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MaterialsNews vom 18.12.2009

Druckansicht

Water droplets shape graphene nanostructures

Graphene -- A single-atom-thick sheet of carbon, like those seen in pencil marks -- offers great potential for new types of nanoscale devices, if a good way can be found to mold the material into desired shapes.

Chemists at the University of Illinois at Chicago say it's possible, reporting that graphene can become quite pliable using only a nanodroplet of water to do the job.

"Up until now, it wasn't thought we could controllably fold these structures," said Petr Král, assistant professor of chemistry at UIC. "But now we know how to shape graphene by using weak forces between nanodroplets carefully positioned on graphene sheets."

Král and two of his graduate students described the process in a recent article in Nano Letters, which is highlighted in Nature's "news and views" section Dec. 17.

Engineers already cut graphene into narrow ribbons and other shapes, expanding the set of carboneous systems such as fullerenes, carbon nanotubes and nano-diamonds. Using computer simulations, Král showed that weak molecular interactions called van der Waals forces between water nanodroplets and graphene can shape it into a wide variety of forms, without the water and graphene chemically binding.

"Depending on the size of the water droplet and the shape and size of graphene flake used, we can fold it in different shapes for various applications," said Král. "It's similar to the way proteins are folded in biological cells with the help of chaperone proteins."

Král and his students discovered they could use water droplets to roll, bend, slide and shape graphene into different complex structures such as capsules, sandwiches, knots and rings –- all potential building blocks of nanodevices with unique mechanical, electrical or optical properties. By using special techniques like atomic force microscopy and carefully guided microscopic needles, water droplets and other materials can be carefully positioned on graphene to shape it into desired forms, he says.

Král's laboratory is studying potential uses of nanoscale graphene, such as ways to coat it with phospholipid molecules that would allow it to become part of biological cell membranes where it might perform specific functions. His lab is also designing graphene sheet nanoscale pores that allow the building of novel ion and molecular separation membranes for use in desalination and other applications.

While the materials he works with are inorganic, Král sees a growing trend to developing hybrid multifunctional systems that combine inorganic nanostructures with biological cellular systems.

"We're trying to detect signals from the biological world or pass signals to the biological world," he said. "In the future, perhaps proteins will evolve to interact with inorganic systems. It's a way of evolution to form a new interface, or hybrid system, working together on novel functions."

Source: University of Illinois at Chicago - 17.12.2009.

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Atom
Ein Atom – von gr. atomos: unteilbar – ist der kleinste, mit chemischen Methoden nicht weiter teilbare, Baustein der Materie. Jedes Atom gehört zu einem bestimmten chemischen Element und trägt keine elektrische Ladung.

Carbon
Umgangssprachlicher Begriff zur Kennzeichnung von Materialien und Werkstoffen auf der Basis von kohlenstofffaserverstärkten Kunststoffen (CFK).

zum Glossar

Empfehlungen zum Thema

Understanding Carbon Nanotubes. From Science to Applications

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Springer, Berlin
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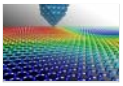
Possible Ordered States in Graphene Systems

der Technologie-Agentur Materialsgate

Mehr zu diesem Thema:

Graphene's electrical nature
20.11.2009

First, it was the soccer-ball-shaped molecules dubbed buckyballs. Then it was the cylindrically shaped nanotubes. Now, the hottest new material in physics and nanotechnology is graphene: a remarkably flat molecule made of carbon atoms arranged in hexagonal rings much like molecular chicken wire.

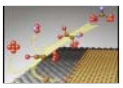


Not only is this the thinnest material possible, but it also is 10 times stronger than steel and it conducts electricity better than any other known material at room temperature. These and graphene's other exotic properties have attracted the interest of physicists, who want to study them, and nanotechnologists, who want to exploit them to make novel electrical and mechanical devices. "There are two features that make graphene exceptional," says Kirill Bolotin, who has just joined the Vanderbilt... mehr

- Forscher der Saar-Uni entwickeln neues Verfahren zur Graphen-Gewinnung
- Graphen und Galliumarsenid: Zwei perfekte Partner finden sich
- Graphene Shows High Current Capacity & Thermal Conductivity
- Scientists Observe and Manipulate Ripples in Graphene

Forscher der Saar-Uni entwickeln neues Verfahren zur Graphen-Gewinnung
14.10.2009

Kohlenstoff wird die Informationstechnologie revolutionieren. Vielleicht schon in einigen Jahren arbeiten die elektronischen Bauteile von Computern, die derzeit auf Silizium-Technologie basieren, mit einem Stoff, der aus einer Schicht von Kohlenstoff-Atomen besteht: Graphen.



Obwohl Kohlenstoff als Bestandteil nahezu jeder organischen Substanz universell verfügbar ist, war es bisher nicht möglich, Graphen großflächig zu gewinnen. Eine Arbeitsgruppe aus Chemikern und Physikern der Universität des Saarlandes hat nun ein grundlegend neues Verfahren entwickelt, mit dem graphenbeschichtete Oberflächen hergestellt werden können. Eine einzelne Lage von Kohlenstoff-Atomen, die sich wabenartig zu einem geordneten Gitter fügen: Dieser Stoff namens Graphen wird der Computertechnologie... mehr

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- Bilayer Graphene Gets a Bandgap

Graphen und Galliumarsenid: Zwei perfekte Partner finden sich
15.09.2009

Die PTB hat erstmals Graphen auf Galliumarsenid sichtbar gemacht - Kombination zweier einzigartiger Elektronikmaterialien gelungen.

Es ist die Heirat zweier Top-Kandidaten für die Elektronik der Zukunft, beide exzentrisch und äußerst interessant: Graphen, der eine Partner, ist ein extrem dünner Geselle und zudem noch sehr jung an Jahren. Erst 2004 gelang es, die einzige Lage Kohlenstoffatome gezielt herzustellen und zu untersuchen. Seine elektronischen Eigenschaften sind bemerkenswert, unter anderem weil sich seine Elektronen so ungeheuer schnell bewegen können. Ein perfekter Partner für Galliumarsenid, den Halbleiter... mehr

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Graphene Yields Secrets to Its Extraordinary Properties

Graphene Shows High Current Capacity & Thermal Conductivity
17.08.2009

Study Examined Graphene Nanoribbons as Narrow as 16 Nanometers

Recent research into the properties of graphene nanoribbons provides two new reasons for using the material as interconnects in future computer chips. In widths as narrow as 16 nanometers, graphene has a current carrying capacity approximately a thousand times greater than copper—while providing improved thermal conductivity. The current-carrying and heat-transfer measurements were reported by a team of researchers from the Georgia Institute of Technology. The same team had previously reported... mehr

Scientists Observe and Manipulate Ripples in Graphene
Bilayer Graphene Gets a Bandgap
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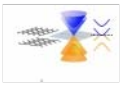
Faster Computers, Electronic Devices Possible After Scientists Create Large-Area Graphene on Copper

Bilayer Graphene Gets a Bandgap
16.06.2009

A tunable graphene bandgap opens the way to nanoelectronics and nanophotonics.



Graphene's electrical properties include electrons so mobile they travel at near light speed. But without a bandgap, graphene's promise for electronics and photonics can't be realized. Now researchers can precisely tune a bandgap in bilayer graphene from zero to the infrared. Graphene is the two-dimensional crystalline form of carbon, whose extraordinary electron mobility and other unique features hold great promise for nanoscale electronics and photonics. But there's a catch: graphene... mehr

Graphene Yields Secrets to Its Extraordinary Properties
Faster Computers, Electronic Devices Possible After Scientists Create Large-Area Graphene on Copper
Closest Look Ever at Graphene
Graphene Nanoelectronics: Making Tomorrow's Computers from a Pencil Trace

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