

By: Tom Foley

Graphene Flagship

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## Graphene-based biomedical technologies

*Graphene Flagship team developing methods to treat neurological diseases such as epilepsy and Parkinson's.*

Graphene Flagship Package designs devices to manage diseases of the nervous system using various types of graphene and layered



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They worked with Graphene Flagship industrial partners to launch two commercial products by the end of the Core 2 phase. This is a great achievement, as the Graphene Flagship [roadmap](#) predicted applications in medical technology by 2023 to 2024. In addition, they are now performing the first in-human clinical trials of graphene-based neural interface devices. These activities show that the Work Package is at the cutting edge of this exciting technological field.



Partner company Guger Technologies, Austria, developed a biosignal amplification and acquisition system that enables recording from graphene transistors. The device has a TRL of 7, meaning their prototype has been demonstrated in an operational environment. Multi Channel Systems, also a Graphene Flagship partner, used graphene-based neural probes and headstages to develop headstages: all-in-one solutions for amplifying, recording and analysing data in living organisms or cells. The devices have a TRL of 8, showing that the devices are complete and qualified. They plan to market the devices in 2021.

## Their story

The Work Package was established three years after the Graphene Flagship's inception. Initially, the Graphene Flagship focused more on physics and materials, so graphene's biomedical applications came along a bit later. However, the great potential of graphene



In these four years, the work package focused on investigating several graphene and layered material-based applications in the central and peripheral nervous system. Their goal was to identify the most promising applications of these materials in the field.

In Core 3, their focus is to further raise the [technology readiness level](#) (TRL) of their devices for selected, targeted areas, ensuring they are adopted by clinics and industry. To reach this goal sooner, they work closely with a Business Developer focused exclusively on this field. The Graphene Flagship's industrial and clinical partners are becoming increasingly important for Biomedical Technologies.

## Their research

The applications of their research in the field of neuroscience are already moving forward. For instance, two industrial partners of the Work Package, [Multi Channel Systems GmbH](#), Germany, and [Guger Technologies OG](#), Austria, launched commercial products developed within the Work Package.

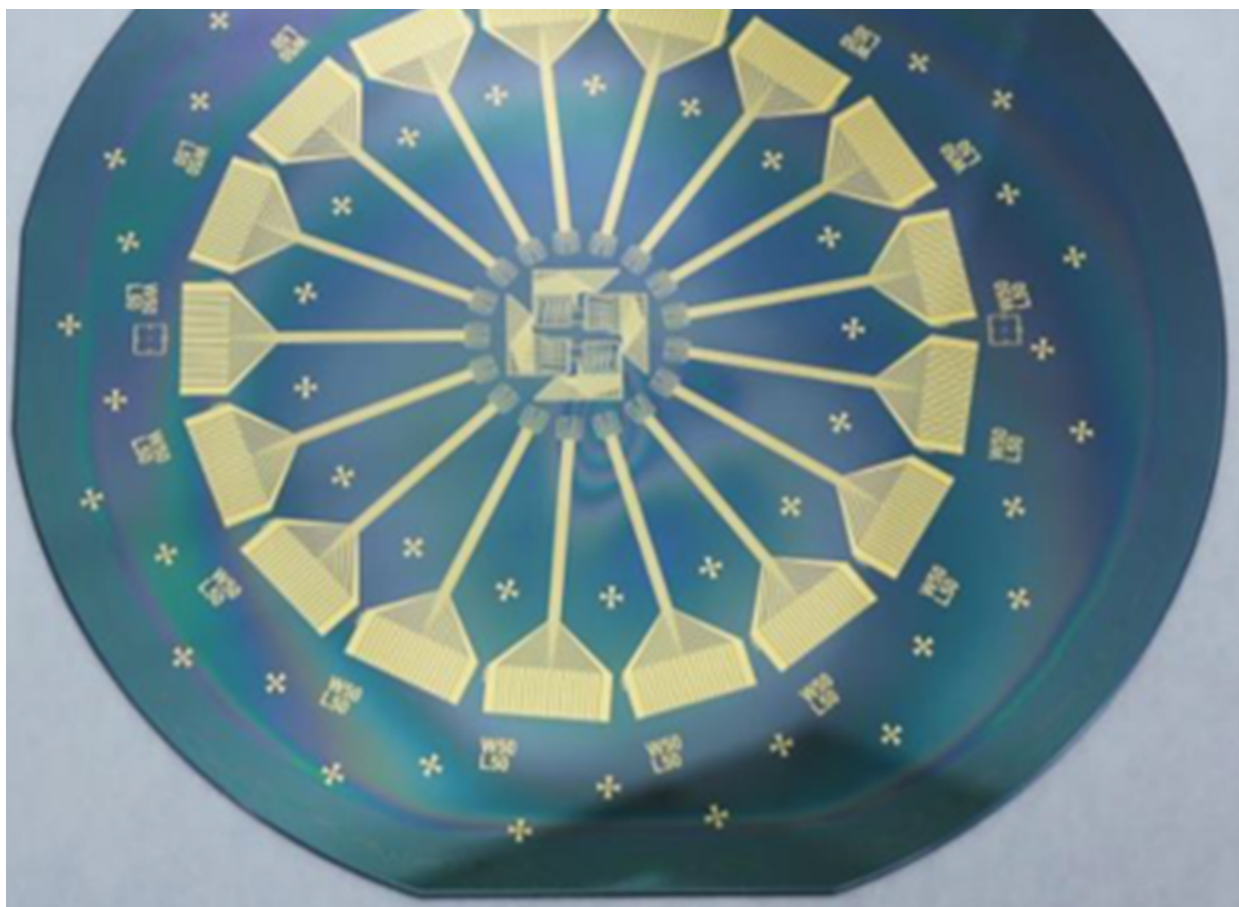
Now, they aim to design graphene-enabled sensors that record seizures in patients with epilepsy. Together with partners ICN2 and ICREA, they launched spin-off company [INBRAIN Neuroelectronics](#), which will use this graphene-enabled technology to detect seizures moments before they happen, with greater precision than current technologies.

In addition, they are investigating how graphene can improve the electrical stimulation of neuronal circuits to rehabilitate patients with blindness or Parkinson's. This technology could open the door to brain-machine interfaces that reintroduce lost brain function.





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The scientific output of our work Package directly contributes to the UN's [Sustainable Development Goal 3](#): ensuring healthy lives. Furthermore, through our conscious and ethical hiring, purchasing and waste disposal practices, we also ensure that our research meets SDGs 5, 8 and 12: for gender equality, sustainable economic growth and sustainable production.

## Their impact

They launched the first graphene-based neural interface device, in collaboration with Graphene Flagship partner Multi Channel Systems, aimed at the neuroscience market. This development will allow neuroscientists around the world to use graphene for their own research, and lead to new discoveries about the human brain beyond the scope of the project.

An additional and remarkable accomplishment during such a challenging year was the



Their technologies have all significantly benefited from the synergy with other Work Packages enabled by the Graphene Flagship. They all belong to the same large consortium, meaning they can easily communicate with each other, sharing know-how, results and more. In this way, close interactions with other teams working on materials, electronics and industrialisation have accelerated the maturity of this Work Package's technology.

## Their future

In Core 3, the Work Package's objectives have advanced considerably – to the point that several companies are now involved with commercialising their graphene-enabled products, or commencing investigations in clinical settings. In a few years, they are pleased to have achieved many of their short-term goals.

But their ambitious long-term objectives, like using electrical stimulation to rehabilitate patients, will require long-term studies to assess safety and efficacy. These technologies are poised to be included in medical devices expected to last several decades, so it is important for them to be safe and durable. Therefore, in this funding phase, they expect to provide proof-of-concept devices ready to enter clinical trials. These studies will also provide highly valuable information on graphene's performance in a real clinical setting.

**Now we are performing the first in-human clinical trials of graphene-based neural interface devices. We are at the cutting edge of this technological field."**

**Kostas Kostarelos**



## ***Author bio***



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Science Writer and Communications Coordinator for the Graphene Flagship



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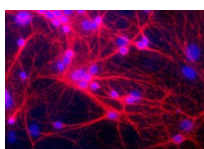




**The CEO** of INBRAIN Neuroelectronics, Carolina Aguilar, talks about using graphene-based implants to treat patients with brain disorders



**Graphene Flagship** researchers in Italy have discovered that graphene nano-tools can trigger bone formation in a mouse experiment. They hope the discovery will someday have a clinical application.



**The Graphene** Flagship has dedicated a considerable amount of time and resource to develop a safe approach to use and handle graphene and related materials. By integrating this approach at every level the Graphene Flagship aims to engineer out risks

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## About

The Graphene Flagship is part of the European Union's biggest scientific research initiative. With a budget of €1 billion, the project represents a new form of joint,







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