Graphene: Potential of one carbon atom-thick wonder material has not escaped industry's radar

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Graphene FET Flagship is an ambitious European project focused on the eponymous new wonder material. Graphene, a one-atom thick layer of carbon, is light, transparent and strong, whose characteristics have yet to be fully discovered. The flagship project will receive one billion euros over a ten -year period to move graphene out of academic labs and into society, where its applications are expected to have a strong technological and economic impact.

Jani Kivioja, a Finnish scientist, who is a research leader at the Nokia Research Centre in Cambridge, UK, is leading the industrial activities within the project. His group looks to solve scientific challenges in order to transform the converging Internet and communications industry. Here, he talks to youris.com about what graphene can do for European citizens.

How was graphene discovered and by whom?

Graphene has in the scientific limelight since the first ground-breaking experiments in 2004. Andre Geim and Kostantin Novoselov at the University of Manchester are pioneers in graphene. They were recognised by the Nobel Prize in Physics in 2010. The first applications also saw daylight in 2010.

Nokia's research with graphene dates back to 2006. Our work has focused on both experimental and theoretical work on based batteries and supercapacitors, transparent flexible films, graphene transistors and sensors.

What applications may come from graphene?

Graphene is transparent but it is also extremely flexible yet still rigid and a very good conductor. It could be used to create products that are lighter, more robust, transparent, flexible and stretchable. And to make novel electronic and photonic devices possible. Key potential applications are, for instance, fast electronic and optical devices, flexible electronics, functional lightweight components and advanced batteries.

Examples of new products that could be enabled by graphene technologies include fast, flexible and strong consumer electronics such as electronic paper and bendable personal communication devices, and

lighter and more energy-efficient airplanes. In the longer term, graphene is expected to give rise to new computational paradigms and revolutionary medical applications, with one possibility being artificial retinas. It also has potential in spintronics, an emerging technology exploiting both the intrinsic degree of freedom of electrons, called spin, and its associated magnetic moment.

How can graphene be considered a platform technology?

Graphene has superior mechanical, electrical, thermal and optical properties versus any other known materials. Moreover, graphene has truly unique combinations of superior properties. All this will enable a multitude of applications in different fields. Furthermore, different applications could be realised by using the very same material, graphene, and graphene-related processes. This is what we mean when we say graphene is a platform technology.

What is the purpose of the FLAGSHIP project?

The mission of Graphene Flagship is to take graphene and related layered materials from academic laboratories and into society. Its objective is to revolutionise multiple industries and create economic growth and new jobs in Europe.

This research effort will cover the entire value chain from materials production to components and system integration. It also targets a number of specific goals that exploit the unique properties of graphene. For now there are lots of gaps in graphene manufacturing industries, but this will change.

There are some promising applications already. You can print electronics

using graphene inks, for example. But the technology will really have a big impact in future, five to ten years from now.

What potential benefits does this project offer to industry?

It is a unique opportunity for many businesses, allowing them to engage with academia to jointly create European graphene industries, offering the prospect of increased economic growth and new employment opportunities.

Nokia is interested in graphene, but cannot do everything by itself and we and other industries can benefit from an improved supply chain. Also, Nokia can give a lot to this project. Often large publicly funded projects tend to be quite academic where applications and impact is not so clear. But my role and Nokia's role here is to makes sure that the project impacts the whole of Europe through its future applications.

Are there challenges to using graphene industrially on a mass product like this?

Graphene technology is still in its infancy and coordinated large-scale research is needed, but if the same progress continues we expect to see some pretty amazing things in the not-too-distant future. Global investments in graphene technology are in the billions of dollars, but the supply chain structure is still developing. And proper standardisation of graphene-derived applications is also needed before mass products reach the market.

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