

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

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

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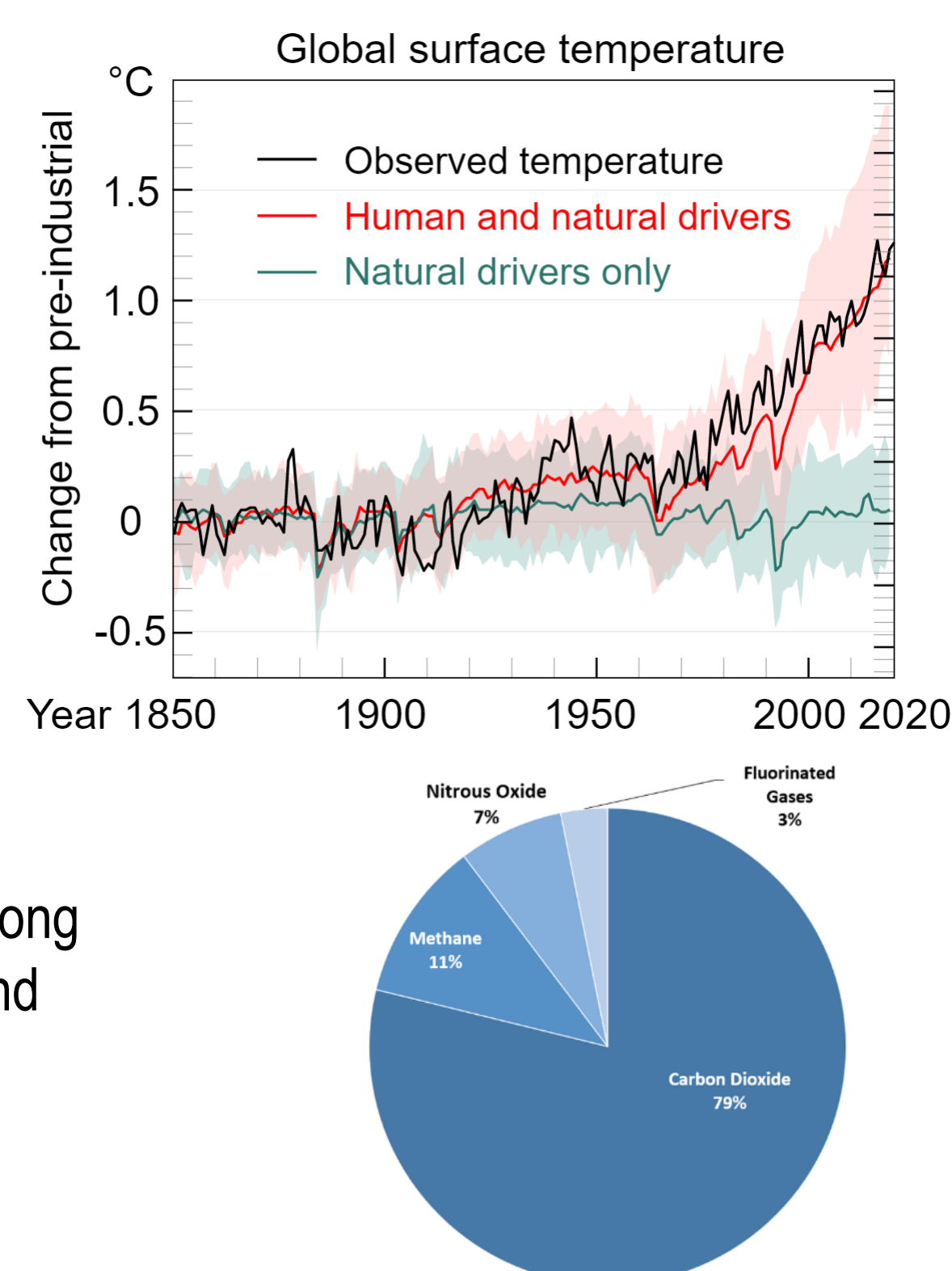
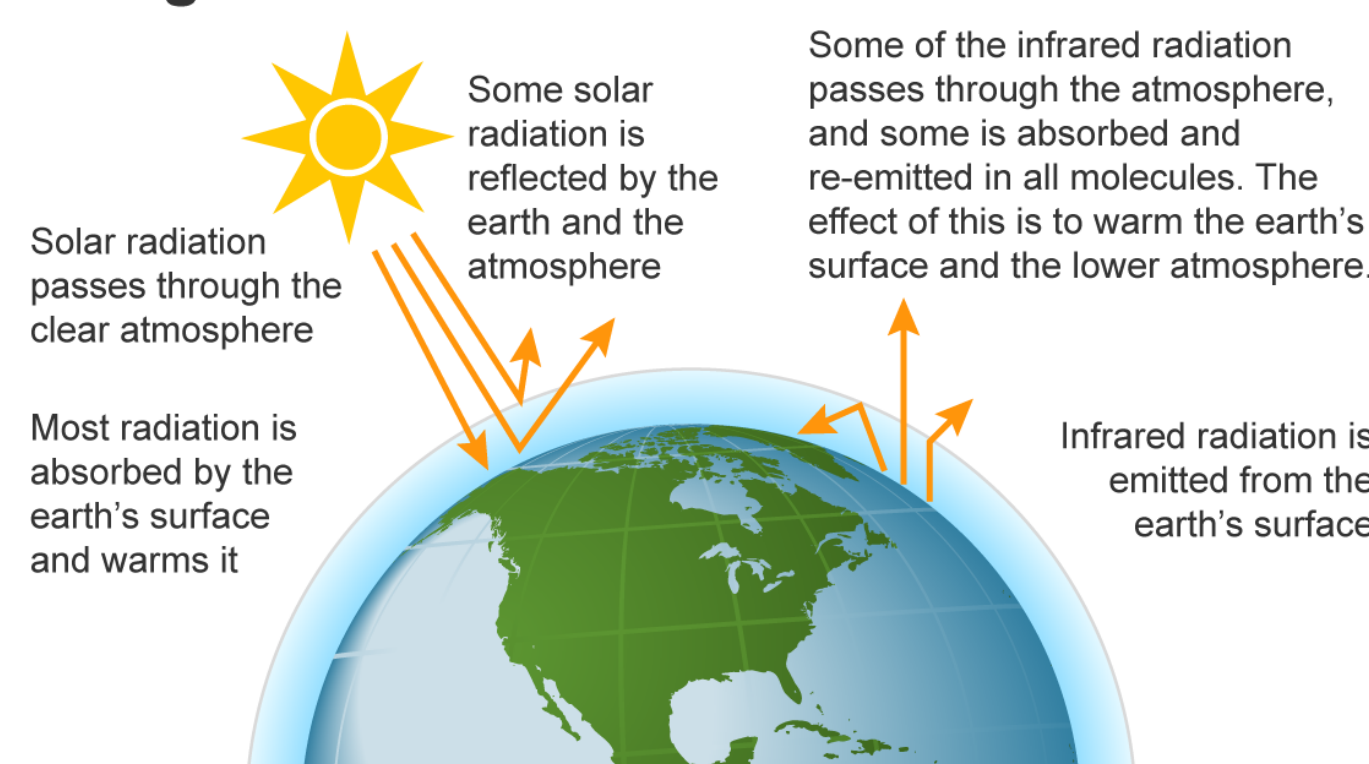
11 October, 2023



## 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



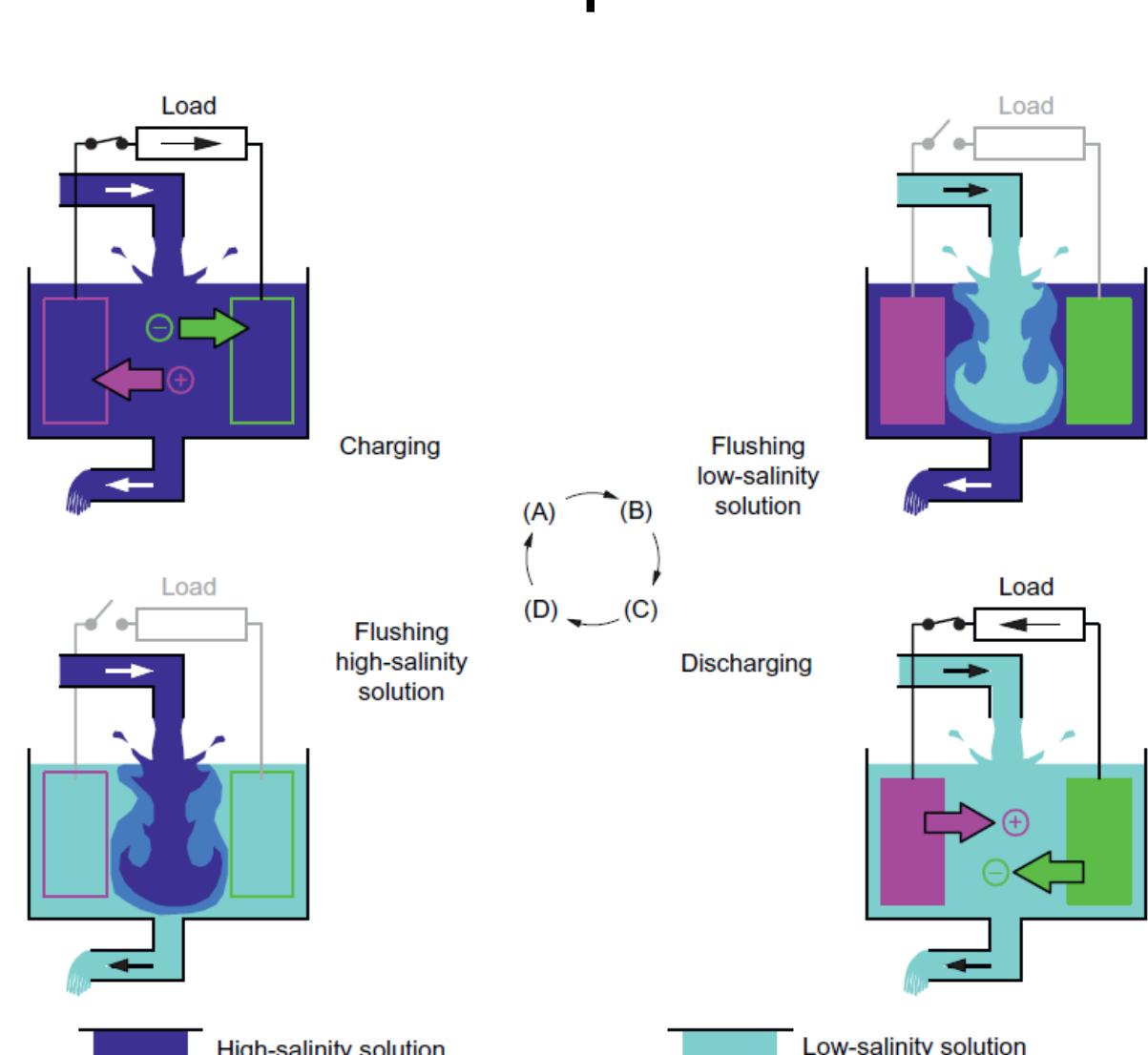
- Greenhouse gas composition: the most abundant gas among g.h.g. is **Carbon dioxide (CO<sub>2</sub>)**, coming mainly from oil and coal.
- CO<sub>2</sub> is **responsible for 60% of global warming** due to human activity

## Addressed research questions/problems

- The goal is to **harvest energy from CO<sub>2</sub> capture** adapting the Capmix technique, but the mechanism is totally different.

### Working principle

#### Capmix



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

#### CO<sub>2</sub>Cap

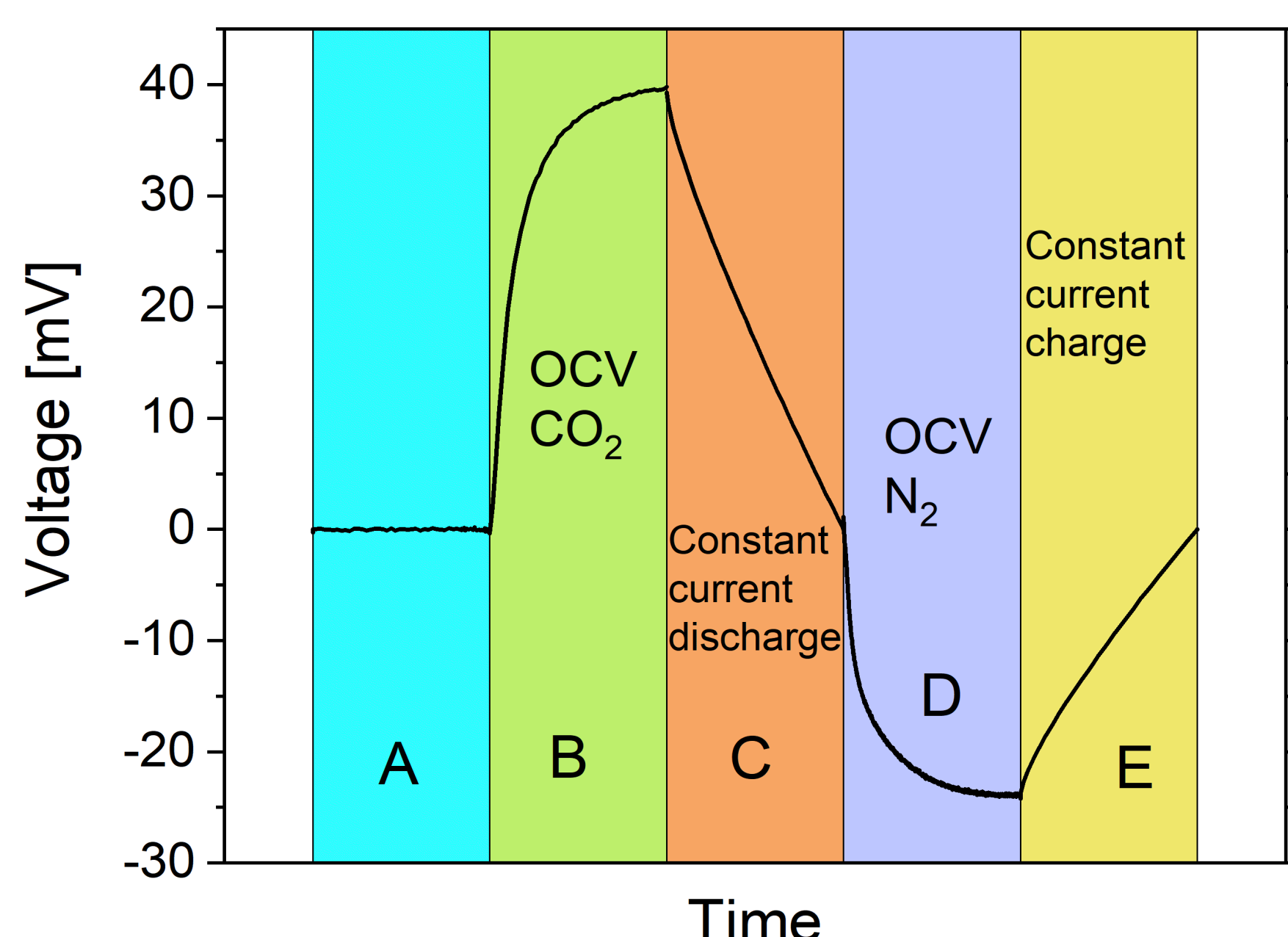


The reaction between the ionic liquid and CO<sub>2</sub> **happens only on one electrode**, producing a junction across which a voltage difference is created

## Adopted methodology

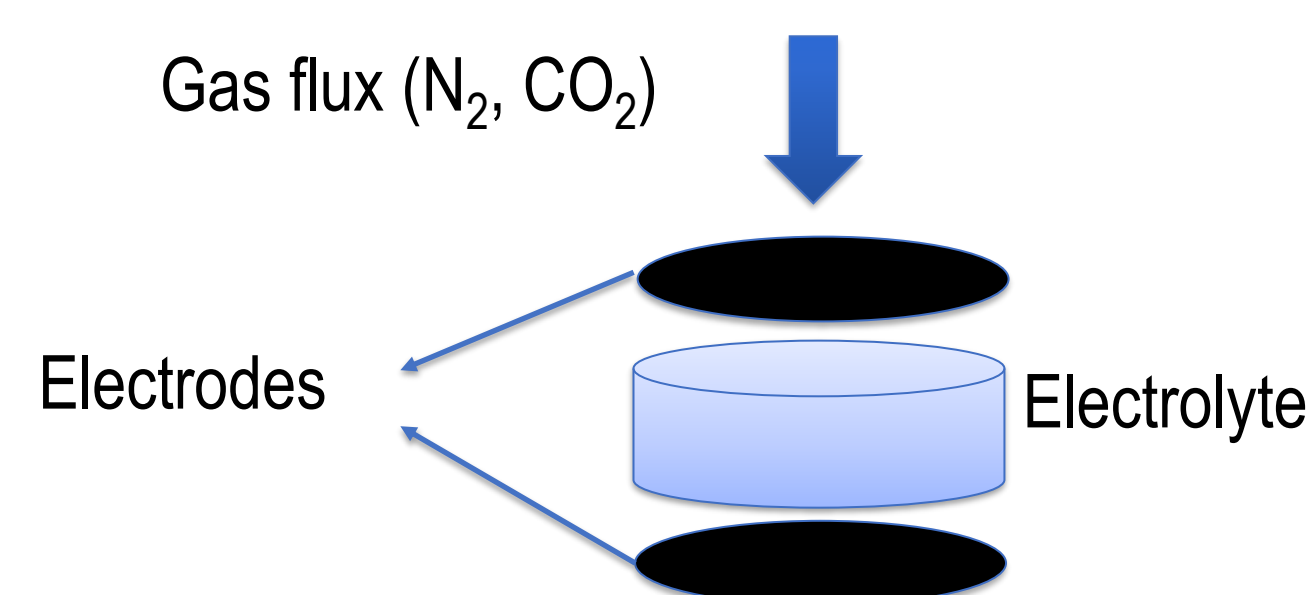
**Procedure:** inspired from Capmix, but avoiding the polarization of the device used to store charges at the electrodes interfaces.

- A: 5' short circuit
- B: OCV + CO<sub>2</sub> flush (50 ml/min)
- C: Constant current discharge (energy recovery)
- D: 15' OCV + N<sub>2</sub> flush (50 ml/min) (regeneration of the electrolyte)
- E: Constant current charge (energy recovery)



## Results

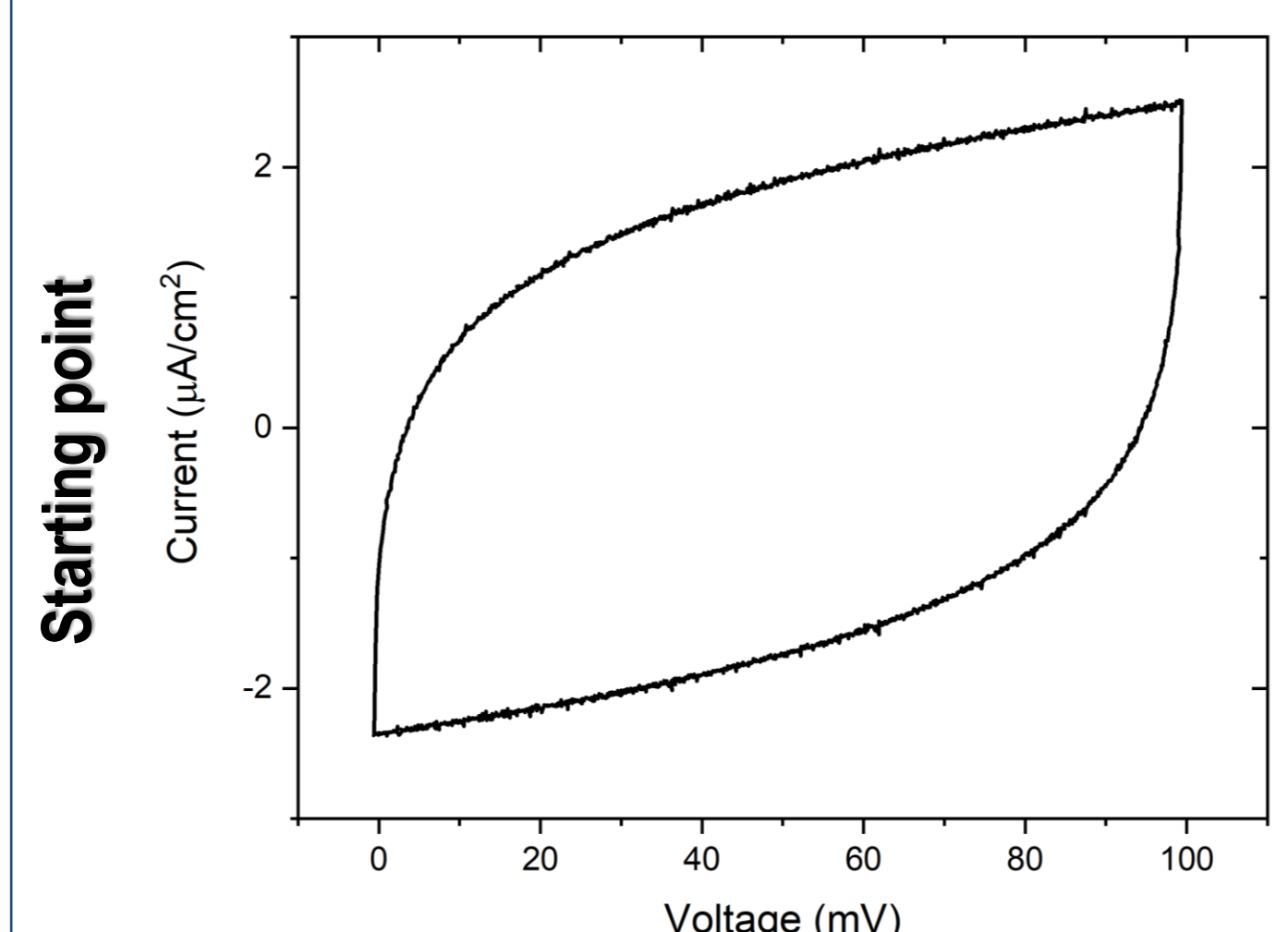
- Idea to **improve CO<sub>2</sub>Cap performances** is to exploit **ionic liquids** as electrolyte inside the harvesting device. As in Capmix technology, we substitute high and low concentration solutions with fluxes of CO<sub>2</sub> and N<sub>2</sub>.



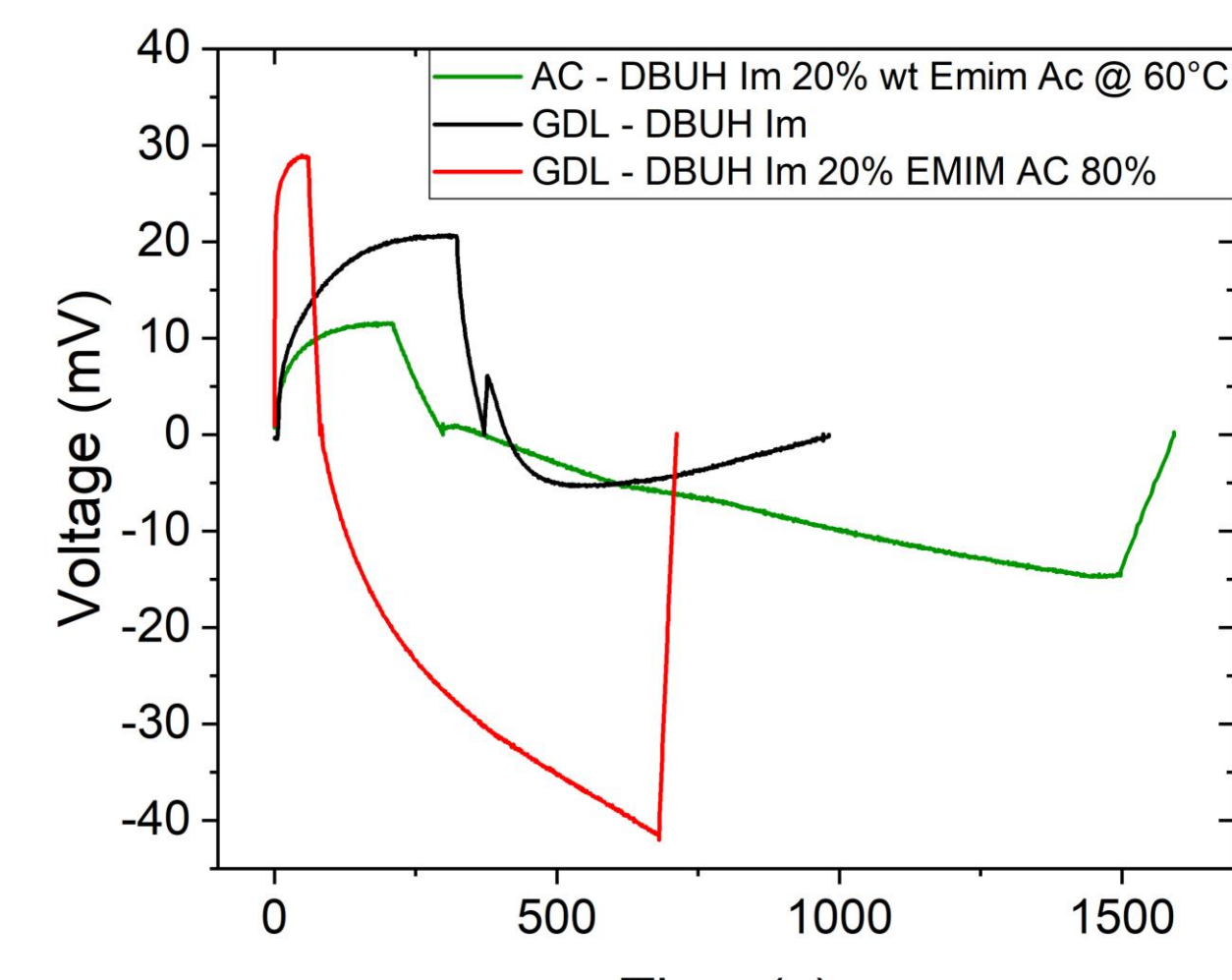
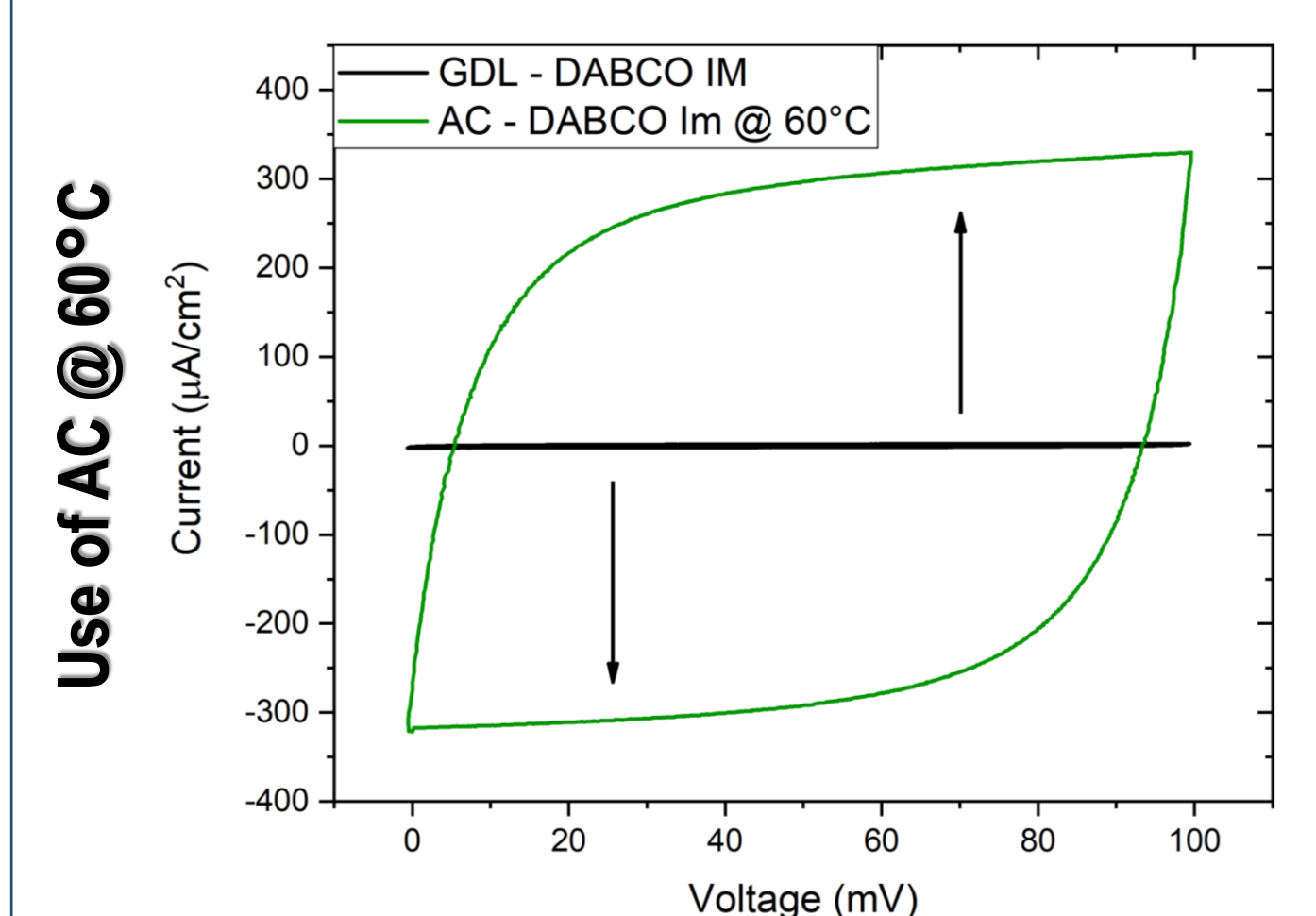
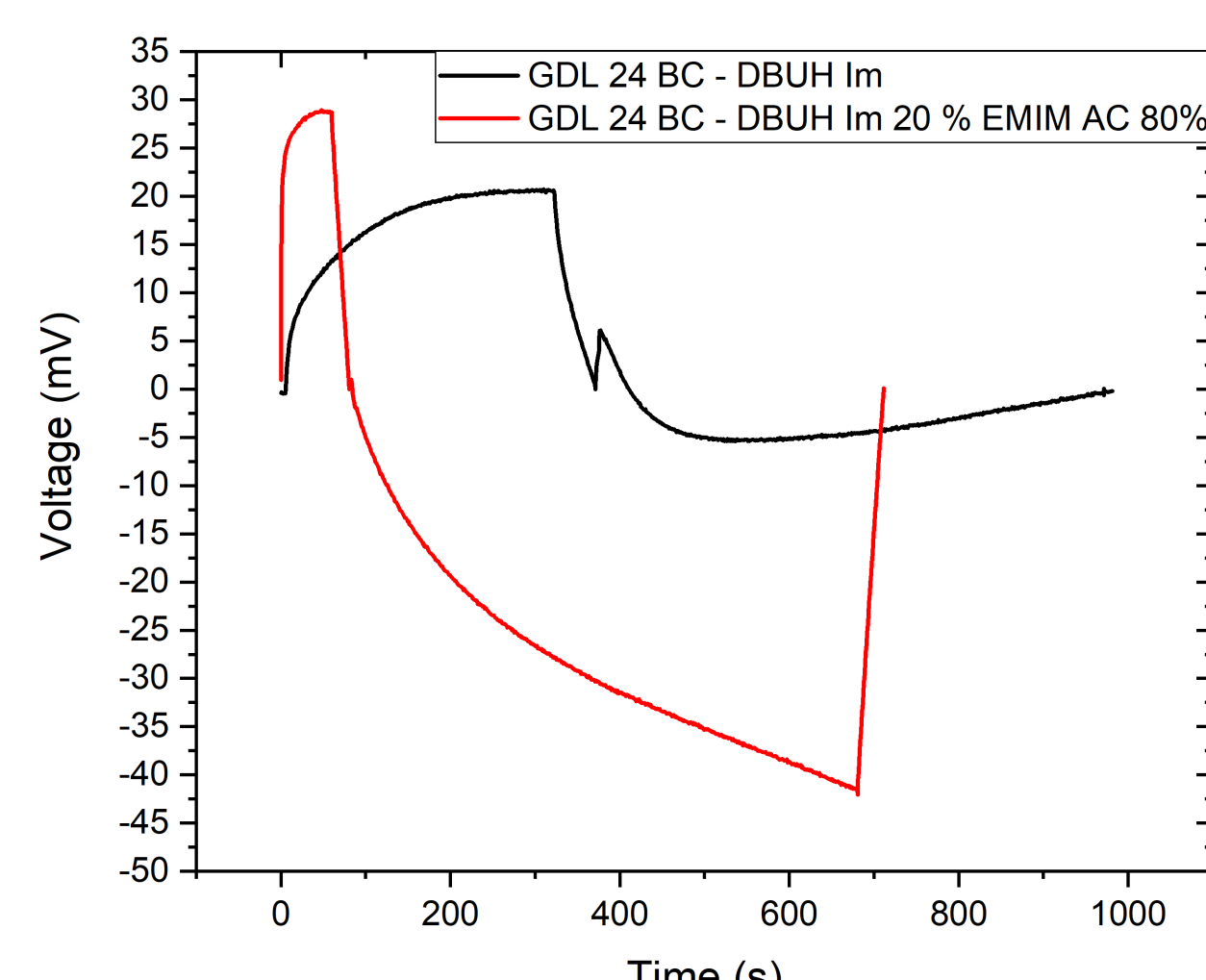
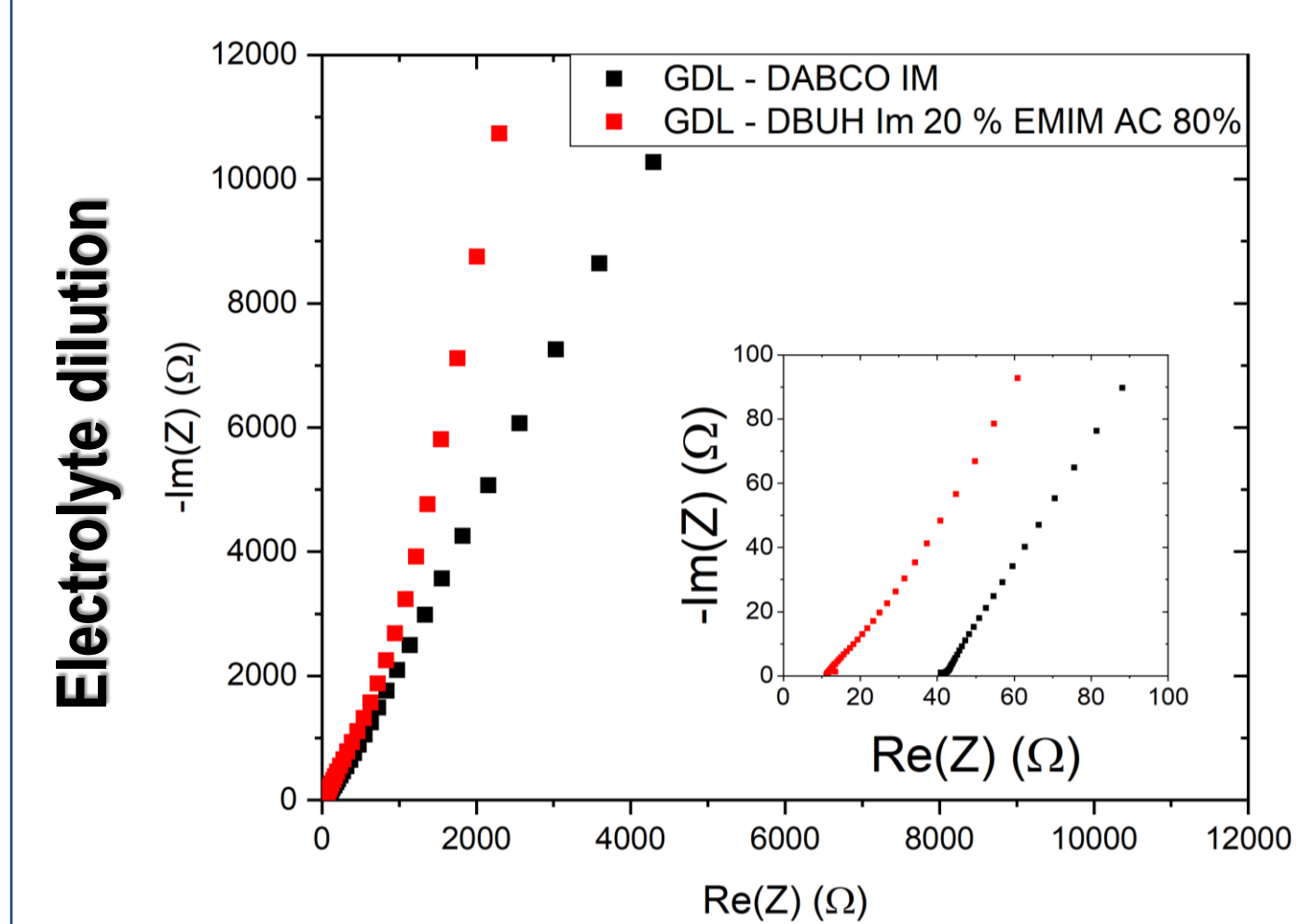
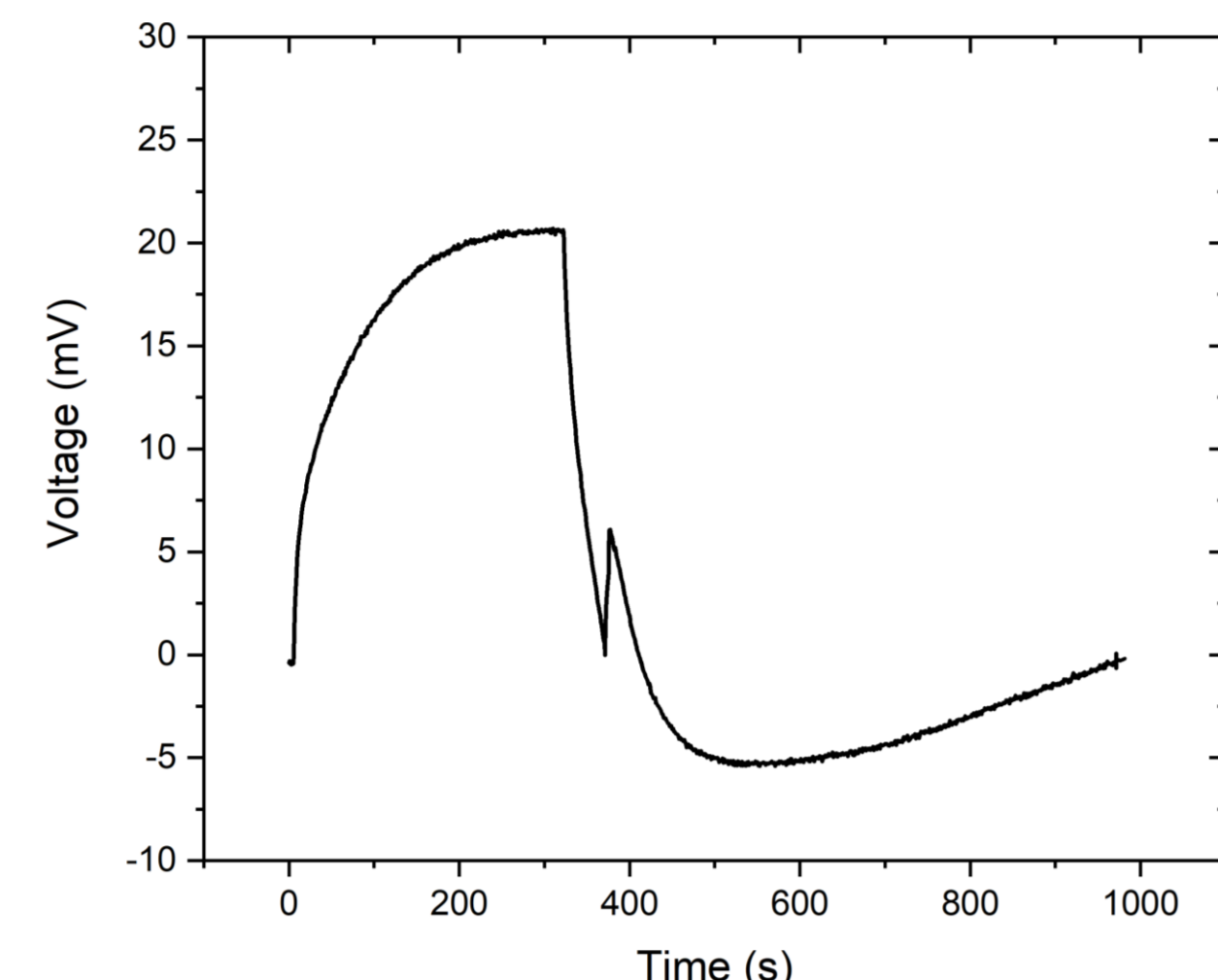
### 3 tested configurations

| Electrodes:     | Electrodes:              | Electrodes:              |
|-----------------|--------------------------|--------------------------|
| GDL             | GDL                      | Act. Carbons             |
| Electrolyte:    | Electrolyte:             | Electrolyte:             |
| Dabco Imidazole | 20% Dabco Im 80% Emim AC | 20% Dabco Im 80% Emim AC |

### EC characterization



### Capmix performances



## Future work

- Use of new ionic liquids** more selective for CO<sub>2</sub> 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 CO<sub>2</sub> by exploiting **functionalized electrodes**, able to autonomously accumulate specific charges at their surface

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