Graphene activates immune cells helping bone regeneration in mice

A team of Italian researchers from the European consortium Graphene Flagship has discovered that graphene nano-tools can trigger bone formation in a mouse experiment. They hope the discovery will someday have a clinical application.

Sergio Ferrer 27/11/2019 08:00 CEST

Laboratory mouse. / Pixabay

Graphene has been used for many years in the aeronautics and automotive industries and is even used to create new composites. However, it still has a long way to go to offer the consumer the revolutionary applications promised since its discoverers, Andre Geim and Konstantin Novoselov, received the Nobel Prize in Physics in 2010.

A team of researchers from several Italian universities, within the **Graphene Flagship** consortium, intends to change this and apply it to **regenerative medicine** therapies.

These nanosystems can improve bone regeneration, a process that requires

interaction between immune and skeletal cells.

Publications about the **biomedical applications** of graphene-based materials have increased in recent years. So says the researcher from the **University of Padua** (Italy) **Lucia Gemma Delogu**, who considers that this is due to its "incredible" physicochemical properties, a long list that ranges from its high flexibility and resistance to its good conductivity, both electrical and thermal.

Delogu and her team have worked to take advantage of the material in the field of biomedicine. Their study, published this year in the *Nanoscale* journal, shows how the immune properties of graphene allow bone tissue to regenerate in mice. This is possible through nano-tools that can activate or deactivate the immune response, an approach that is of great interest for cancer therapies and tissue engineering.

"Graphene-based **nanosystems** can improve **bone regeneration**, a complex process that requires interaction between immune and skeletal cells," Delogu explains to Sinc. In the study, the researchers combined a type of graphene oxide with calcium phosphate, a substance capable of activating this regeneration.

"The injection of the nanosystem into the **tibia** of **mice** showed an improvement in the bone mass in the area and in bone formation, suggesting that the combination is capable of activating monocytes to induce osteogenesis," continues the researcher.

How does the body respond to graphene?

Delogu is also the coordinator of the G-Immunomics project, whose objective is to analyse the impact of graphene on the health of living beings, with a view to its possible biomedical applications. The project is part of the Graphene Flagship, a European consortium of more than 150 research centres and companies, with a budget of 1,000 million euros and the goal of taking graphene out of laboratories.

"The use of graphene in biomedicine seeks to revolutionize medical protocols with new theranostic approaches," a concept that merges the terms "therapy" and "diagnosis" in the context of **personalized medicine**. "If

we learn how graphene interacts with our immune system, we will be able to explore much more specific **therapies** for the treatment of diseases," she says.

The researcher explains that these interactions are complex, so it is still "an image that lacks several colours." By injecting a nanomaterial, it comes into contact with the immune cells in the blood, which means that studying the impact of graphene on the immune response is "fundamental".

For this reason, Delogu's team is also studying how graphene can stimulate or suppress the immune response. "Our research wants to show a broad picture of the interaction of immune cells in blood with 2D materials such as those based on graphene," with the ultimate goal of their possible to apply in biomedicine efficiently but also safely.

The method could be applied in the future to combat bone loss suffered by astronauts due to lack of gravity

Graphene against osteoporosis

Diseases related to bone loss, such as osteoporosis, are a problem for millions of people worldwide. The World Health Organisation estimates that, in Europe alone, 22 million women and 5.5 million men aged 50-84 suffer from osteoporosis.

"Our preclinical research reveals that functionalized graphene may offer a medical opportunity to fight these bone-related diseases," says Delogu. "By promoting bone regeneration, they could also be used to improve the healing of bone wounds and shorten their duration."

Even, she says, to combat bone loss suffered by **astronauts** due to lack of gravity. Indeed, Delogu is involved in the project "WHISKIES" recently funded by the European Space Agency.

For all these reasons, she is confident that graphene can a have a future in biomedicine "We are at an early stage, but we hope that the work will open the door to real clinical applications for graphene-based nanomaterials," she says. Her dream is to explore the immunological potential of graphene in

other fields of **regenerative medicine**.

Sinc agency participates in the **SCOPE European project** coordinated by FECYT and financed by the European Union through Horizon 2020. The objectives of SCOPE are to communicate visionary research results from projects associated with the **Graphene Flagship** and the **Human Brain Project**, as well as to promote and strengthen relations within the scientific community of the Future and Emerging Technologies Emblematic Research Initiatives (FET Flagships) in the EU.

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