GRAPHENE FLAGSHIP

PRESS RELEASE

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Graphene shows unique potential to exceed bandwidth demands of future telecommunications

Graphene enables ultra-wide bandwidth communications coupled with low power consumption, with potential to surpass the needs of 5G, IoT and Industry 4.0.

- **Graphene Flagship industrial and academic partners published a new paper in "Nature Reviews Materials" analysing the possibilities of graphene in the internet of everything market, expected to reach over 12 billion connected devices in 2020**
- **This collaboration between international research centres and leading companies like Nokia and Ericsson concludes that graphene offers a unique evolutionary pathway for next-generation communications**

Researchers within the Graphene Flagship project, one of the biggest research initiatives of the European Commission, showed that integrated graphene-based photonic devices offer a unique solution for the next generation of optical communications. Researchers in the initiative have demonstrated how properties of graphene enable ultra-wide bandwidth communications coupled with low power consumption to radically change the way data is transmitted across the optical communications systems. This could make graphene-integrated devices the key ingredient in the evolution of 5G, the Internet-of-Things (IoT), and Industry 4.0. The findings were published in Nature Reviews Materials and highlighted on the cover.

"As conventional semiconductor technologies are approaching their physical limitations we need to explore entirely new technologies to realise our most ambitious visions of a future networked global society," explains Wolfgang Templ, Department Head of Transceiver Research at Nokia Bell Labs in Germany, which is a Graphene Flagship partner. "Graphene promises a significant step in performance of key components for optical and radio communications beyond the performance limits of today's conventional semiconductor-based component technologies."

Paola Galli, Nokia IP and Optical networks Member of Technical Staff, agrees: "Graphene photonics offer a combination of advantages to become the game changer. We need to explore new materials to go beyond the limits of current technologies and meet the capacity needs of future networks."

The Graphene Flagship presents a vision for the future of graphene-based integrated photonics, and provides strategies for improving power consumption, manufacturability and wafer-scale integration. With this new publication, the Graphene Flagship partners also provide a roadmap for graphene-based photonics devices surpassing the technological requirement for the evolution of datacom and telecom markets driven by 5G, IoT, and the Industry 4.0. "Graphene integrated in a photonic circuit is a low cost, scalable technology that can operate fibre links at a very high data rates," said Marco Romagnoli, from Graphene Flagship partner CNIT, the National Interuniversity Consortium for Telecommunications in Italy.

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Antonio D'Errico from Graphene Flagship partner Ericsson Research explains how "graphene for photonics has the potential to change the perspective of information and communications technology in a disruptive way." "This paper published on Nature Reviews Materials explains how to enable new feature rich optical networks. I am pleased to say that this fundamental information is now available to anyone interested around the globe," he adds.

This industrial and academic partnership, comprising companies and research centres in five different European countries, has developed a compelling vision for the future of graphene photonic integration. The team involves researchers from CNIT, Ericsson, IMEC, Nokia, Nokia Bell Labs, AMO, ICFO and the University of Cambridge. These collaborations are at the heart of the Graphene Flagship, set up by the European Commission to support the commercialisation of graphene and related materials until 2023. "The Graphene Flagship is a unique ecosystem in which industrial and academic partners work together for a longer period than a normal EU project. This synergy over an enduring term produces unprecedented results both in science and innovation," comments Romagnoli.

"Collaboration between industry and academia is key for explorative work towards entirely new component technology. Research in this phase bears significant risks, so it is important that academic research and industry research labs join the brightest minds to solve the fundamental problems. Industry can give perspective on the relevant research questions for potential in future systems," adds Templ of Nokia Bell Labs. "Thanks to a mutual exchange of information we can then mature the technology and consider all the requirements for a future industrialization and mass production of graphene-based components."

"This case exemplifies the power of graphene technologies to transform cutting edge applications in telecommunications. We already start to see the fruits of the Graphene Flagship investments when moving from materials development towards components and system level integration," explains Kari Hjelt, Head of Innovation for the Graphene Flagship.

Graphene photonics offers advantages in both performance and manufacturing over the state of the art. Graphene can ensure modulation, detection and switching performances meeting all the requirements for the next evolution in photonic device manufacturing. "We aim for highly integrated optical transceivers which will enable ultra-high bitrates well beyond one terabit per second per optical channel. These targeted systems will differentiate from their semiconductor-based forerunners by substantially lower complexity, energy dissipation and form factor going along with a higher flexibility and tunability," explains Templ.

Daniel Neumaier from Graphene Flagship partner AMO GmbH, also leader of the Graphene Flagship Division on Electronics and Photonics Integration, adds: "Optical communication links will become more and more important in 5G for supporting the required high data rates at all nodes. Graphene-based optical components integrated on a silicon platform will be able to deliver both increased performance and a low-cost production process, thus are expected to become key components in the 5G era."

"This paper makes a clear case of why an integrated approach of graphene and silicon-based photonics can meet and surpass the foreseeable requirements of the ever-increasing data rates in future telecom systems," says Andrea C. Ferrari, professor at the University of Cambridge, Science and Technology Officer of the Graphene Flagship and Chair of its Management Panel. "The advent of the Internet of Things and the 5G era represent unique opportunities for graphene to demonstrate its ultimate potential," he concludes.

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Reference

Graphene-based integrated photonics for next-generation datacom and telecom.
M. Romagnoli, V. Sorianello, M. Midrio, F. H. L. Koppens, C. Huyghebaert, D. Neumaier, P. Galli, W. Templ, A. D'Errico, A. C. Ferrari.
Nature Reviews Materials, **3**, 392-414 (2018). DOI: 10.1038/s41578-018-0040-9.

About the Graphene Flagship

The Graphene Flagship is one of the largest research initiatives of the European Union. With a budget of €1 billion, it represents a new form of joint, coordinated research initiative on an unprecedented scale. The overall goal of the Graphene Flagship is to take graphene and related materials from the realm of academic laboratories into European society, facilitating economic growth and creating new jobs, in the space of ten years. Through a consortium that combines nearly 150 partners, both academic and industrial, the research effort covers the entire value chain, from materials production to components and system integration, and targets several specific goals that exploit the unique properties of graphene and related materials.

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