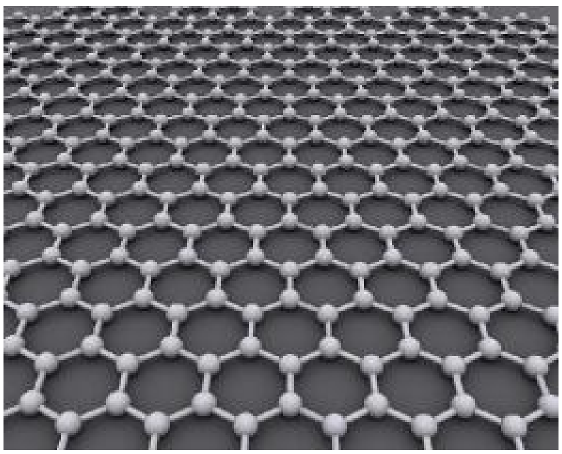
Bilayer graphene is another step toward graphene electronics

August 11 2011



Made of a single sheet of carbon atoms, graphene can be spun at the fastest rate of any known macroscopic object. Image credit: Wikimedia Commons.

The Nobel Prize winning scientists Professor Andre Geim and Professor Kostya Novoselov have taken a huge step forward in studying the wonder material graphene and revealing its exciting electronic properties for future electronic applications.

Writing in the journal *Science*, the academics, who discovered the world's thinnest material at The University of Manchester in 2004, have revealed more about the electronic properties of its slightly fatter cousin – bilayer graphene.

The researchers, from the universities of Manchester, Lancaster (UK), Nijmegen (the Netherland) and Moscow (Russia), have studied in detail the effect of interactions between electrons on the electronic properties of bilayer graphene.

They used extremely high-quality bilayer graphene devices which are prepared by suspending sheets of the material in vacuum. This way most of the unwanted scattering mechanisms for electrons in graphene could be eliminated, thus enhancing the effect of electron-electron interaction.

The latter could be seen as strong changes in the low-energy electronic spectrum – it becomes strongly anisotropic, or directionally dependent. This is the first effect of its kind where the interactions between electrons in graphene can be clearly seen.

The reason for such unique electronic properties is that quasiparticles (electrons and holes, which carry electric current) in this material are very different from those in any other metals. They possess chiral symmetry (a symmetry between electrons and holes) of the sort which exist between particles and antiparticles in high-energy physics.

Due to such properties graphene-based materials are sometimes called 'CERN on a desk' – referencing the Large Hadron Collider in Switzerland. This is just one of the reasons why the electronic properties are particularly exciting and often bring surprises.

Professor Geim and Professor Novoselov's pioneering work won them the Nobel Prize for Physics in 2010 for "groundbreaking experiments regarding the two-dimensional material graphene".

The pair, who have worked together for more than a decade since Professor Novoselov was Professor Geim's PHD student, used to devote every Friday evening to 'out of the box' experiments not directly linked to their main research topics.

One Friday, they used Scotch tape to peel away layers of carbon from a piece of graphite, and were left with a single atom thick, two dimensional film of carbon – graphene.

Graphene is a novel two-dimensional material which can be seen as a monolayer of carbon atoms arranged in a hexagonal lattice. When two layers of graphene are bonded in a certain manner, they form bilayer graphene – a very interesting and unusual material in its own right.

Both graphene and bilayer graphene possesses a number of unique properties, such as extremely high electron and thermal conductivities due to very high velocities of electrons and high quality of the crystals, as well as mechanical strength.

Professor Novoselov said: "The technology of graphene production matures day-by-day, which has an immediate impact both on the type of exciting physics which we find in this material, and on the feasibility and the range of possible applications." Professor Geim added: "High-quality bilayer graphene is certainly an exciting material in its own right, and it certainly has its own niche in applications."

Provided by University of Manchester

Citation: Bilayer graphene is another step toward graphene electronics (2011, August 11) retrieved 20 March 2024 from https://phys.org/news/2011-08-bilayer-graphene-electronics.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.