

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, Davide; Zaccagnini, Pietro; Martellone, Simone; Pedico, Alessandro; Ferraro, Giuseppe; Bocchini, Sergio; Lamberti, Andrea. - (2023). (Intervento presentato al convegno 244th ECS Meeting tenutosi a Gothenburg (SE) nel 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

IOP postprint/Author's Accepted Manuscript

(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

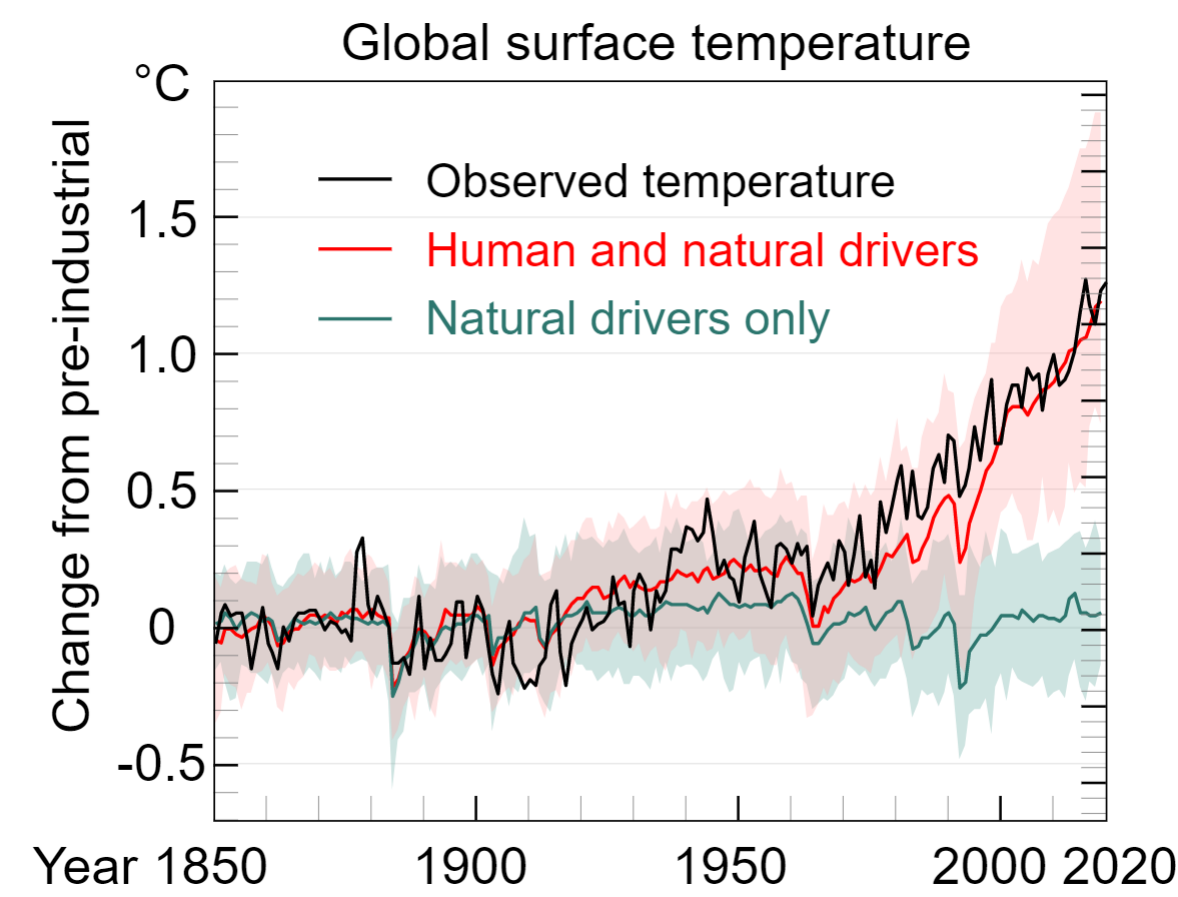
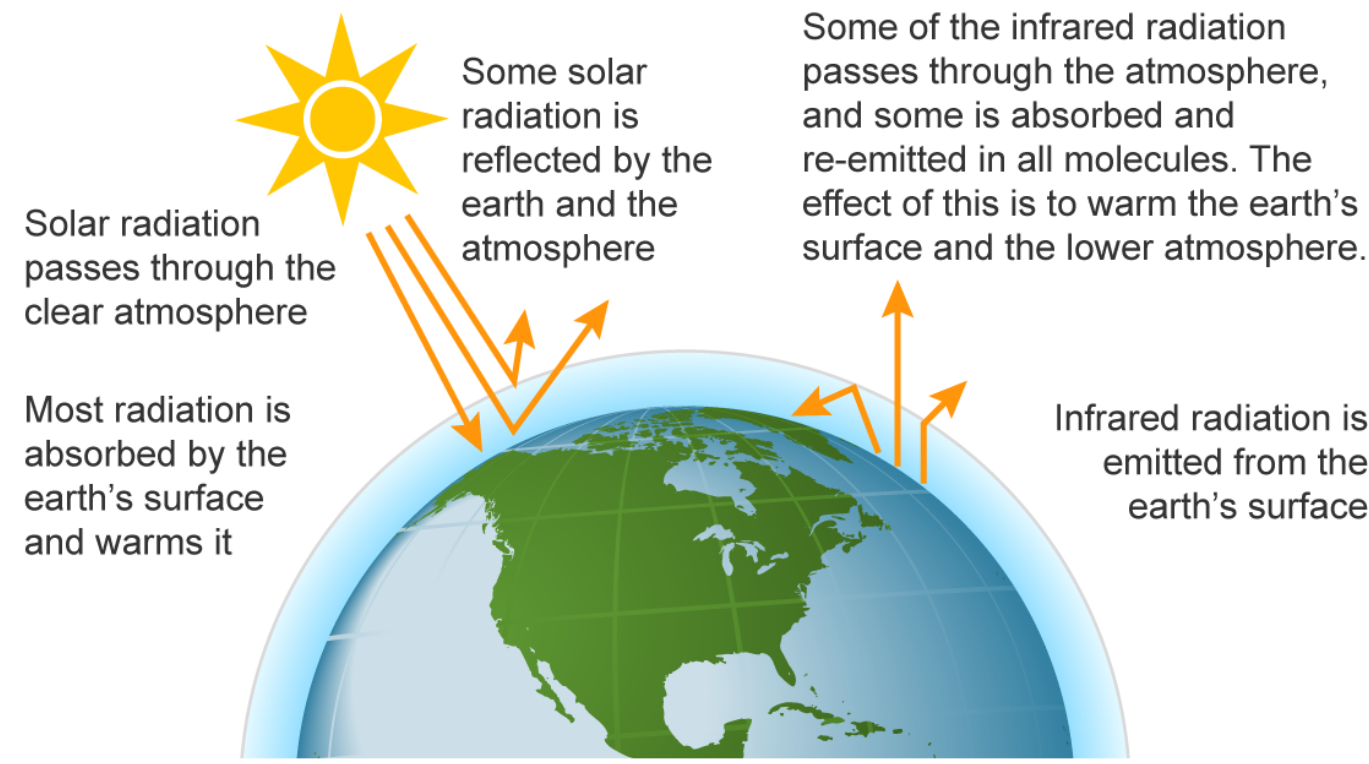
11 October, 2023



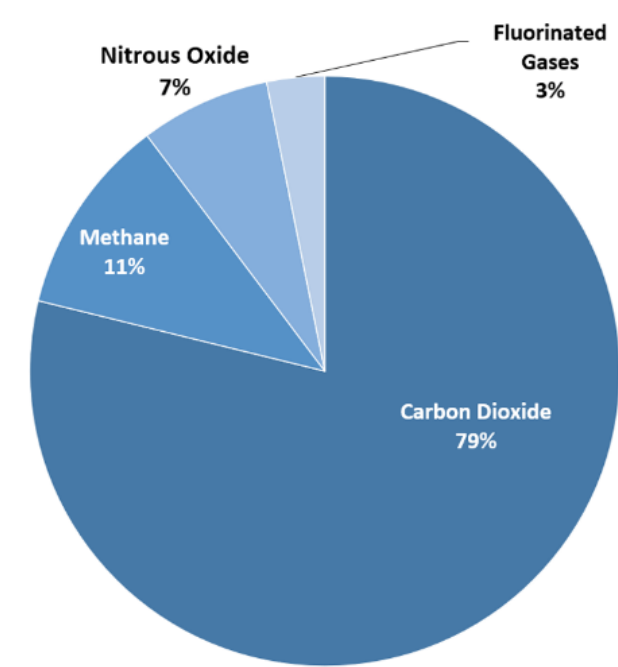
Research context and motivation

- 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

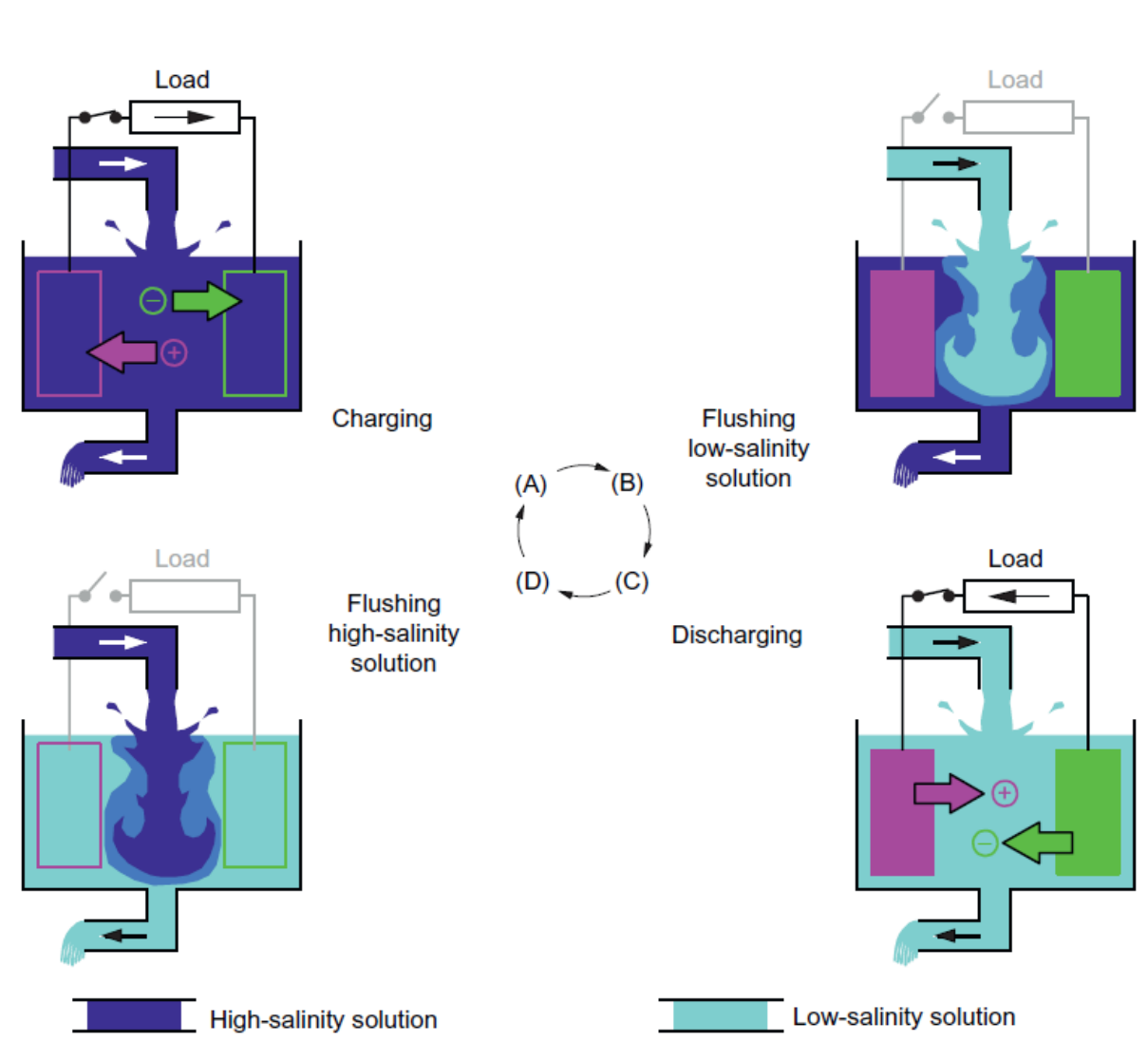


Addressed research questions/problems

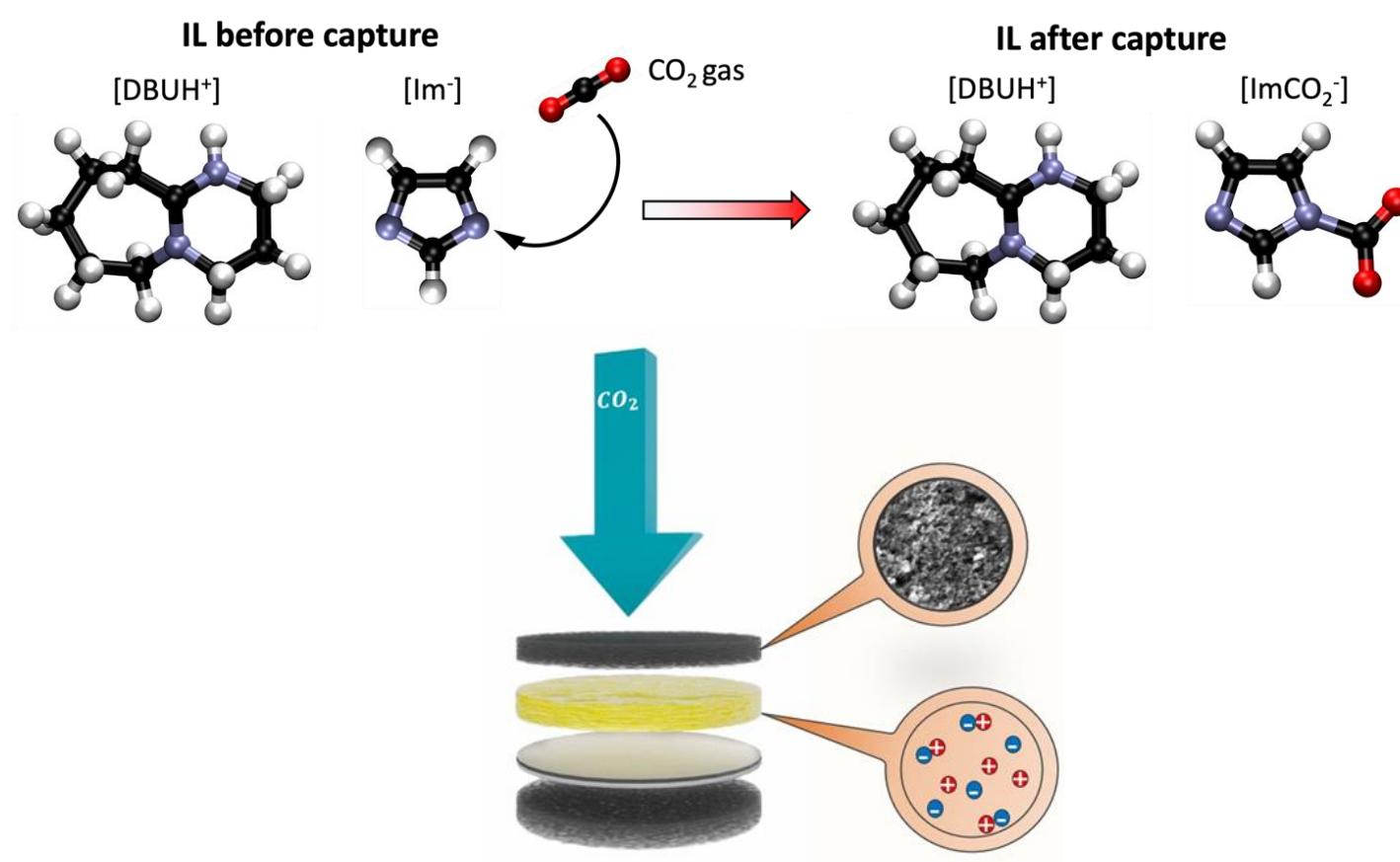
- The goal is to **harvest energy from CO₂ capture** adapting the Capmix technique, but the mechanism is totally different.

Working principle

Capmix



CO₂Cap



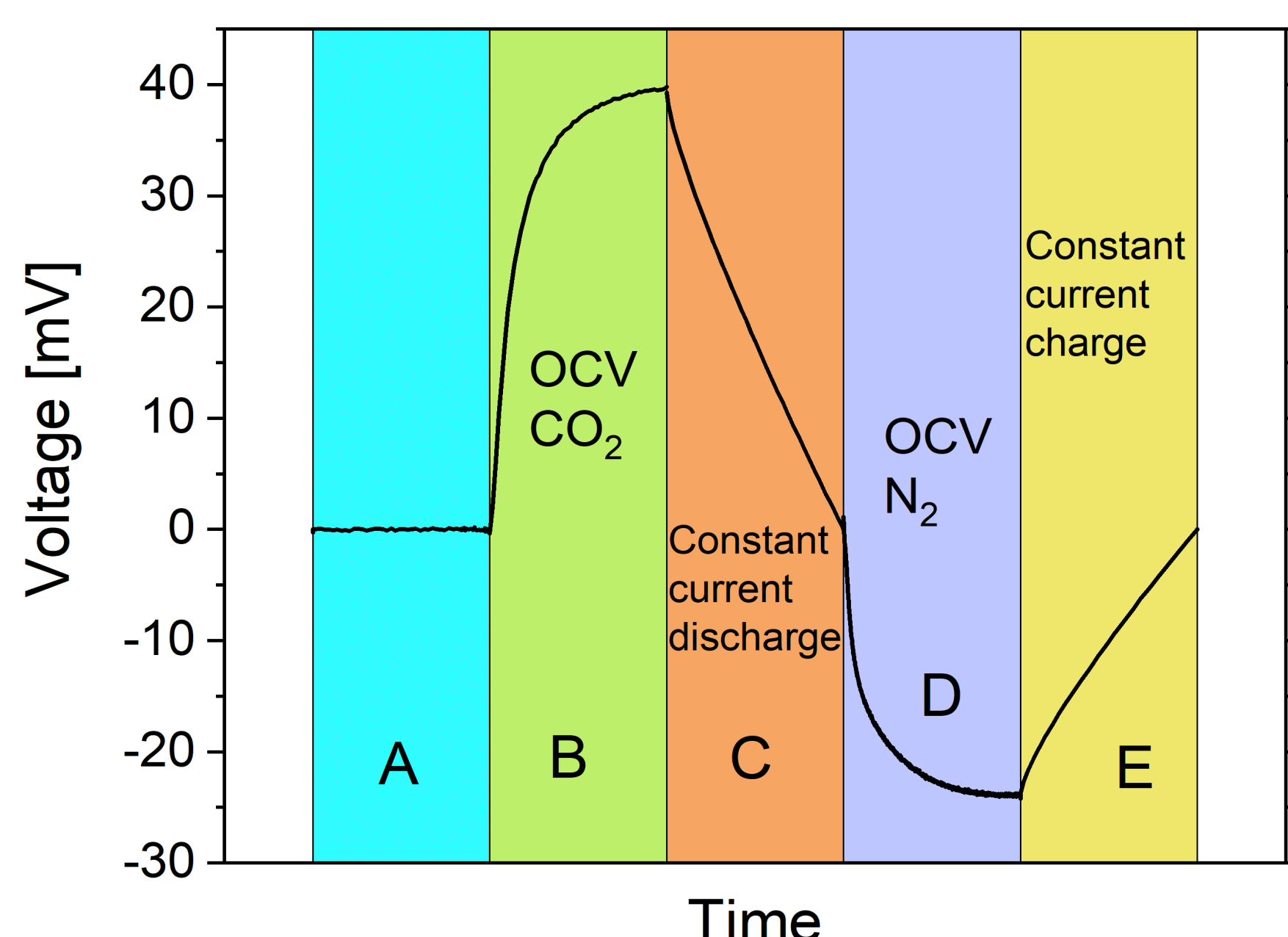
The reaction between the ionic liquid and CO₂ happens only on one electrode, producing a junction across which a voltage difference is created

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

Adopted methodology

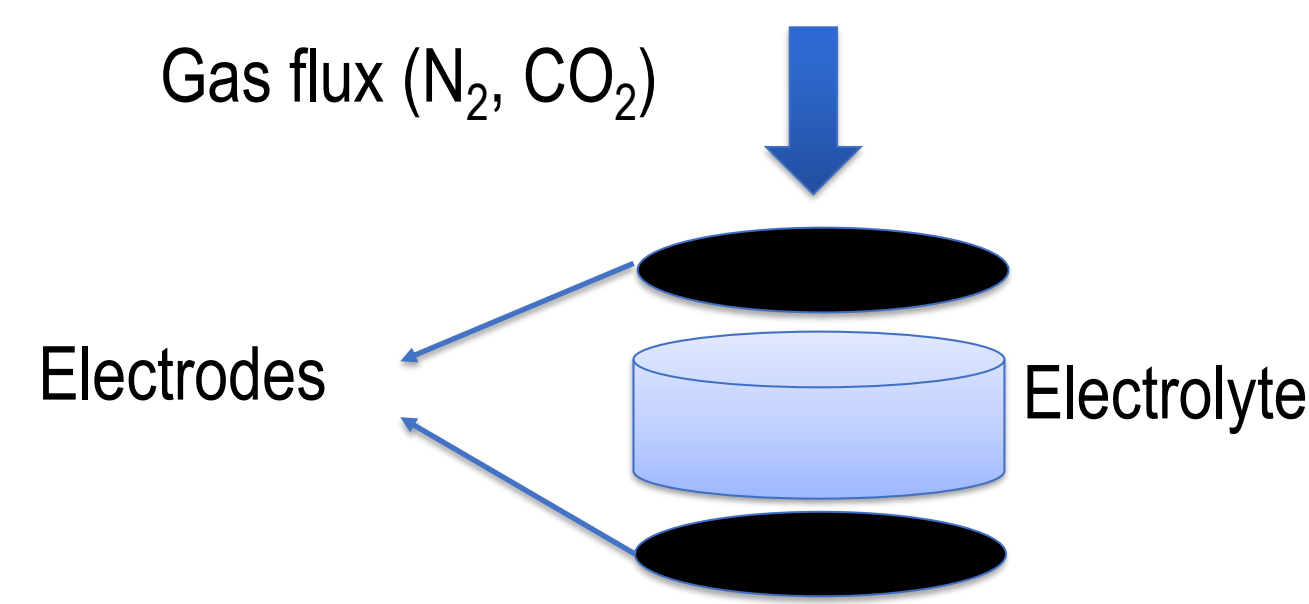
Procedure: inspired from Capmix, but avoiding the polarization of the device used to store charges at the electrodes interfaces.

- 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

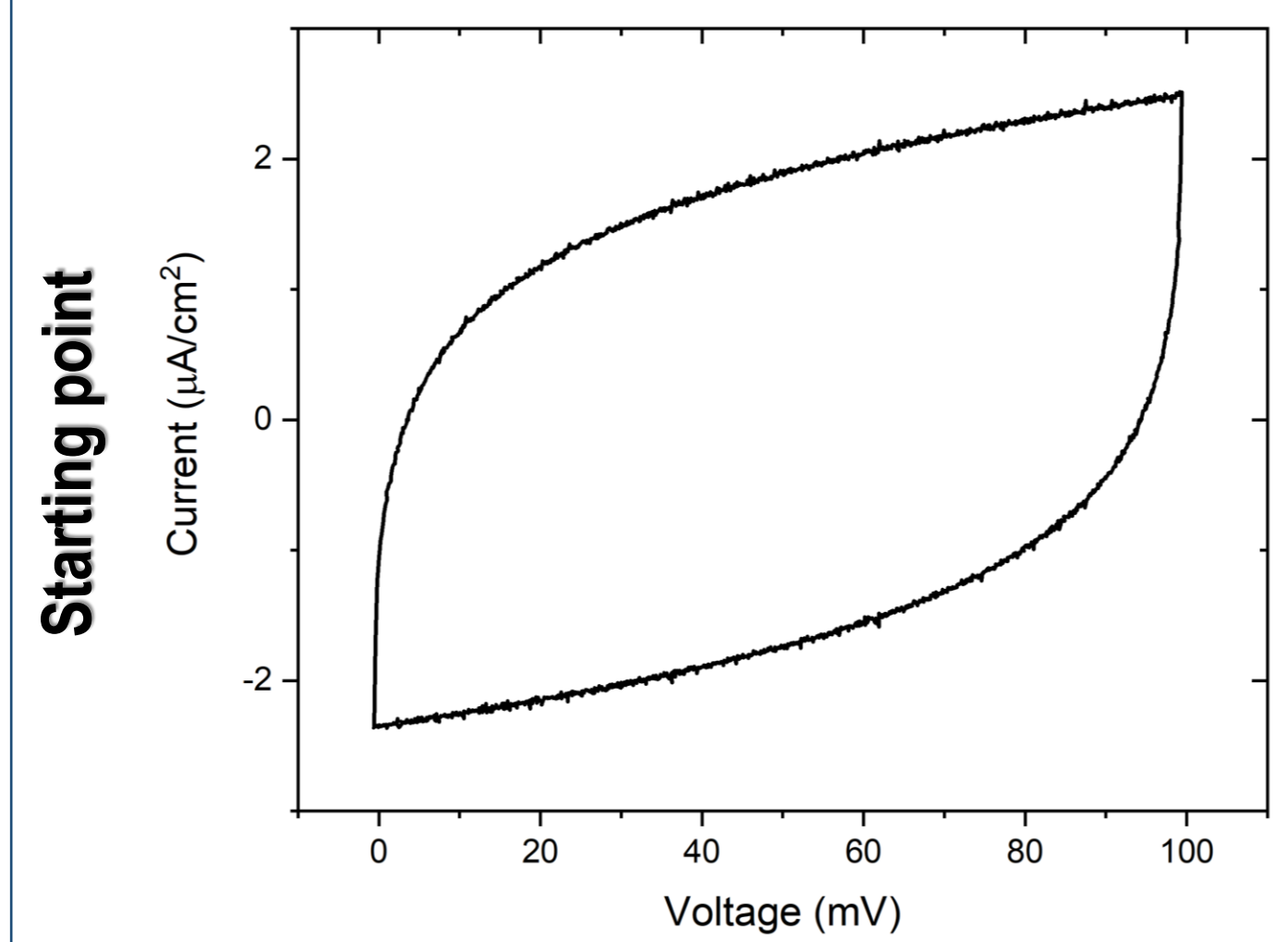
- Idea to **improve CO₂Cap performances** is to exploit **ionic liquids** as electrolyte inside the harvesting device. As in Capmix technology, we substitute high and low concentration solutions with fluxes of CO₂ and N₂.



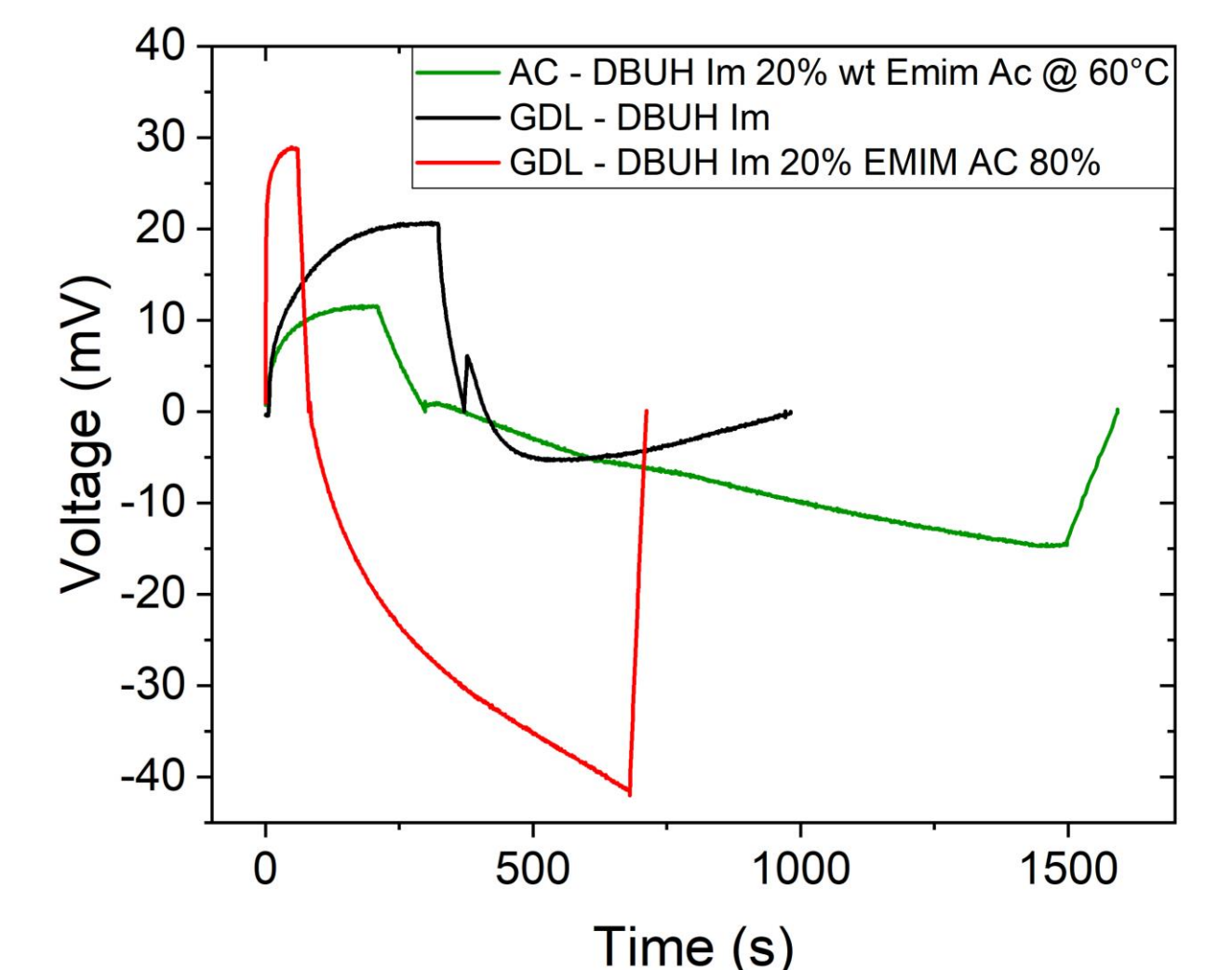
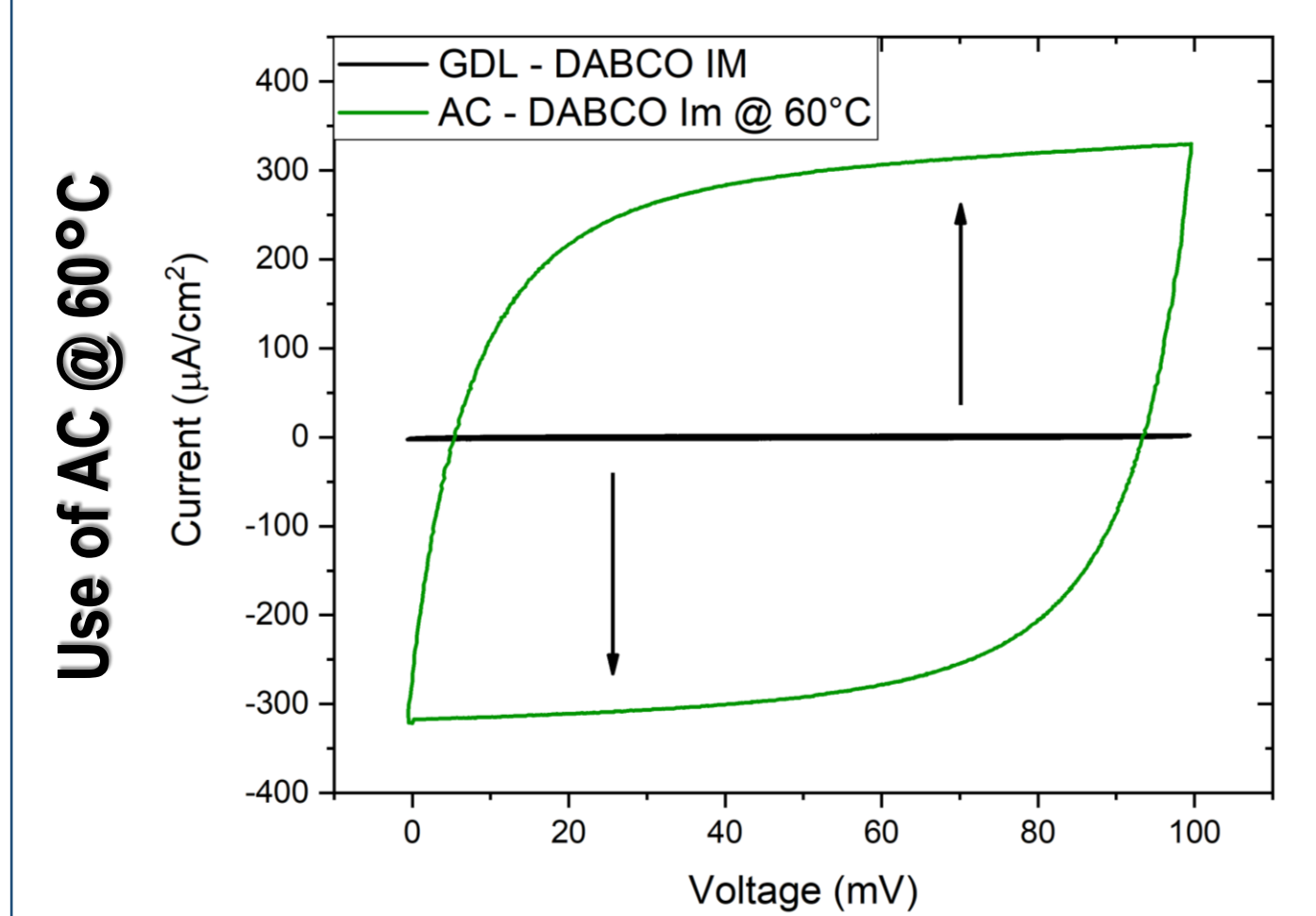
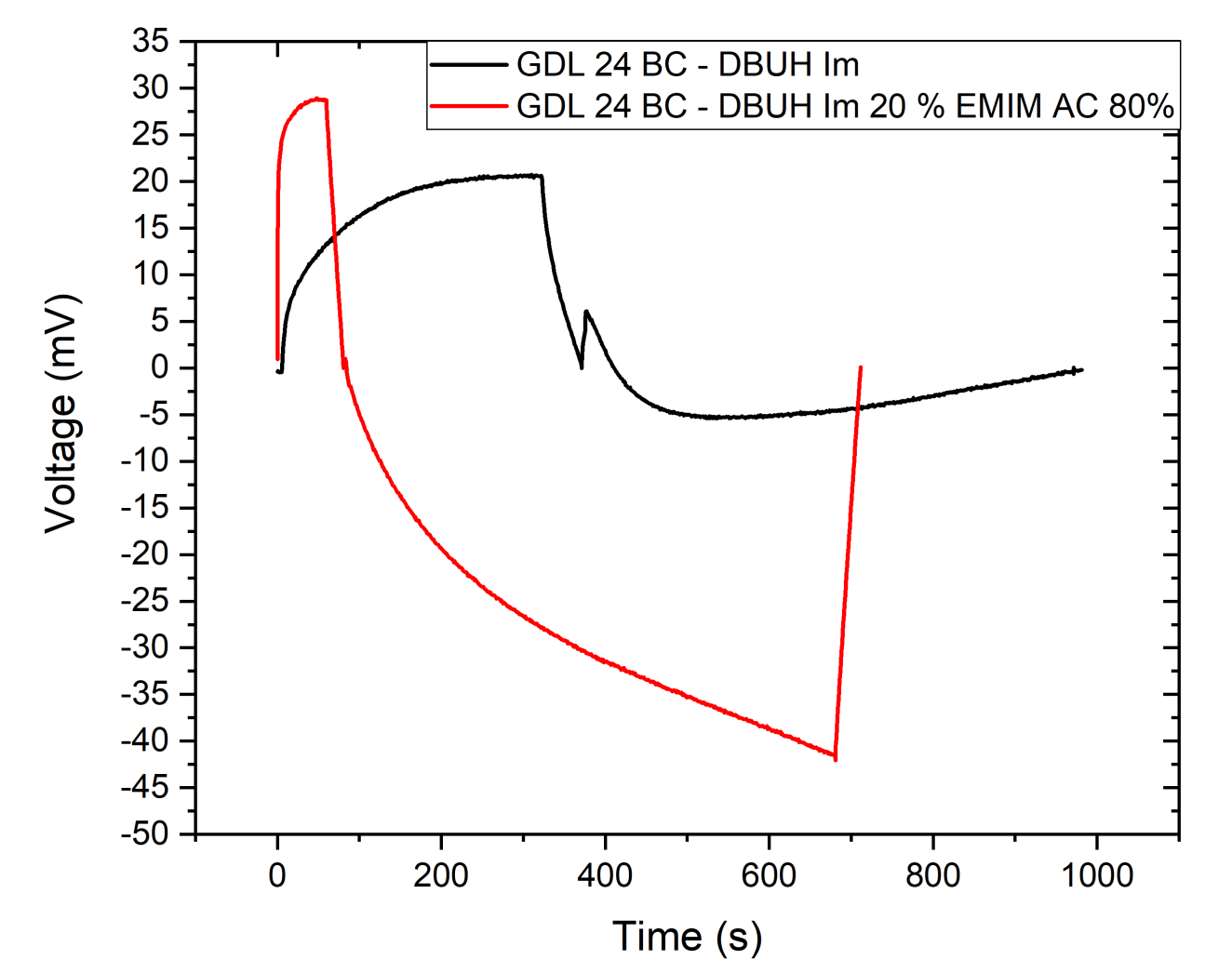
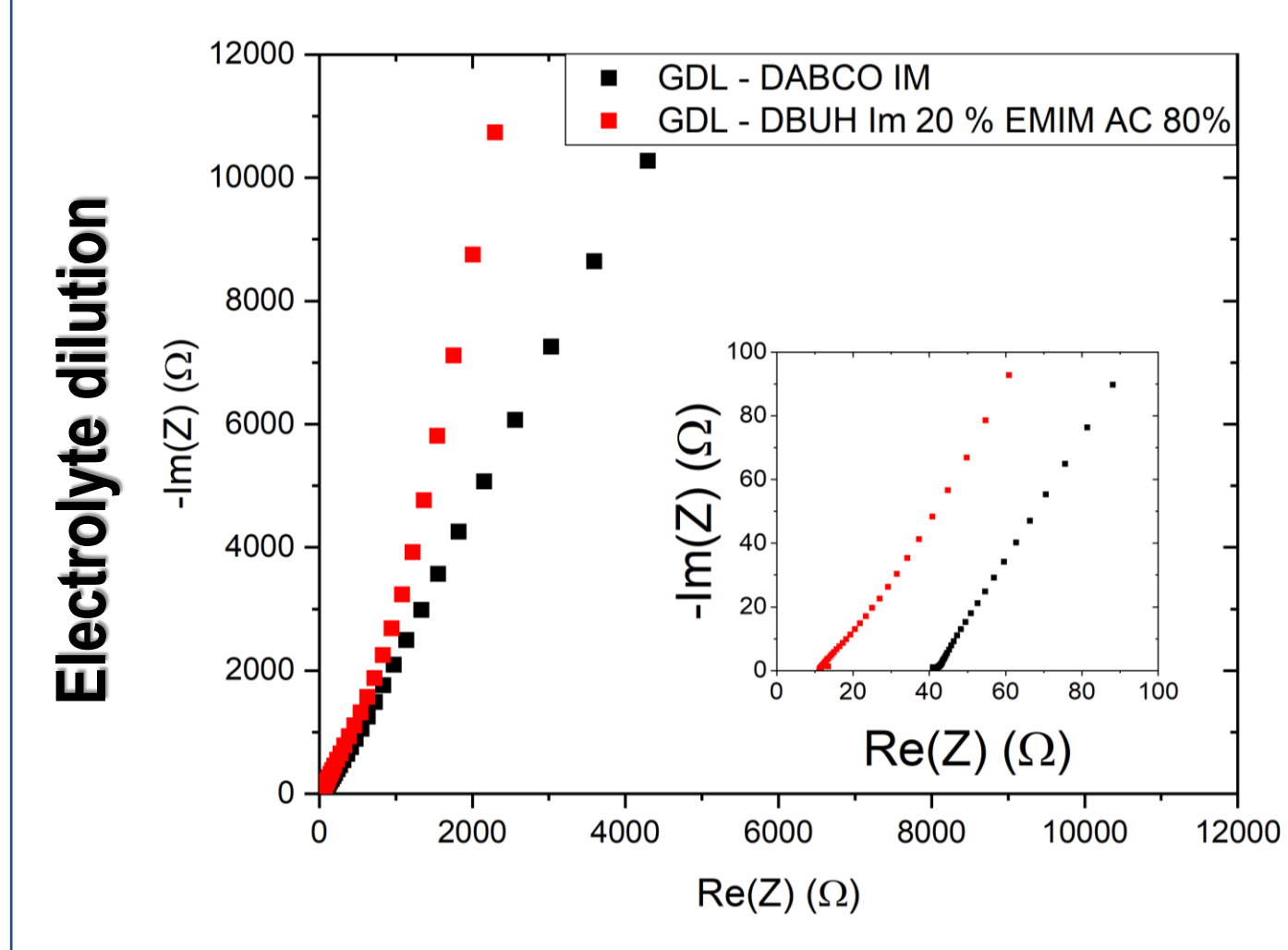
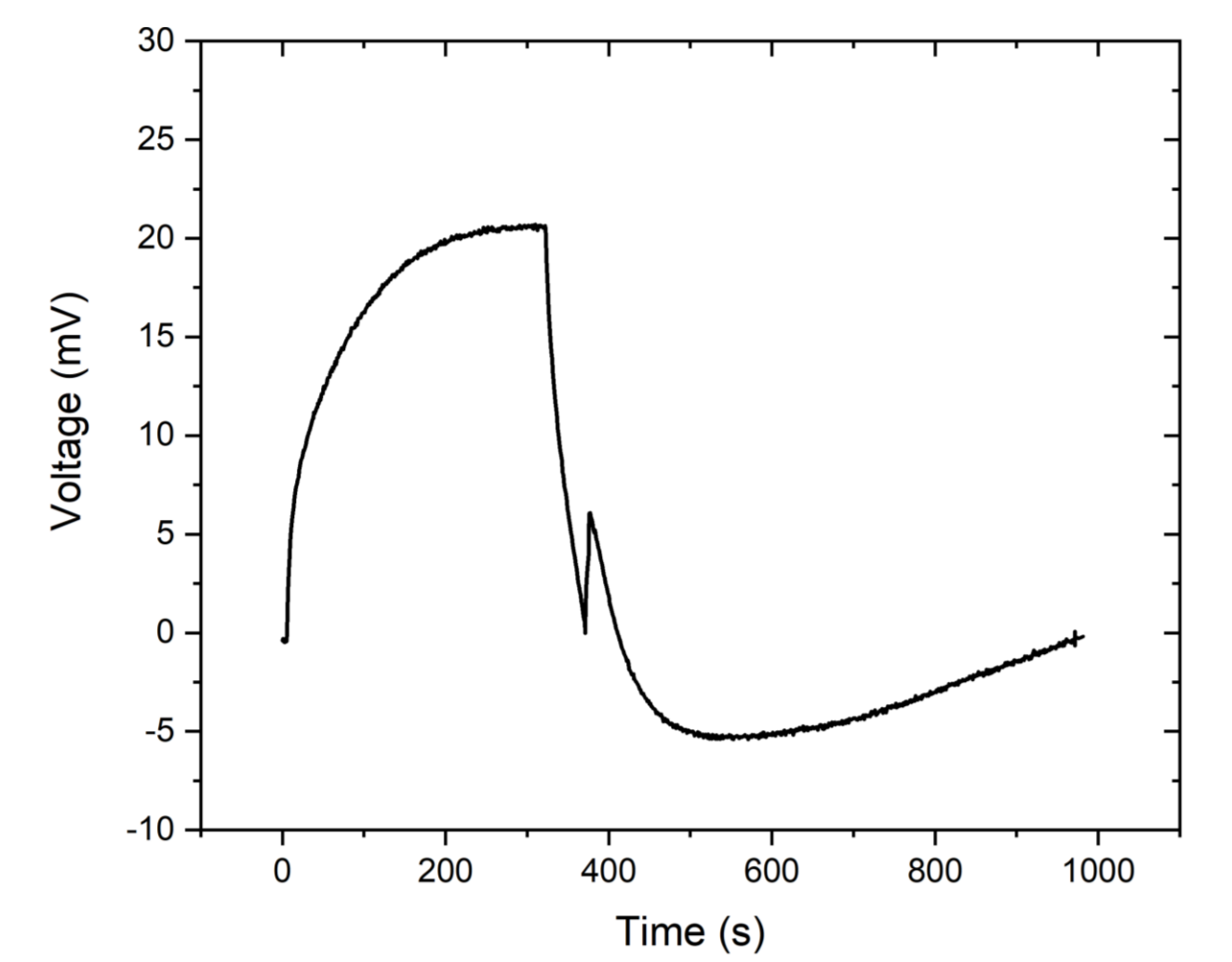
3 tested configurations

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



Politecnico di Torino

Dipartimento di Scienza Applicata e Tecnologia