NOBEL PRIZE MATERIAL REQUIRES EXTREME PRECISION

Image The high temperature graphene process uses induction heating to fabricate the material as precise as possible.

Full control of both the product and the production process are requirements when you produce something that has to be exactly one atom thick. Graphensic AB in Linköping turned to the MAX IV Laboratory – and got unexpected useful information into the bargain.

Graphene is a material consisting of only one layer of carbon atoms arranged in a hexagonal pattern, which gives the material a number of unique properties. It is 200 times stronger than steel, it conducts electricity better than any other material and it can detect single molecules on its surface. After the discovery of graphene led to a Nobel Prize in 2010, the EU invested one billion Euros in a graphene flagship project that is to accelerate its development towards industrial application. Applications of graphene on silicon carbide include biosensors and superfast transistors.

Graphensic has developed a patented method of producing graphene on silicon carbide.

"When silicon carbide is heated up, it moves into the gaseous phase resulting in a residual layer of carbon atoms when the silicon leaves the surface", explains Mikael Syväjärvi, co-founder of Graphensic. "Our customers today are mainly within the research world, but industry is showing an interest and I expect it will take between five and ten years before graphene is used in common electronic products. In Sweden there is a graphene agenda working to ensure that Swedish industry is in a position to benefit from the opportunities offered by graphene."

DOUBLING PRODUCTION

The increased demand for the new super material puts pressure on production. Graphensic is currently producing 50 millimetre wafers, but will shortly be able to start production of wafers with double that diameter.

"The production of an atom-thick layer requires an extreme precision and must also, of course, be repeatable in our processes. Our measurements at the MAX IV Laboratory aimed to characterize our material on the basis of various production parameters by studying it in a completely controlled environment, using a powerful instrument to which we do not have access ourselves", says Mikael Syväjärvi.

A NEW PROCESS TO RECOMMEND

In addition to obtaining a better picture of the evenness and quality of the material in its production process, among other things, Mikael Syväjärvi got information from the experiments that could be fed back into Graphensic's procedures.

"It emerged that in storage, the material could acquire molecules from the surrounding air. It is not a process of oxidation which happens with many common materials, but rather that the molecules can rest in patches on the surface. These can be removed simply by warming up the material and we can now recommend this process to our clients if they store the products for a long time."

Image With the experiments performed at MAX IV Laboratory, Mikael Syväjärvi and his colleagues got a better picture of the evenness and quality of their material in its production process.

"Studying a material like graphene, which is only one atom thick, is extremely demanding on the instruments of analysis. The MAX IV Laboratory had both the methods of measurement and the knowledge required in order to produce the information we needed. It has helped us to quality assure the process and has led to the introduction of better production procedures."

Mikael Syväjärvi, co-founder of Graphensic AB

Fact box:

Graphensic visited the SPELEEM instrument at the I311 beamline at the MAX IV Laboratory. SPELEEM stands for "spectroscopic photoemission and low energy electron microscope" and offer scientists the possibility to produce both microscopy images with nanometer precision of various materials and at the same time investigate the chemical, structural and electronic properties of the surfaces.

Science Link is a network between leading research facilities of photon and neutron sources and its users. The project aims to support and encourage innovation and entrepreneurship in the Baltic Sea Region. Apart from the research facilities, the network also includes scientific institutes, universities and regional organisations that serve as service and promoting units. Science Link is part-financed by the European Union (Baltic Sea Region Programme) and involves 17 partners from 8 countries during the project period 2012 to 2014.

For further information visit science-link.eu

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Research facilities

DESY
HZB Helmholtz Zentrum Berlin
Helmholtz-Zentrum Geesthacht Centre for Materials and Coastal Research
MAX IV LABORATORY