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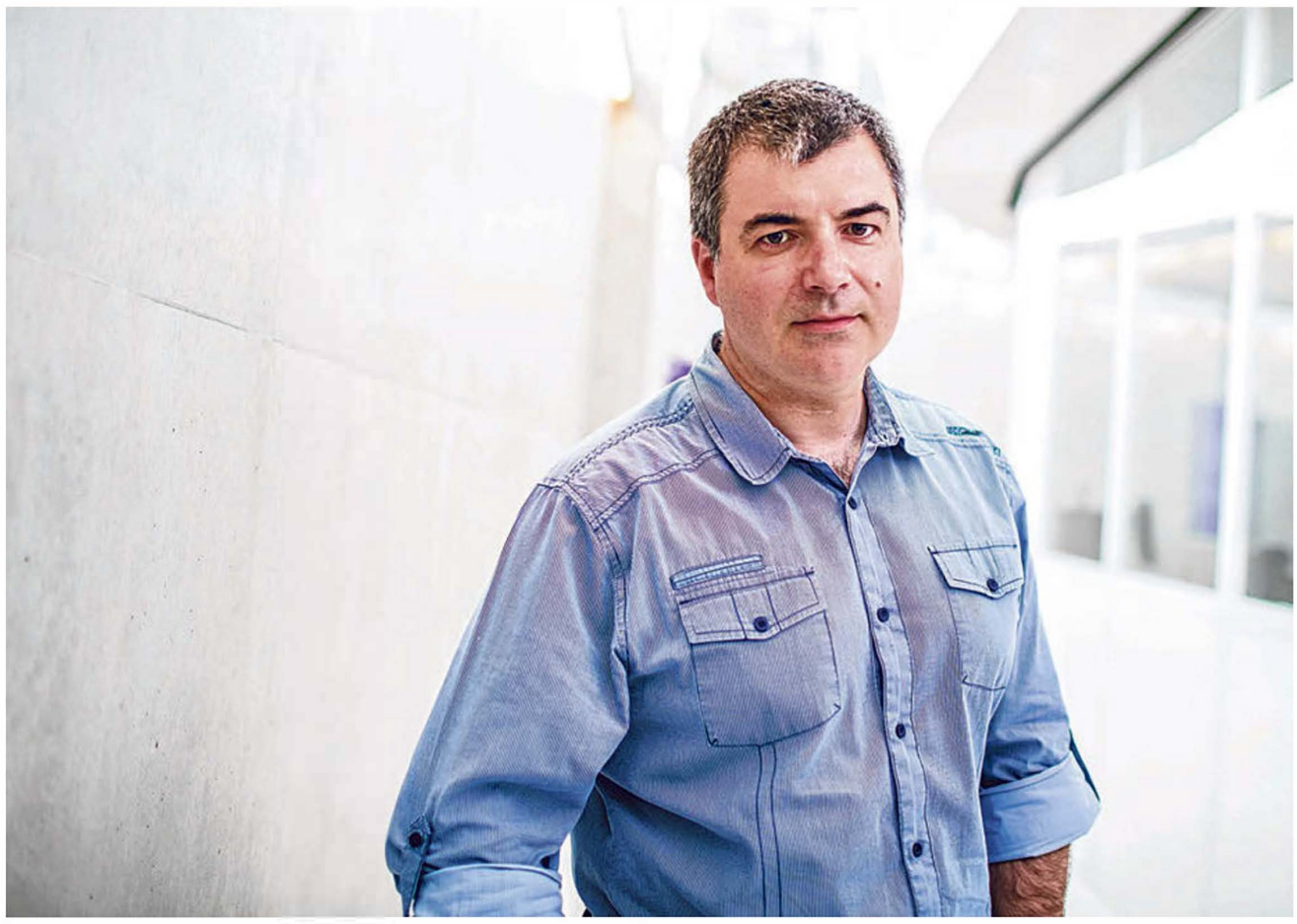


Professor Konstantin Novoselov (above) and fellow researcher Andre Geim were awarded the Nobel Prize for their groundbreaking achievements in graphene. Made up of a single layer of carbon atoms, it is the thinnest material discovered to date, yet it is hundreds of times stronger than steel. PHOTO: UNIVERSITY OF MANCHESTER

Be bold, says Nobel laureate joining NUS

Co-creator of supermaterial graphene wants to infect others with his passion for science

Chang Ai-Lien
Science Editor

When Professor Konstantin "Kostya" Novoselov gives a talk, he never makes any mention of the Nobel Prize in Physics that he was awarded in 2010, when he was just 36.

Yes, the top award is special, he admits, but the man behind the supermaterial graphene does not really think about it.

In Singapore, where he starts work next week, he says his job is to infect others with his passion in science, from small teams of scientists and collaborators with whom he plans to work closely to school students, to show them how they can create something totally new from nothing.

He is also looking for a fresh start and, with it, new inspiration and ideas.

"You need to always test yourself," he says. "People know me as the graphene researcher, and it is an extremely exciting research area, but I would like to expand to designer synthetic materials that do not exist in nature, which have pre-determined properties."

Giving the example of human skin, he says: "This basic human tissue can perform thousands more functions than any materials we humans can create.

"Imagine if we can create artificial skin which can sweat to control humidity or temperature, or perform other functions."

This is not as far-fetched as it sounds, says the physicist, who specialises in condensed matter physics (which looks at the visible and microscopic physical properties of matter), mesoscopic physics (dealing with materials at onset of quantum phenomena) and nanotechnology (where matter is manipulated at an atomic or molecular level).

"What I've learnt from my career in science is that you have to be bold because the progress is so fast that what sounds futuristic now will become mundane five years later."

He and fellow researcher Andre Geim shot to fame when they were awarded the Nobel Prize for their groundbreaking achievements in graphene. Made up of a single layer of carbon atoms, graphene is the thinnest material discovered to date, yet it is hundreds of times stronger than steel.

Prof Novoselov joins the National University of Singapore (NUS) as distinguished professor of materials science and engineering on Monday.

While he will be based here full time, Prof Novoselov, who was born in Russia and has both Russian and British citizenships, will continue to have an academic presence at the University of Manchester, where his graphene breakthrough was made.

He will spend about 10 per cent to 15 per cent of his time there over the next three years, to work with his PhD students.

In Singapore, he says, "my task is to make this community even stronger, to create an even more dynamic and more stimulating environment".

This will include setting up clean rooms in the laboratory where scientists can manipulate materials just an atom thick, and measure their properties.

CREATING NEW MATERIALS

What really motivates me is working with my own hands and being able to make something which changes the world around me... I want to demonstrate to kids that you can really start with nothing and create a new material or something that nobody has seen before.

PROFESSOR KONSTANTIN NOVOSELOV

NUS senior deputy president and provost Ho Teck Hua notes: "We have done quite well in materials science, and Kostya, who is no stranger to us and has been working with us for years, will be the one to bring everything together."

He points out that NUS was at a stage of maturity where it did not need to seek out a "lone star". Prof Novoselov, he stresses, would fit right into the university's long-term plans.

"Materials science is a key area of focus for NUS. Kostya has the vision, scientific credentials and industry exposure that would add strength and depth to our efforts," says Prof Ho.

"He is at the cutting edge of the field, and we believe that his drive and energy will create a sustained impact on our ecosystem."

Prof Novoselov also plans to get students excited about science by giving talks to explain how science works.

"What really motivates me is working with my own hands and being able to make something which changes the world around me," he says. "I want to demonstrate to kids that you can really start with nothing and create a new material or something that nobody has seen before."

Which is exactly how graphene came about.

He and Prof Geim discovered graphene when they were doing something completely different – trying to investigate the electrical properties of graphite, another form of carbon.

"We tried many different ways of doing this, failed many times and just forgot about it. One day I saw scientists cleaning graphite with a piece of sticky tape, a known technique. I saw it, picked the tape up from the trash, and had a working transistor within a minute," says Prof Novoselov.

Transistors are tiny switches that can be triggered by electric signals, and a fundamental device at the heart of computing.

The flakes on the sticky tape were initially made up of many layers of graphene, and the duo realised that as they repeated this process many times, the flakes got thinner and thinner, finally leading to the one-atom-thick graphene.

"It is special, and it has presented me with a lot of opportunities... People listen to you for a change.

"I'm the same person as before; (it's) just that the weight of my opinions increased suddenly, so I have to think carefully about what I say," he says wryly.

On relocating to Singapore, he is worried neither about the weather, the food nor the school he will enrol his daughters in.

"That will sort itself out. The most important thing is the research."

ailien@sph.com.sg

Strong focus on materials science

Billions of dollars are being pumped into graphene research by institutes and companies worldwide. But long before it became a hot field, scientists in Singapore were already showing interest in it.

In fact, the Graphene Research Centre at the National University of Singapore (NUS) began operations almost a decade ago. This evolved into the $50 million Centre for Advanced 2-Dimensional Materials (CA2DM) in 2014.

NUS says that one of its research strengths is materials science, where scientists focus on studying nanostructured materials such as graphene, as well as the development of novel materials for use in sustainable energy, environmental engineering, infocommunications technology and biomedical technology.

In 2017, the university's materials scientists produced 1,053 publications and were granted 29 primary patents.

They have also been awarded the nation's top honours for their work, including the President's awards for science and technology.

CA2DM comprises teams of researchers from diverse backgrounds ranging from physics, chemistry and biotechnology, to electrical, computer, civil and environmental engineering.

It focuses on the study of the properties of new materials such as phosphorene and molybdenum disulfide.

Phosphorene is an ultrathin version of black phosphorous, with better thermal stability and conductivity than graphene.

Molybdenum disulfide is a compound with the ability to convert light into electricity, which could improve the efficiency of solar panels, digital cameras and a range of other devices.

Chang Ai-Lien

Where art and science mix

Beyond his highly noted work in physics, Professor Konstantin Novoselov is also an artist who trained in traditional Chinese painting in China.

Science and art are two sides of a coin, he notes, as both professions call for curiosity, a willingness to learn and imagination, as well as the ability to think outside the box.

He says the reductionist approach in traditional Chinese art ties in nicely with his physics background.

The search for a minimal solution – the most basic distribution of ink on the paper that is able to cause a particular mood – is very similar to his work as an experimental physicist, where his task is to pick, highlight and amplify the effect of interest.

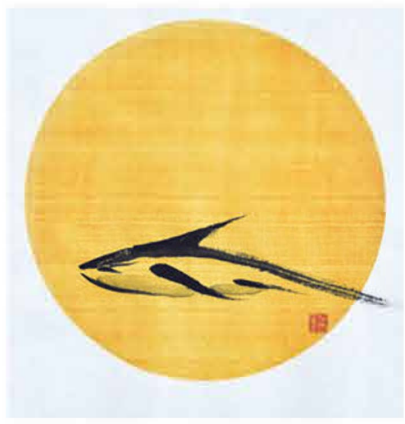
"For me, it's not the subject matter which is so important, but how you use ink and brush strokes to convey a mood," he explains.

In fact, he even uses his own invention, graphene, in ink in his paintings. It not only produces nice sheens of grey, but can also be used to encode secret information. He often collaborates with other artists on installations and exhibitions.

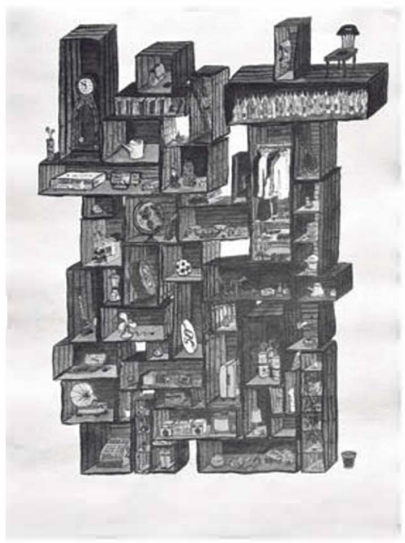
"The most exciting breakthroughs are often created at the crossroads between disciplines," he says.

"The same is applied to art as well, where new media and new techniques can result in very exciting developments."

Chang Ai-Lien



In this painting, Shark, done on rice paper with Chinese and graphene ink, Professor Konstantin Novoselov uses just a few deft strokes to depict the determined, slick and fast moves of the shark.



This painting, Time, was finished recently and will be displayed at an exhibition, Everything Is Connected, at a paper mill in Auvergne, France, in July. Explaining the thought process behind the work, done in Chinese and graphene ink on paper from the mill, Prof Novoselov says every living being is linked by time, which is irreversible. "It piles upon us, completely without any control, just like the random items piled together in the work."
PHOTOS: KONSTANTIN NOVOSELOV

CROSS-DISCIPLINARY BENEFITS

The most exciting breakthroughs are often created at the crossroads between disciplines. The same is applied to art as well, where new media and new techniques can result in very exciting developments.

PROFESSOR KONSTANTIN NOVOSELOV