

Energy Harvesting from Carbon Dioxide Capture through an Ionic Liquid Based Supercapacitor

Original

Energy Harvesting from Carbon Dioxide Capture through an Ionic Liquid Based Supercapacitor / Molino, D., Zaccagnini, P., Martellone, S., Pedico, A., Ferraro, G., Bocchini, S., Lamberti, A.. - (2023). (244th ECS Meeting Gothenburg (SE) October 8-12, 2023) [10.1149/MA2023-02482444mtgabs].

Availability:

This version is available at: 11583/2989083 since: 2024-05-29T08:41:21Z

Publisher:

IOP Publishing

Published

DOI:10.1149/MA2023-02482444mtgabs

Terms of use:

This article is made available under terms and conditions as specified in the corresponding bibliographic description in the repository

Publisher copyright

(Article begins on next page)



Energy harvesting from carbon dioxide capture through an ionic liquid based supercapacitor

Davide Molino,^a Pietro Zaccagnini,^{a,b} Simone Martellone,^a Alessandro Pedico,^{a,b} Giuseppe Ferraro,^b Sergio Bocchini,^{a,b} Andrea Lamberti,^{a,b}

^a DISAT Dipartimento di Scienza Applicata e Tecnologia, Politecnico di Torino, corso Duca degli Abruzzi 24, 10129, Torino, Italy

^b Istituto Italiano di Tecnologia, Center for Sustainable Future Technologies, Via Livorno 60, 10144, Torino, Italy

davide.molino@polito.it

106-2444

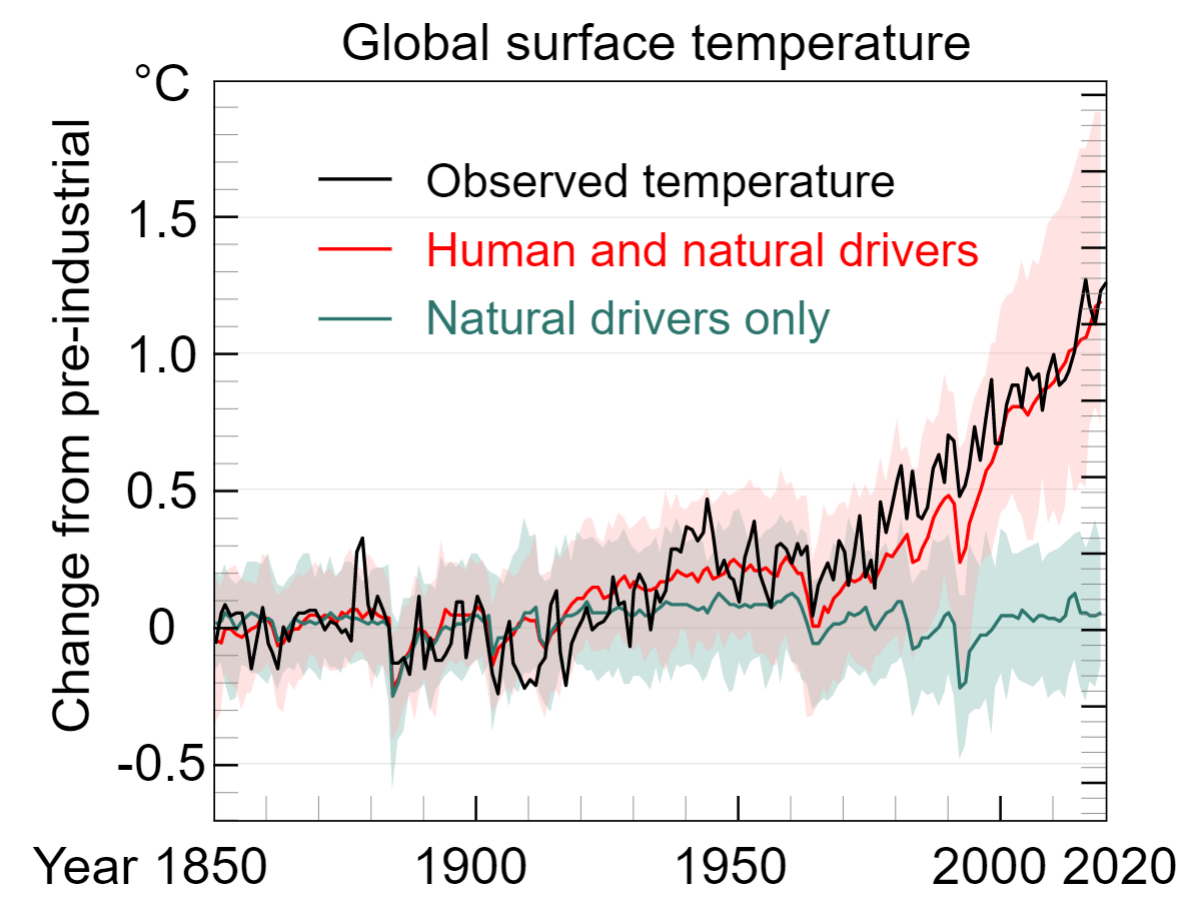
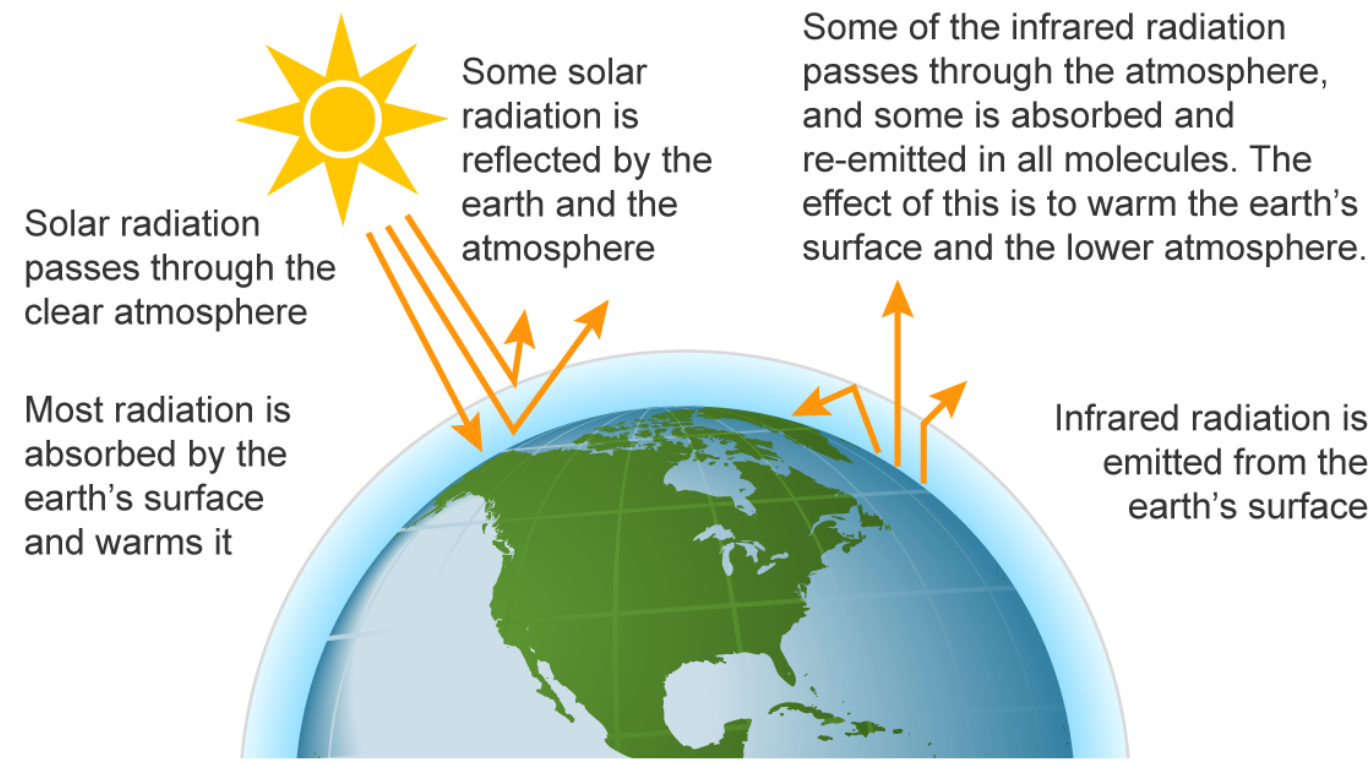
11 October, 2023



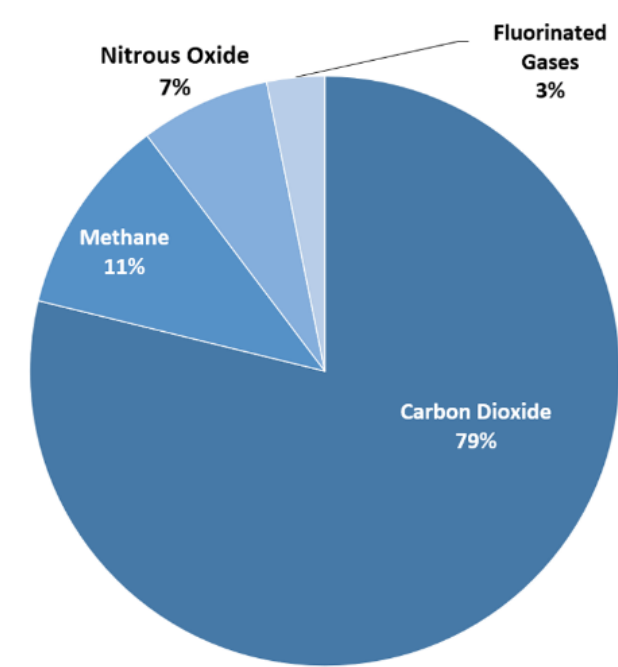
Research context and motivation

- Starting from 1900 **global temperature started to increase**, mainly because of human influence: emission of greenhouse gases (g.h.g.) and deforestation

The greenhouse effect



- Greenhouse gas composition: the most abundant gas among g.h.g. is **Carbon dioxide (CO₂)**, coming mainly from oil and coal.
- CO₂ is **responsible for 60% of global warming** due to human activity

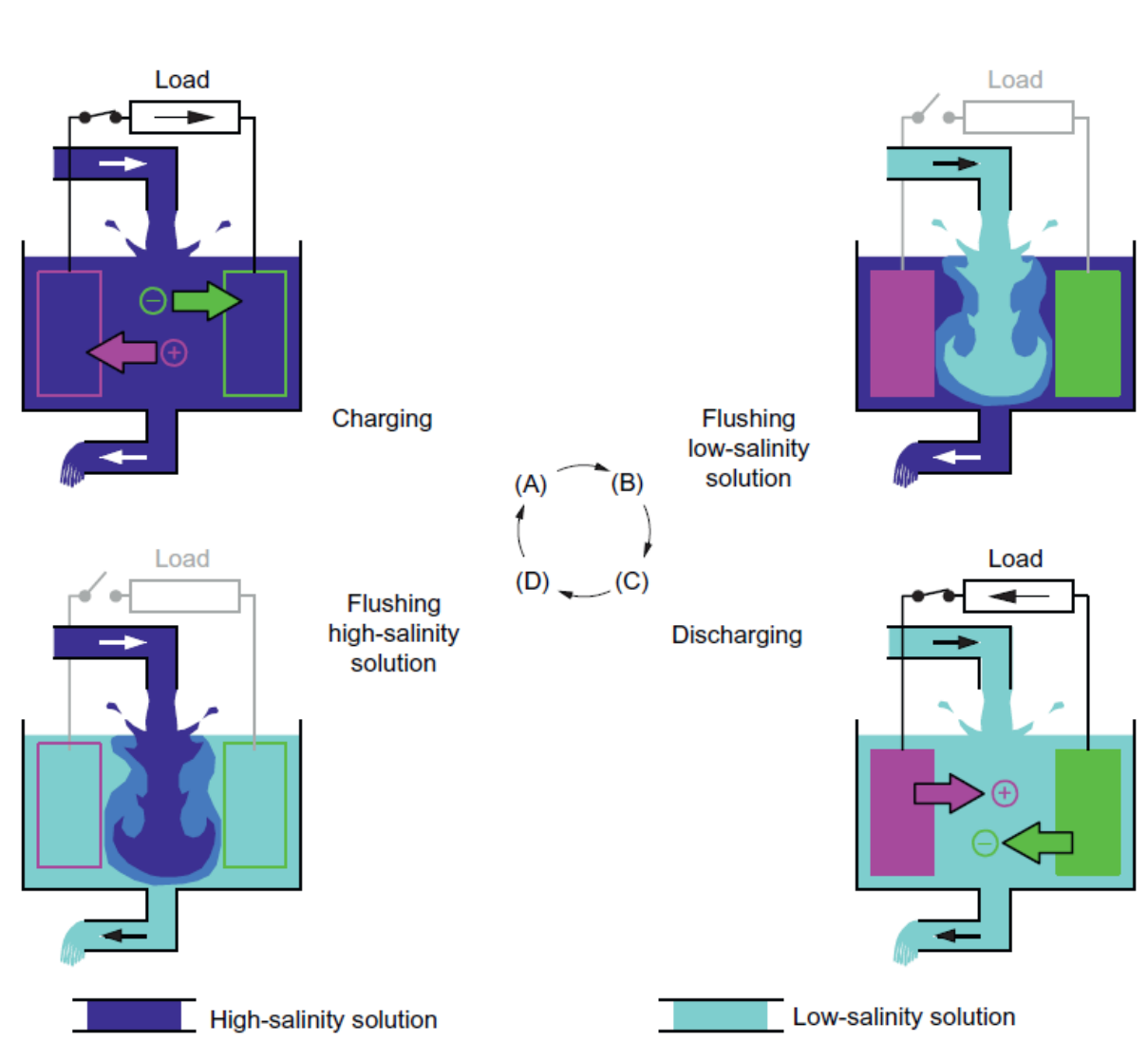


Addressed research questions/problems

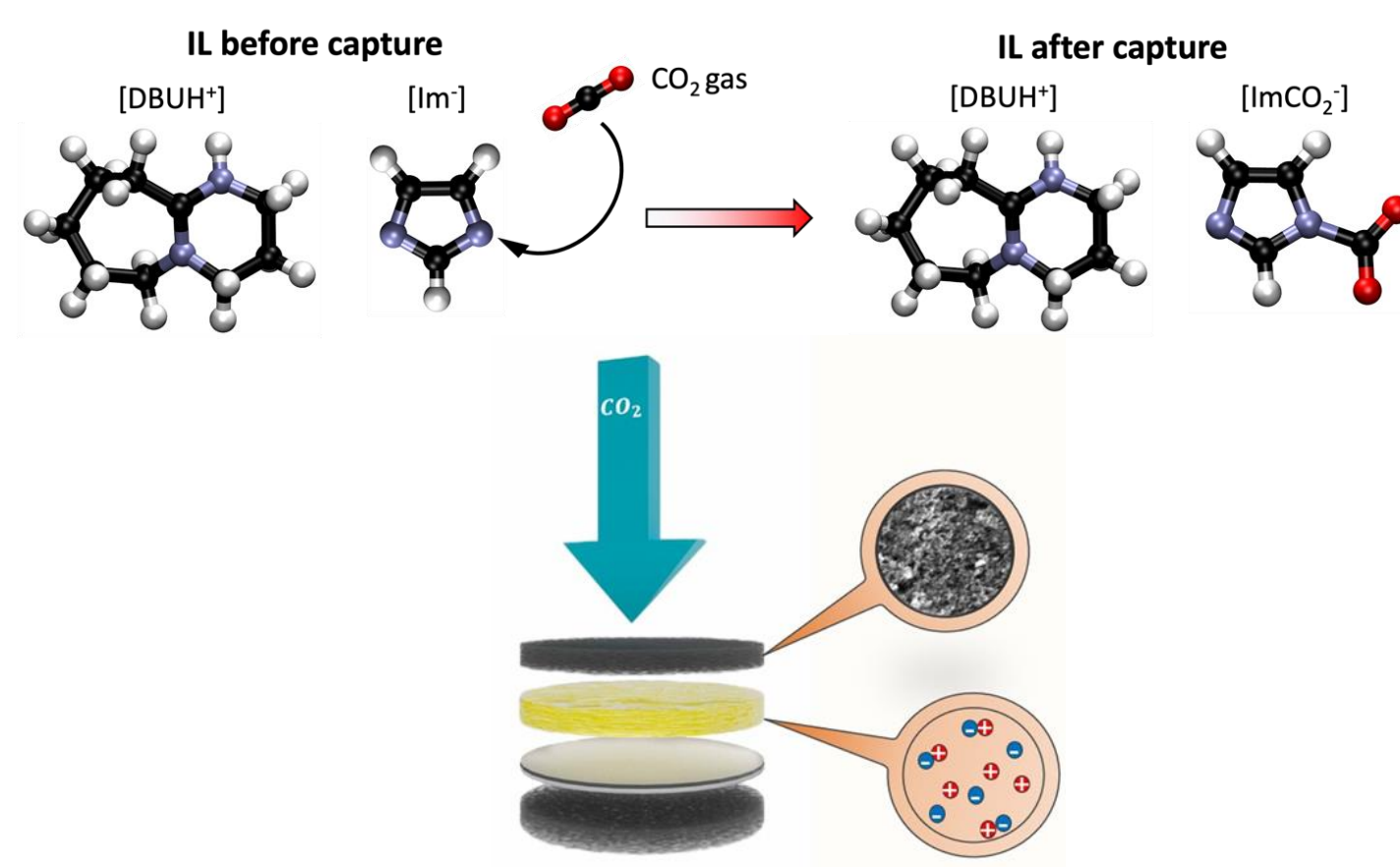
- The goal is to **harvest energy from CO₂ capture** adapting the Capmix technique, but the mechanism is totally different.

Working principle

Capmix



CO₂Cap



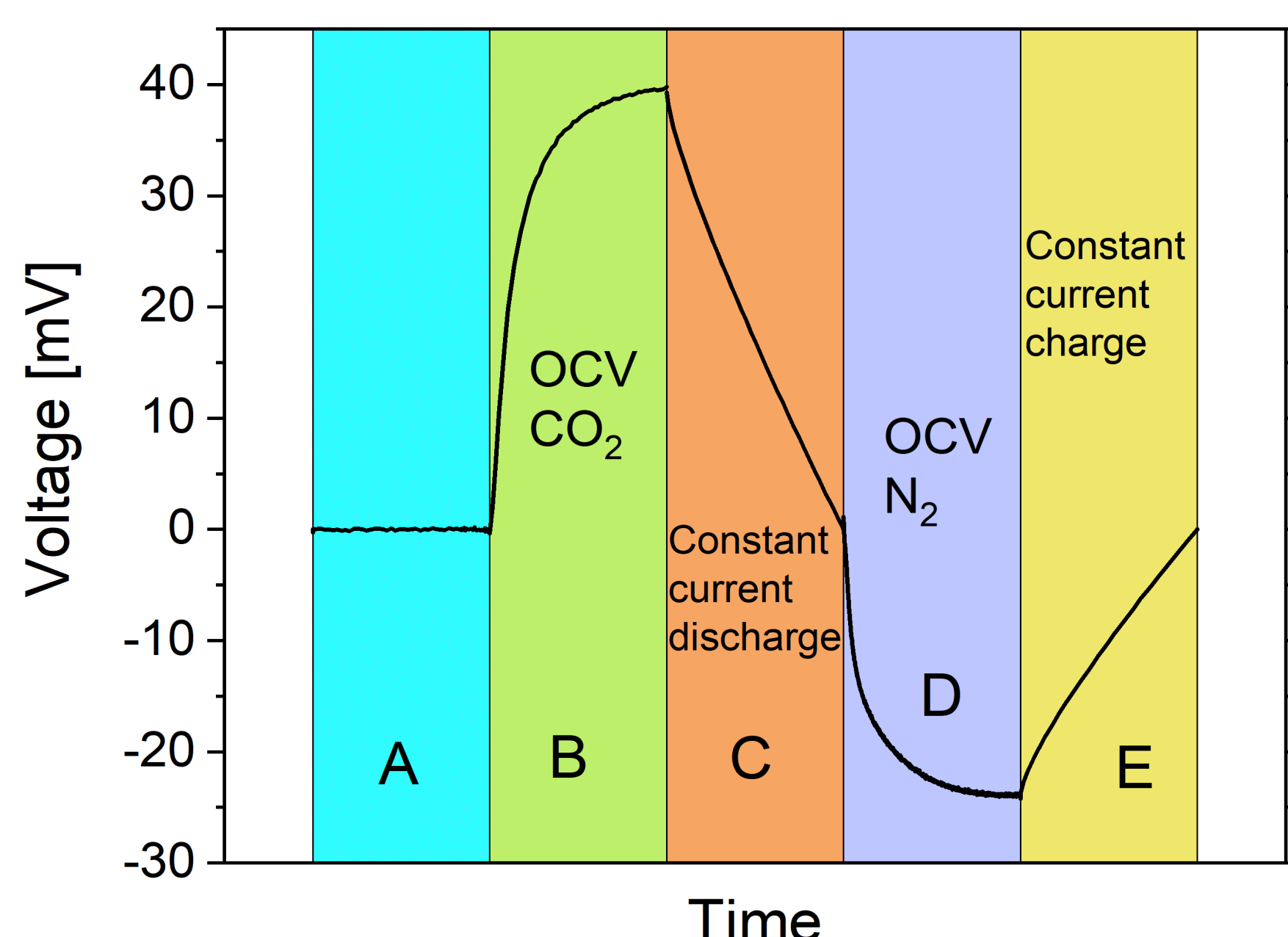
The reaction between the ionic liquid and CO₂ happens only on one electrode, producing a junction across which a voltage difference is created

Technology exploited in blue energy field, based on **EDL enlargement**

Adopted methodology

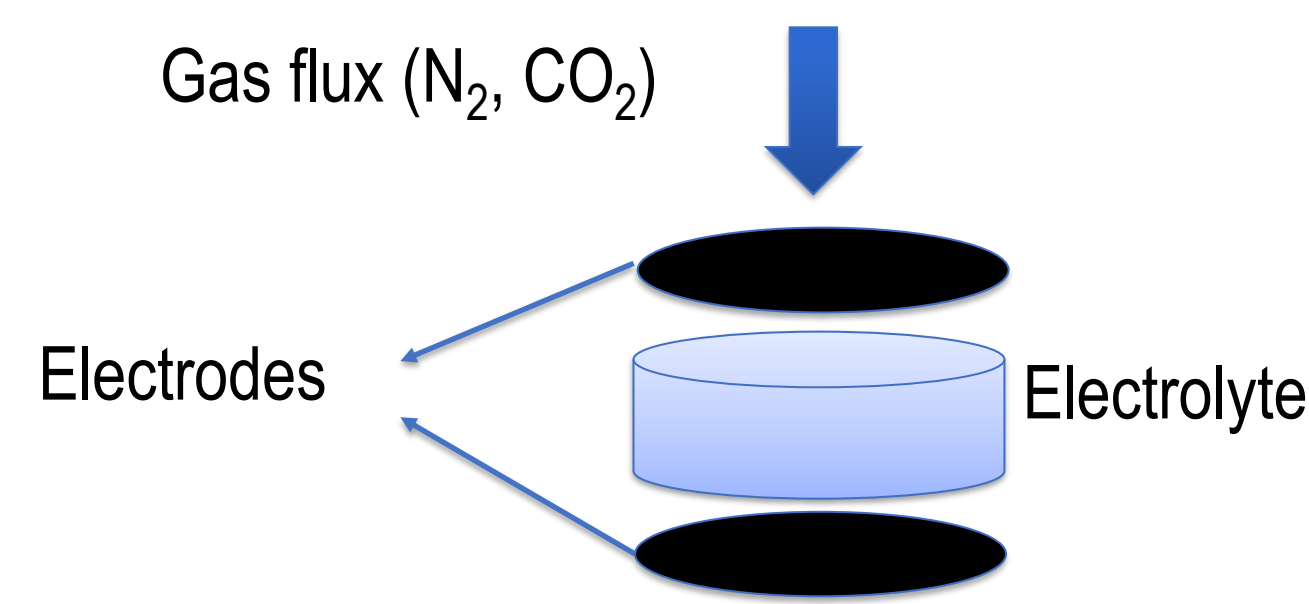
Procedure: inspired from Capmix, but avoiding the polarization of the device used to store charges at the electrodes interfaces.

- A: 5' short circuit
- B: OCV + CO₂ flush (50 ml/min)
- C: Constant current discharge (energy recovery)
- D: 15' OCV + N₂ flush (50 ml/min) (regeneration of the electrolyte)
- E: Constant current charge (energy recovery)



Results

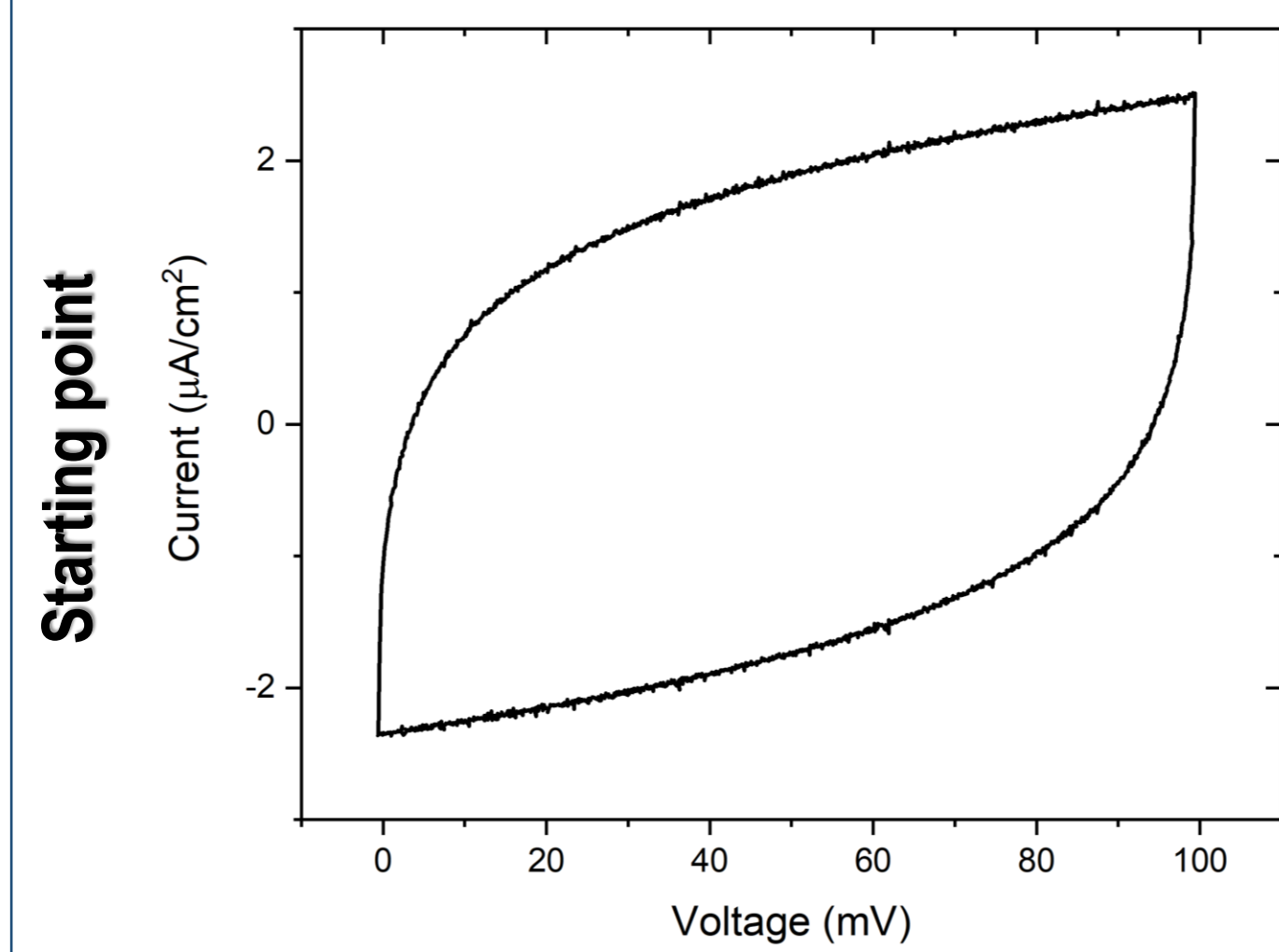
- Idea to **improve CO₂Cap performances** is to exploit **ionic liquids** as electrolyte inside the harvesting device. As in Capmix technology, we substitute high and low concentration solutions with fluxes of CO₂ and N₂.



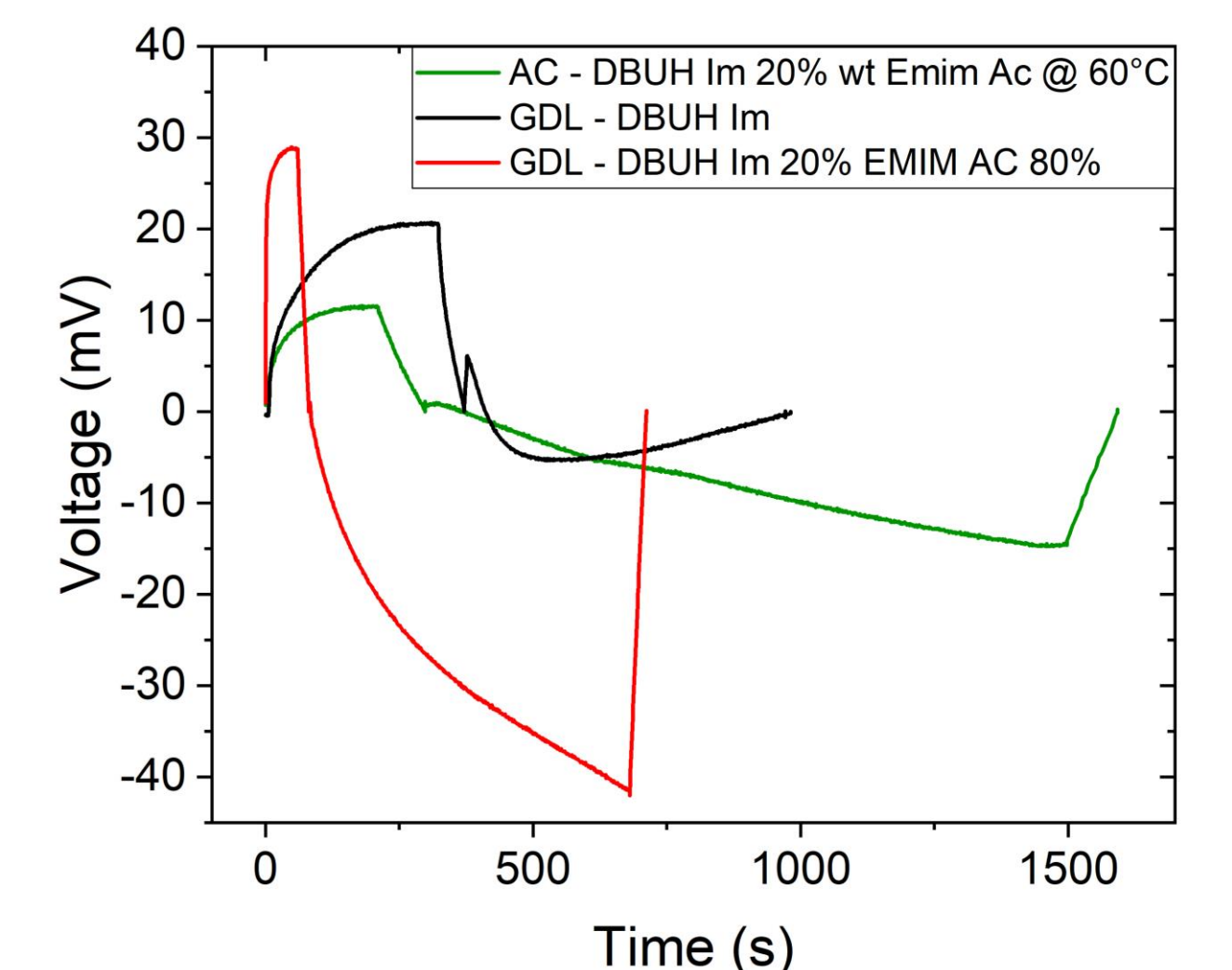
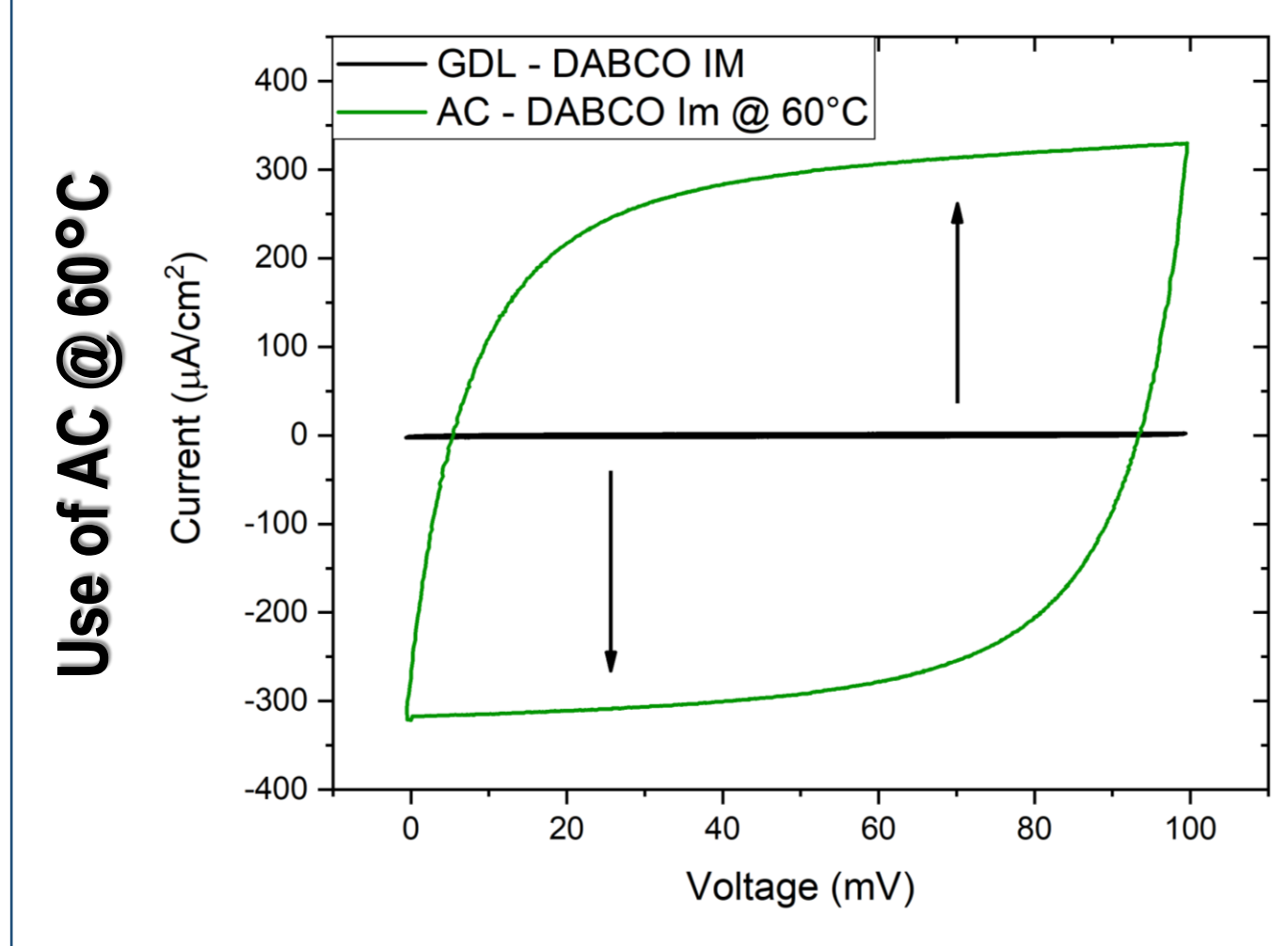
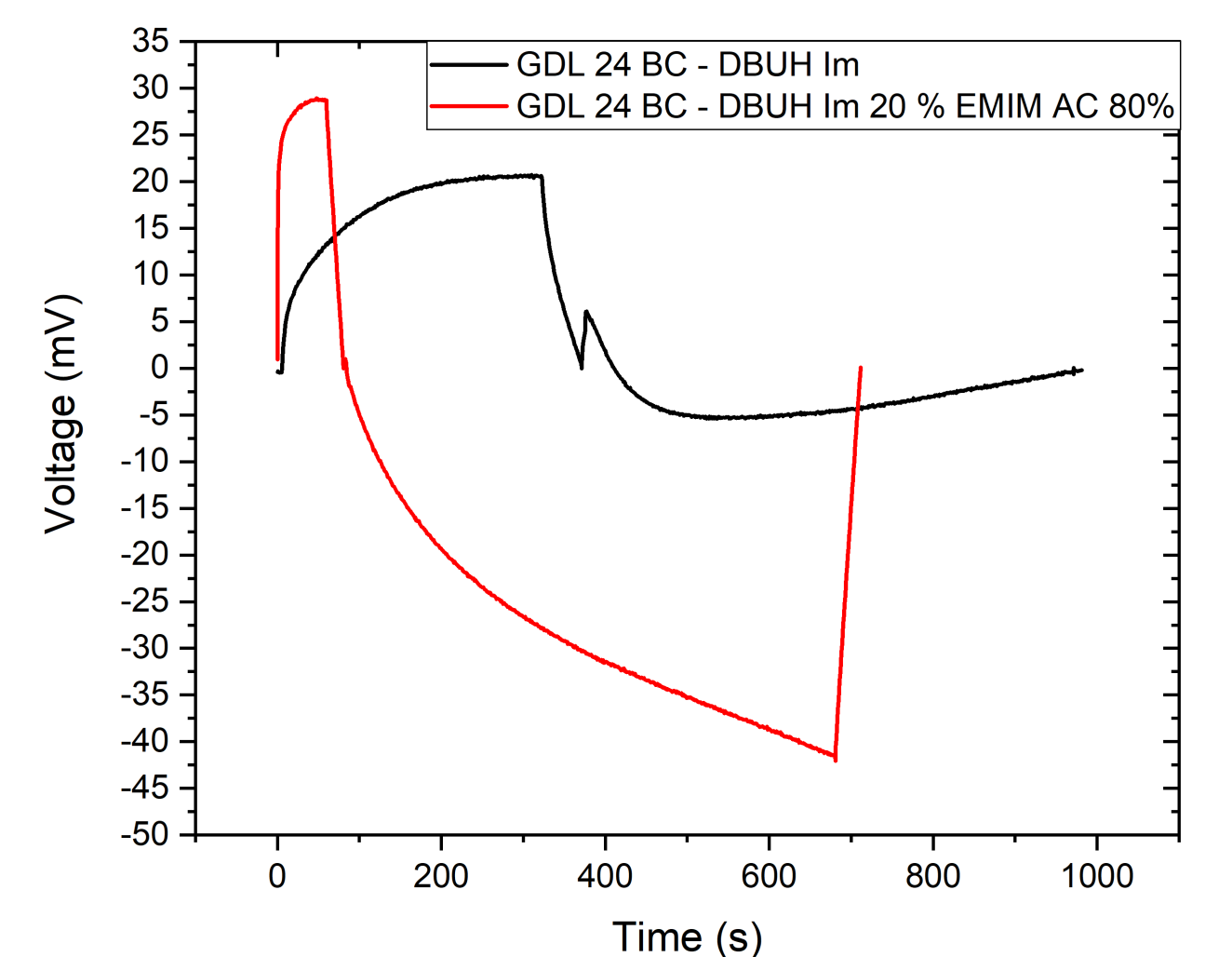
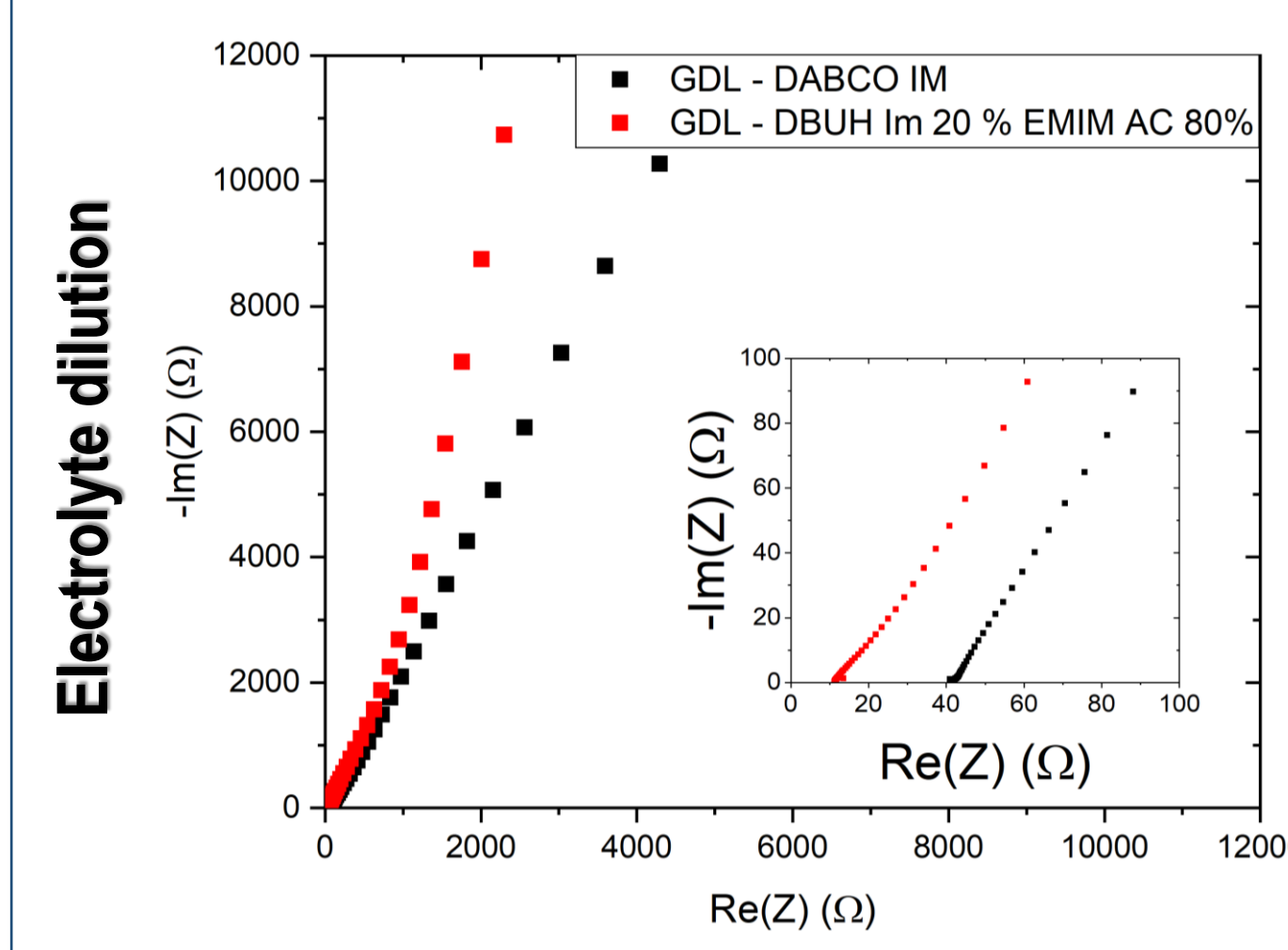
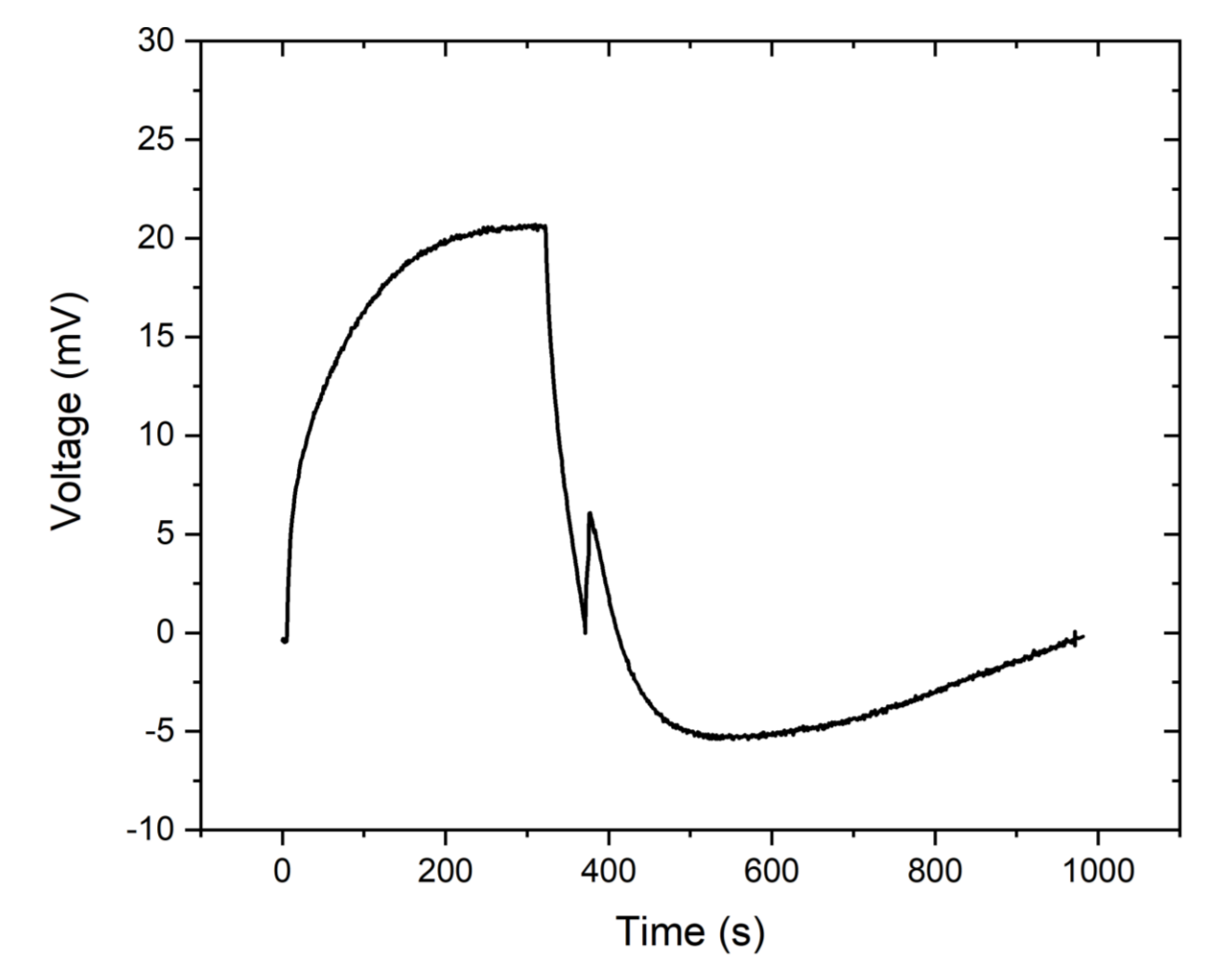
3 tested configurations

Electrodes: GDL	Electrodes: GDL	Electrodes: Act. Carbons
Electrolyte: Dabco Imidazolide	Electrolyte: 20% Dabco Im 80% Emim AC	Electrolyte: 20% Dabco Im 80% Emim AC

EC characterization



Capmix performances



Future work

- Use of new ionic liquids** more selective for CO₂ capture
- Improve ionic mobility, reducing ion pairing by **polar aprotic solvent**, such as Propylene carbonate
- Enhance conductivity of the electrolyte by inserting a **supporting salt**
- Increase the voltage rise due to the adsorption of CO₂ by exploiting **functionalized electrodes**, able to autonomously accumulate specific charges at their surface

ACKNOWLEDGEMENT: This result is part of a project that has received funding from the European Research Council (ERC) under the European Union's ERC Starting Grant. Grant agreement "CO₂CAP" No. 949916

