Graphene: Taking the wonder-stuff from dream to reality

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A centre for research on graphene, a material which has the potential to revolutionise numerous industries, ranging from healthcare to electronics, is to be created at the University of Cambridge. The University has been a hub for graphene engineering from the very start and now aims to make this "wonder material" work in real-life applications.

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> —*Sir Leszek Borysiewicz*

The Cambridge Graphene Centre will start its activities on February 1st 2013, with a dedicated facility due to open at the end of the year. Its objective is to take graphene to the next level, bridging the gap between academia and industry. It will also be a shared research facility with state-of-the-art equipment, which any scientist researching graphene will have the opportunity to use.

The Centre's activities will be funded by a Government grant worth more than £12 million, which was allocated to the University in December by the Engineering and Physical Sciences Research Council (EPSRC). The rest of this money will support projects focusing both on how to manufacture high-quality graphene on an industrial scale, and on developing some of its potential applications.

Graphene is a one-atom thick layer of graphite with remarkable properties. It is exceptionally strong, yet also lightweight and flexible, enables electrons to flow faster than silicon and functions as a transparent conductor. Researchers in industry and academia are keen to harness its potential to make significant technological advances. This work might lead to numerous new devices and applications which could then be commercialised by industry and help to boost economic growth.

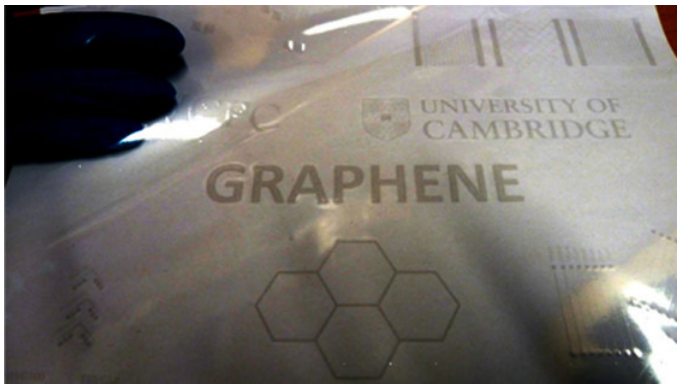

Image: Graphene is a one-atom thick layer of carbon atoms. Producing high-quality single layers in a manner compatible with industrial processes is just one of the challenges that researchers will be trying to surmount. The image shows a printed graphene device.

Credit: Andrea Ferrari.

There is still much to be done before that early promise becomes reality. The first job for those working in the Cambridge Graphene Centre will be to find ways of manufacturing and optimising graphene films, dispersions and inks so that it can be used to good effect.

Professor Andrea Ferrari, who will be the Centre's Director, said: "We are now in the second phase of graphene research, following the award of the Nobel Prize to Geim and Novoselov. That means we are targeting applications and manufacturing processes, and broadening research to other two-dimensional materials and hybrid systems. The integration of these new materials could bring a new dimension to future technologies, creating faster, thinner, stronger, more flexible broadband devices."

Professor Sir Leszek Borysiewicz, Vice-Chancellor of the University of Cambridge, said: "Graphene's potential is beyond doubt, but much more research is needed if we are to develop it to a point where it proves of benefit to society as a whole. The pioneering work of Cambridge engineers and scientists in fields such as carbon nanotechnology and flexible electronics, coupled with our record working with industry and launching spin-out firms based on our research, means that we are in a unique position to take graphene to that next level."

Professor Bill Milne, who will be part of the Centre's management group, said: "Graphene has amazing fundamental properties but at the moment we cannot produce it in a perfect form over large areas. Our first aim is to look at ways of making graphene that ensure it is still useful at the end of the process. We have to find modes of production that are consistently effective – and there is still a lot of work to be done in this respect."

One such project, led by Dr Stephan Hofmann, a Reader and specialist in nanotechnology, will look specifically at the manufacturability of graphene and other, layered, 2D materials. At the moment, sheets of graphene that are just one atom thick are difficult to grow in a controllable manner, manipulate, or connect with other materials.

Dr Hofmann's research team will focus on a growth method called chemical vapour deposition (CVD), which has already opened up other materials, such as diamond, carbon nanotubes and gallium nitride, to industrial scale production.

"The process technology will open up new horizons for nanomaterials, built layer by layer, which means that it could lead to an amazing range of future devices and applications," Dr Hofmann said.

The Government funding for the Centre is complemented by strong industrial support, worth an additional £13 million, from over 20 partners, including Nokia, Dyson, Plastic Logic, Philips and BaE systems. A further £11M of European Research Council funding will support activities with the Graphene Institute in Manchester, and Lancaster University.

Its work will focus on taking graphene from a state of raw potential to a point where it can revolutionise flexible, wearable and transparent electronics. The Centre will target the manufacture of graphene on an industrial scale, and applications in the areas of flexible electronics, energy, connectivity and optoelectronics.

Professor Yang Hao, of Queen Mary, University of London, will lead Centre activities targeting connectivity, so that graphene can be integrated into networked devices, with the ultimate vision of creating an "internet of things".

Professor Clare Grey, from Cambridge's Department of Chemistry, will lead the activities targeting the use of graphene in super-capacitors and batteries for energy storage. The research could, ultimately, provide a more effective energy storage for electric vehicles, storage on the grid, as well as boosting the energy storage possibilities of personal devices such as MP3 players and mobile phones.