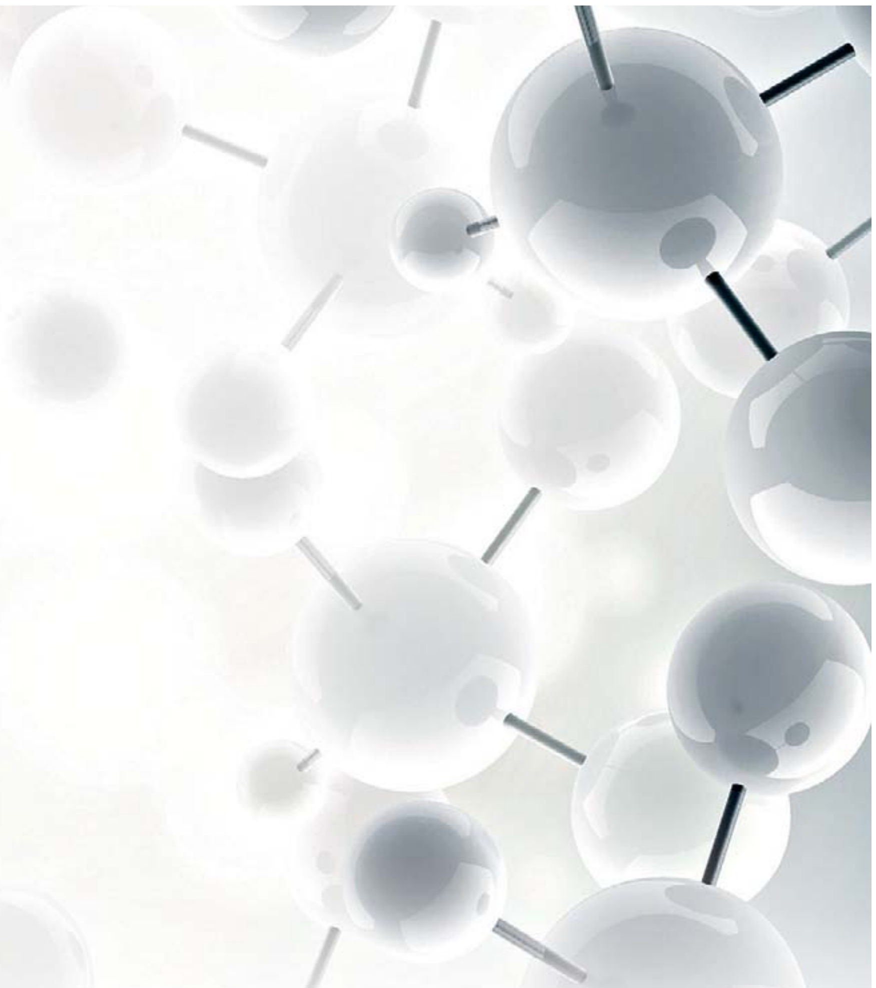

2D world of opportunities

After studying overseas, scientist returns to China to continue researching carbon material that is stronger than steel

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For more than a decade, Chinese physicist Zhang Yuanbo has been hunting for two-dimensional materials in our three-dimensional world.

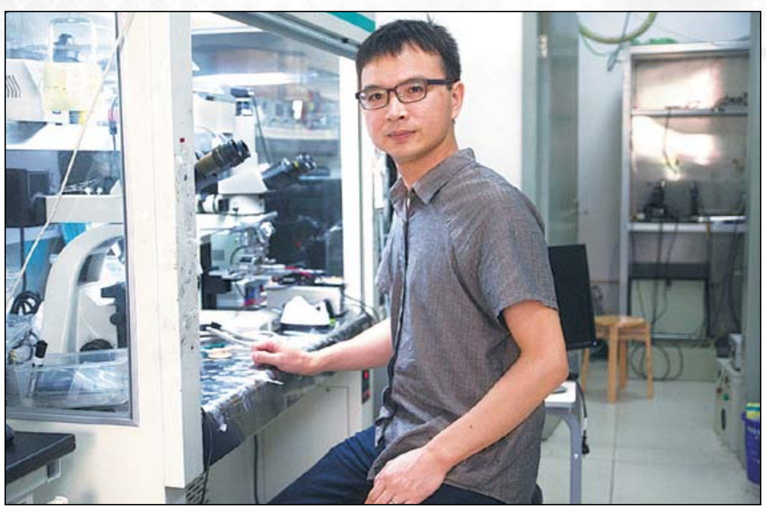
2D materials are crystals that are made up of a single layer of atoms. Zhang, 39, is one of the early scientists who have tried to extract and analyze graphene, a carbon allotrope in the form of an atomic scale.

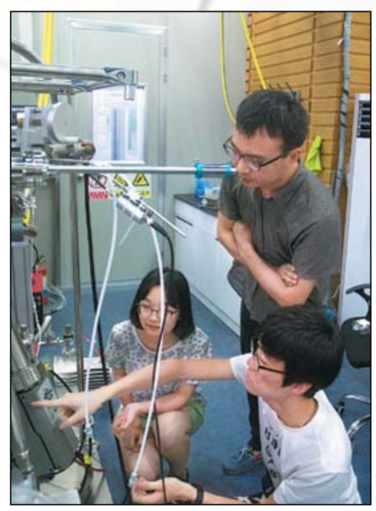
Graphene is hundreds of times stronger than steel. Pioneering work on it earned a Nobel Prize for two scientists based at the University of Manchester in the United Kingdom, and opened the door to a whole new world of physics research in 2D materials.

"Scientists have since found more than 200 2D materials," said Zhang, who works at Fudan University in Shanghai. "The field is very active. Almost all the universities I know pursue some kind of research related to it."

Graphene is a good conductor of electricity and the best conductor of heat among all known materials. It is almost transparent, yet its structure is so dense that even a gas atom cannot pass through it.

Graphene and other 2D materials are composed of known elements, but they exhibit different properties. Zhang, in collaboration with other scientists in China, managed to pin down phosphorene, a 2D material made up of phosphorus atoms. It is a natural semiconductor and has the potential to replace silicon and make microchips in computers and smartphones even smaller.





Physicist Zhang Yuanbo, one of the early scientists who tried to extract and analyze graphene, a carbon allotrope, in his laboratory at Fudan University in Shanghai; Zhang and his team at work in the lab, which he took two years to set up at Fudan University after he completed his postdoctoral studies in the United States. PHOTOS BY XING YI / CHINA DAILY

In 2014, the academic journal *Nature Nanotechnology* published a research paper on phosphorene, written by Zhang and his partners.

But there is much work to be done before phosphorene can be mass-produced, Zhang said.

Born in 1978 in a village in Xinyang, in Central China's Henan province, Zhang took part in a national physics competition while in high school.

He clinched the first prize in his province, and that helped him secure a place at Peking University.

When Zhang completed his degree in 2000, he was admitted to Columbia University in New York for his PhD studies. In 2002, he met his adviser Philip Kim, who was at that time a new professor at Columbia. Kim introduced him to the field of 2D materials.

According to Zhang, Kim told him that research had been done on both carbon atoms in the shape of nanoballs and nanotubes, which are zero- and one-dimensional, but little research had been done on the 2D form of carbon.

"That sounded like exciting research to me," Zhang said.

Their first task was acquiring such a form of carbon. Zhang found out that layers of graphite, the naturally occurring crystalline carbon, are like a stack of playing cards — different layers would slip away from each other if they were "pushed" aside. Just like writing with a pencil, where the graphite layers left on paper are the traces left behind.

Following that line of reasoning, Zhang set up some nano pencils and tried to "write down" a few single layers of graphite.

Before Zhang and Kim could separate graphene in this way, University of Manchester researchers Andre Geim and Konstantin Novoselov, who were working in the same field, succeeded and published their paper in 2004.

Their method applied the use of adhesive tape, to "peel off" the thin layers. Their discovery helped them win the Nobel Prize for physics in 2010.

Zhang himself continued to study graphene and other 2D materials. After earning his doctorate at Columbia, Zhang went to the University of California, Berkeley, in 2006 for postdoctoral research.

Five years later, he returned to China through its Young Thousand Talents program, which recruits younger scientists working overseas.

"I chose Fudan University because I found that it gave me a lot of freedom in research, and the relationship between colleagues was very good," Zhang said.

He took two years to set up the laboratory. The university also did not pressure him to publish papers, an approach he feels is beneficial for young researchers.

"Scientists need time to develop and explore. Too much emphasis on publishing papers will stifle their creativity," he said.

There are now many laboratories in China good enough to compete with their US counterparts, Zhang said.

During his student days, going abroad seemed to offer the best option for aspiring scientists who wanted to further their studies, but "the situation has changed", he said. "In the past, some might have said that scientists who returned to the motherland sacrificed their good life and research abroad. But that is not the case now."

To help further address the tendency to place more value on researchers who have earned their degrees abroad, he said: "We should also give homegrown researchers equal opportunity in applying for funds."