PRESS RELEASE

Artificial proteins for fast, sustainable and biocompatible energy devices

CIC biomaGUNE, BCMaterials and CIC energiGUNE have achieved a type of protein able to transport and store electricity

Conductive proteins are of particular interest for developing bioelectronic devices, such as pacemakers, implantable glucose sensors and brain electrodes

Donostia – San Sebastian. 5 November, 2025. Researchers at the CIC biomaGUNE, BCMaterials and CIC energiGUNE Basque research centres have managed to modify a class of proteins to give them the ability to transport and store electricity. These proteins can be used to create sustainable, efficient and biocompatible conducting materials. These materials are highly stable and easy to process, which means they can be incorporated into industrial processes.

The study, led by Aitziber L. Cortajarena (Ikerbasque Research Professor and scientific director of CIC biomaGUNE), Reyes Calvo (Ikerbasque Research Professor at BCMaterials) and Maica Morant (senior researcher at CIC EnergiGUNE), has been published in the prestigious journal *Advanced Materials*, and comes within the framework of the e-PROT project, which has received funding from the European Union's Horizon 2020 Research and Innovation Programme.

The proteins used in this work were designed in the lab. "They are made up of small, repeated units that are assembled one by one like LEGO bricks. Each 'brick' has the same overall shape, and when fitted one after the other, a larger, ordered, stable and modular structure is built. This structure makes them more useable, as they can be provided with specific functions without altering their structure, which renders them tailor-made.

In this case, the team of researchers were seeking to get the protein to conduct electricity efficiently. To achieve this, they genetically modified the DNA, which contains the instructions for producing the protein.

The future of energy storage devices

The changes made to the protein facilitated the movement of ions within the material, and thanks to this ionic conduction property, the proteins were successfully incorporated into an efficient energy storage device capable of storing and releasing energy very quickly.

Going forward, these conducting, protein-based materials could replace the traditional conducting materials used in batteries and supercapacitor devices, which would make them much safer for the human body. Conductive proteins are of particular interest for the development of bioelectronic devices, such as pacemakers,

implantable glucose sensors, and brain electrodes used to treat diseases such as Parkinson's.

The results of this study are opening the door to the next generation of energy storage devices based on sustainable, safe and inherently biocompatible materials.

In fact, it is no longer difficult to imagine a future in which energy can be stored sustainably. A world in which phones, fitness trackers and other portable devices run on energy stored in biodegradable, sustainable and safe materials. Scientific research is closer than ever to making this vision a reality.

About CIC biomaGUNE

The Center for Cooperative Research in Biomaterials CIC biomaGUNE, member of the Basque Research and Technology Alliance (BRTA), is a not-for-profit research centre located in Donostia and which conducts state-of-the-art research at the interface between Chemistry, Biology and Physics, devoting particular attention to studying the properties of biological nanostructures at the molecular scale, and their biomedical applications. It was recognised in 2018 as a "María de Maeztu" Unit of Excellence for meeting requirements of excellence, which are characterised by a high impact and degree of competitiveness in its field of activity on the global scientific stage.

About CIC energiGUNE

CIC energiGUNE is a leading research centre in both electrochemical energy storage and conversion and thermal energy storage and conversion. During its 14-year-long existence, CIC energiGUNE has positioned itself as one of the main international leaders in the field of solid-state batteries and has become the leading reference in southern Europe in energy storage. It is also part of the Basque Research & Technology Alliance (BRTA).

Since it was set up in 2011, CIC energiGUNE has participated in 303 R&D projects, of which more than 40 are European; it has over 1,000 scientific publications and has developed more than a hundred projects in collaboration with industry, thus contributing towards increasing the competitiveness of their products and services. For this purpose, CIC energiGUNE has various unique facilities, featuring its prototyping and testing infrastructure for electrochemical storage (including solid-state batteries for the automotive industry) and thermal storage.

About BCMaterials

BCMaterials, Basque Center for Materials, Applications and Nanostructures is dedicated to scientific research into new materials capable of being converted into

(multi)functional solutions and devices for the benefit of society. Set up in 2012 with the momentum of the University of the Basque Country (EHU) and the Basque Foundation for Science - Ikerbasque, it is one of the Basque Country's nine BERCs (Basque Excellence Research Centres). BCMaterials explores and develops new materials with applications in the environment (cleaning and monitoring), energy (generation and storage), biotechnology and biomedicine, plus digitalisation and new devices.

Located on the EHU's Science Campus in Leioa, the centre currently has 125 researchers, annually it participates in and/or manages about a hundred research projects, and produces about 250 scientific papers a year.

Bibliographic reference

Juan David Cortés-Ossa, Paolo Blesio, Marcial Fernandez-Castro, Lisa Almonte, Maxence Fernandez, Mantas Liutkus, Perumal Pandurangan, Carlos Sabater, Aitor Villaverde, Manuel Melle-Franco, Nurit Ashkenazy, Felipe Jiménez-Ángeles, M. Carmen Morant-Miñana, M. Reyes Calvo, Aitziber L. Cortajarena

Engineered protein-based ionic conductors for sustainable energy storage applications

Advanced Materials

DOI: 10.1002/adma.202508838

Photo captions:

1 - The modified proteins are deposited onto electrodes for their conductivity to be characterized. Acknowledgements: CIC biomaGUNE.

2 - Conductive proteins are integrated into an energy storage device. Acknowledgements: CIC energiGUNE.

3 - Juan David Cortés, a Pre-PhD researcher at BCMaterials recruited by the eProt project, exploring the conductivity of films formed by modified proteins. Acknowledgements: BCMaterials.