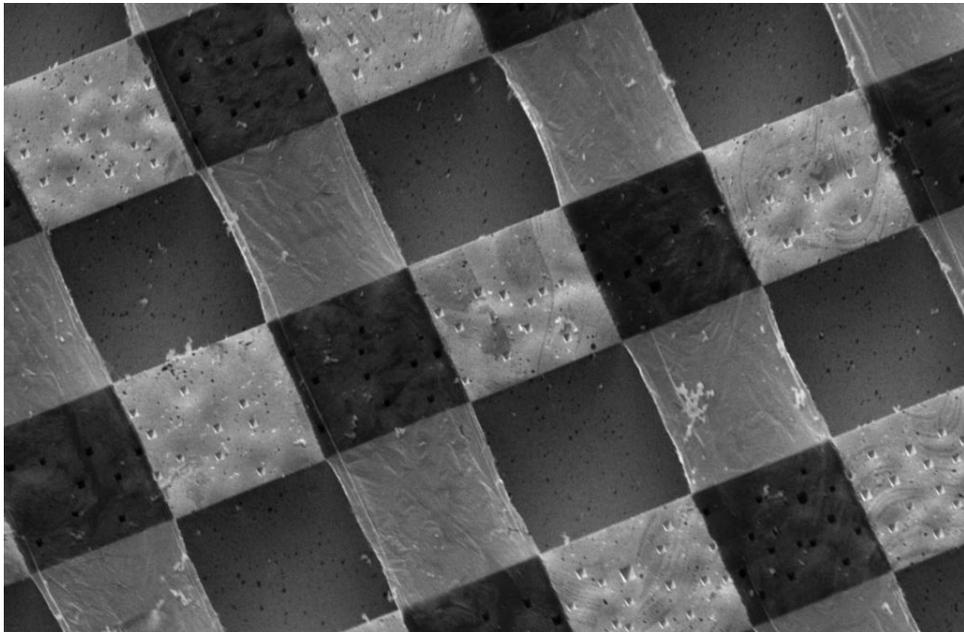


PRESS RELEASE

Graphene carpets: so neurons communicate better

Research by SISSA reveals that graphene can strengthen neuronal activity, confirming the unique properties of this nanomaterial. The study has been published on *Nature Nanotechnology*



Trieste, 12 June 2018

A work led by SISSA and published on *Nature Nanotechnology* reports for the first time experimentally the phenomenon of ion ‘trapping’ by graphene carpets and its effect on the communication between neurons. The researchers have observed an increase in the activity of nerve cells grown on a single layer of graphene. Combining theoretical and experimental approaches they have shown that the phenomenon is due to the ability of the material to ‘trap’ several ions present in the surrounding environment on its surface, modulating its composition.

Graphene is the thinnest bi-dimensional material available today, characterised by incredible properties of conductivity, flexibility and transparency. Although there are great expectations for its applications in the biomedical field, only very few works have analysed its interactions with neuronal tissue.

A study conducted by SISSA – Scuola Internazionale Superiore di Studi Avanzati, in association with the University of Antwerp (Belgium), the University of Trieste and the Institute of Science and Technology of Barcelona (Spain), has analysed the behaviour of neurons grown on a single layer of graphene, observing a strengthening in their activity. Through theoretical and experimental approaches the researchers have shown that such behaviour is due to reduced ion mobility, in particular of potassium, to the neuron-graphene interface. This phenomenon is commonly called ‘ion trapping’, already known at theoretical level, but observed experimentally for the first time only now. “It is as if graphene behaves as an ultra-thin magnet on whose surface some of the potassium ions present in the extra cellular solution between the cells and the graphene remain trapped. It is this small variation that determines the increase in neuronal excitability” comments Denis Scaini, researcher at SISSA who has led the research alongside Laura Ballerini.

The study has also shown that this strengthening occurs when the graphene itself is supported by an insulator, like glass, or suspended in solution, while it disappears when lying on a conductor. “Graphene is a highly conductive material which could potentially be used to coat any surface. Understanding how its behaviour varies according to the substratum on which it is laid is essential for its future applications, above all in the neurological field” continues Scaini, “considering the unique properties of graphene it is natural to think for example about the development of innovative electrodes of cerebral stimulation or visual devices”.

It is a study with a double outcome. Laura Ballerini comments as follows: “This ‘ion trap’ effect was described only in theory. Studying the impact of the ‘technology of materials’ on biological systems, we have documented a mechanism to regulate membrane excitability, but at the same time we have also experimentally described a property of the material through the biology of neurons.”

The work has been carried out within the *Graphene Flagship* supported by the European Union.

FULL PAPER

<https://www.nature.com/articles/s41565-018-0163-6.pdf>

IMAGE

"Scanning electron microscopy image of suspended graphene foils"

Credit: TASC-IOM @ AREA Science Park, Trieste

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