Ultra-fast Graphene Photodetectors

Results in Brief

Graphene-based solutions for cutting-edge computing

Demonstrating the feasibility of developing graphene-based electronics could help to establish Europe as a world leader in next-generation semiconductors.

DIGITAL ECONOMY

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Graphene is a carbon-based material that offers outstanding properties, including strength, flexibility, transparency, broadband absorption and conductivity. It holds significant potential for the development of next-generation electronics and photonics.

Graphene-based devices for example could be faster and lighter than existing devices made from silicon, germanium and gallium arsenide.

A key challenge however has been the integration complexity and scalability of production to meet commercial demands. This to date has limited the applicability of graphene in this particular industrial sector.

Benefits of graphene-based photodetectors

The objective of the EU-funded ULTRAPHO project was to overcome these concerns by demonstrating the feasibility and attractiveness of producing a type of graphene-based device called a photodetector. These are high-speed sensors in electronic devices that convert the photon energy of light into an electrical signal.

“Photodetectors are found, for example, in data centres,” explains ULTRAPHO project coordinator Amaia Zurutuza from Graphenea in Spain.

A data centre is a large group of networked computer servers, which are typically used by organisations and authorities for the remote storage, processing and distribution of large amounts of data.

“This is where all data communication takes place,” adds Zurutuza. “Every time you send an email, use the internet or watch a movie online, you are using photodetectors.”

A key issue with data centres is that the scale of computation going on generates enormous amounts of heat. This in turn requires huge amounts of energy to stay cool.

One solution here could be to use graphene to make photodetectors. “Graphene is a material with superior optical and electrical properties and could be used to make high-speed devices that produce much less heat,” says Zurutuza. “This could be a game changer in the future.”

Built and tested at industrial scale

The ULTRAPHO project set out to build a graphene-based photodetector, to demonstrate that this could be achieved at an industrial scale. To achieve this, the project created a consortium of SMEs, each with a specific area of expertise.

“The first step was to produce different kinds of graphene materials,” notes Zurutuza.

“These were produced at what we call the wafer scale, which is what the semiconductor industry uses. These wafers are typically 200 mm or 300 mm. We developed graphene wafers 200 mm in size, which is at industrial scale.”

Next, the graphene was processed, and a photodetector designed. The prototype was then engineered and tested to ensure that it was compatible with other critical electronic elements such as microchips and optical fibres.

Commercialising new photodetector products

The project was successful in demonstrating the feasibility of building graphene-based photodetectors at industrial scale, and helping to move the technology ever closer towards eventual commercialisation.

“We were able to show that this is possible,” adds Zurutuza. “The technology will still

take several years to mature, but we have shown that we can build this at the industrial scale, and this is an important first step."

Another key success was the positive collaboration between the project's four partners. Several partners have continued to work together, with the aim of eventually commercialising graphene-based photodetector products.

"We were also able to identify other potential electronic functions," says Zurutuza. "Modulators (which control the intensity of light to encode data) could also be built using graphene – this finding was another nice outcome of the project."

Keywords

ULTRAPHO | graphene | electronics | photodetectors | semiconductor | computer

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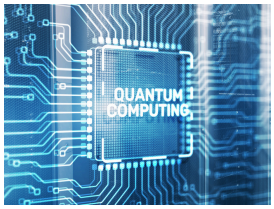

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Project Information

ULTRAPHO

Grant agreement ID: 971398

Project website

DOI
10.3030/971398

Project closed

EC signature date
29 April 2021

Start date
1 May 2021

End date
31 October 2023

Funded under
Horizon 2020 Framework Programme

Total cost
€ 3 937 398,75

EU contribution
€ 2 984 842,50

Coordinated by
GRAPHENEA SEMICONDUCTOR SL
Spain

Last update: 15 March 2024