



**PATENT OPPORTUNITY**

**NOVEL METAL ION CAPACITOR ENABLES  
HIGHER POWER AND ENERGY CAPABILITIES  
USING INDUSTRIALLY COMPATIBLE  
FABRICATION PROCESS**

CIC  
**energi**  
GUNE

MEMBER OF  
BASQUE RESEARCH  
& TECHNOLOGY ALLIANCE

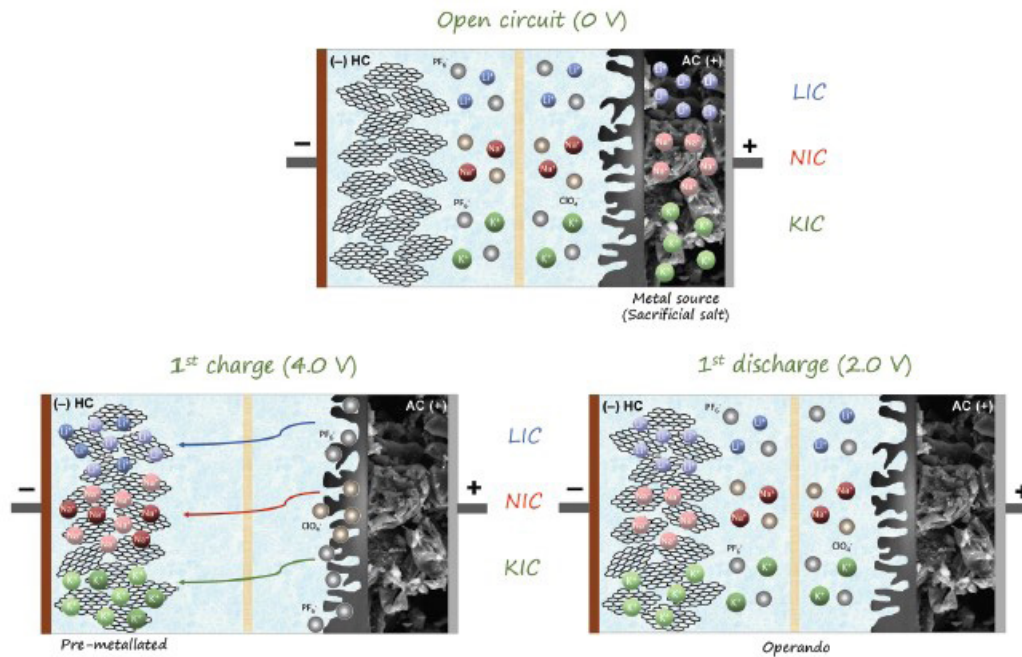
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## **PATENT NUM: WO2021/140149 A1**

Researchers at CIC energiGUNE have developed a **new metal ion capacitor with outstanding power capabilities** comprising a **negative electrode** based on **hard carbon**, and a **positive electrode** based on a combination of **activated carbon with a highly efficient and industrially compatible low-cost sacrificial salt**.

The sacrificial salt enables the efficient compensation of the high irreversibility of the hard carbon by providing the metal-ions necessary for the formation of solid electrolyte interphase, allowing for a 1:1 and superior mass balances between anode and cathode.

The successful fabrication of a lithium-ion capacitor pouch cell prototype with high energy at high power densities showing, on one hand, **capacitance retention over 84% after 1500 h floating at 3.8V and 50°C**, and the other hand, **more than 100.000 cycles at room temperature** validates the strategy. Furthermore, the extraordinary performance of this approach is not limited only in lithium-ion capacitors but also in other metal-ion capacitors such as **sodium and potassium ion capacitors**.



**INVENTORS:** Jon Ajuria Arregi, María Arnaiz González, Michel Armand, Daniel Carrizo Martín and Devaraj Shanmukaraj.

## ADDED VALUE



Higher energy and higher power compared to graphite based LICs enabling higher operative voltage and faster kinetics.



Avoid the use of graphite, thus CRM-free.



Easily scalable, industrially compatible fabrication process.



Lower production costs based on R2R pre-lithiation process avoiding metallic lithium and ex-situ pre-lithiation methods.

## APPLICATION OF THE TECHNOLOGY



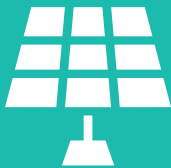
ELECTRIC VEHICLE



HEAVY DUTY  
APPLICATIONS



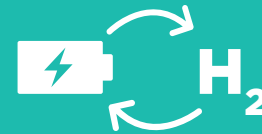
GRID REGULATION, UPS, VOLTAGE  
SAG COMPENSATION, POWER  
QUALITY



STATIONARY  
(RENEWABLE)



RECOVERY  
(TRANSPORTATION)



HYBRIDIZATION WITH FUEL CELLS  
AND LITHIUM ION OR REDOX FLOW  
BATTERIES

# OVERVIEW OF OUR PATENT PORTFOLIO

CIC  
**energigune**

MEMBER OF BASQUE RESEARCH  
& TECHNOLOGY ALLIANCE

TOTAL FAMILIES

**39**

ANNUAL INCREASE % OF CITATIONS

**+150%**

LARGE ENTITIES THAT ECHO OUR ACTIVITY AND PATENTS

**SAMSUNG**



HARVARD  
UNIVERSITY



**BOSCH**



LG Chem

**CATL**

ormazabal  
velatia



MITSUBISHI  
MATERIALS



utorres

BlueSolutions  
BOLLORE



ampricus

**Metal ion capacitors (MICs)** are a next-generation energy storage technology that couple **high energy density** delivered by batteries with **high power/long cycle life** offered by supercapacitors.

As MICs have higher input/output characteristics than batteries, they are suited to fields where **instantaneous power** is needed, and can be **quickly recharged**.

Also featuring **long cycle life and high safety**, MICs are expected to be used in innumerable applications such as electric trams and buses which charge at each stop instead of using power from overhead lines.

The concept was born in 2001 when battery and supercapacitor electrodes were combined by face-to-face assembly. A few years later, in 2008, the technology reached the market and nowadays they have been implemented in integral solutions.

## ABOUT CIC energiGUNE

CIC energiGUNE is a Basque energy research center specialized in electrochemical and thermal energy storage and conversion, that aims to generate disruptive scientific knowledge in materials and technological solutions related to energy, and contributing to improve industry competitiveness and sustainable development.



LEARN MORE

## ABOUT Metal-ion capacitors research line

Within the research line of metal-ion capacitors, our objective is to develop new advanced materials and prototype concepts that are sustainable by design and that contribute to bridge the energy gap existing between supercapacitors and metal-ion batteries, while still maintaining charge and discharge times in few seconds and long cycle life.



## LICENSING CONTACT

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