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

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

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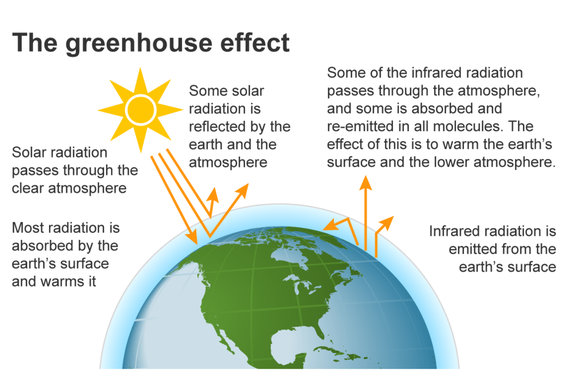
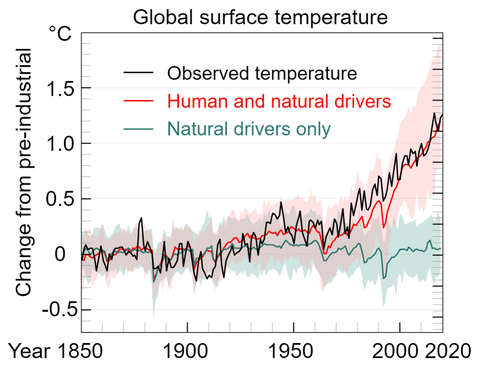
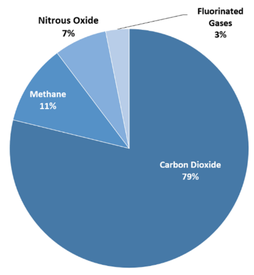
Research context and motivation

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







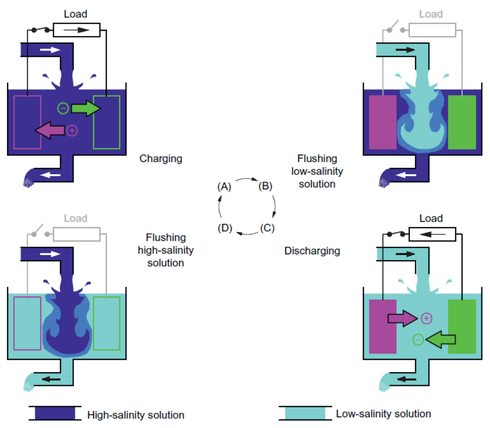
- Greenhouse gas composition: the most abundant gas among g.h.g. is **Carbon dioxide (CO_2)**, coming mainly from oil and coal.
- CO_2 is **responsible for 60% of global warming** due to human activity

Addressed research questions/problems

- The goal is to **harvest energy from CO_2 capture** adapting the Capmix technique, but the mechanism is totally different.

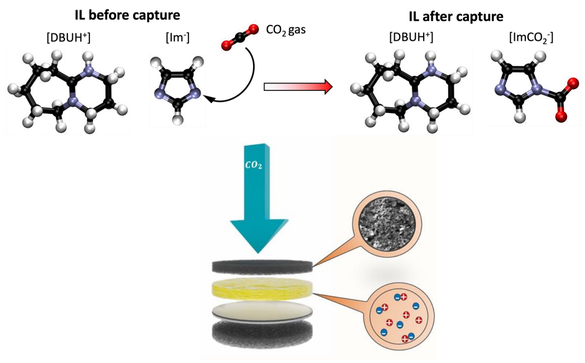
Working principle

Capmix



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

CO2Cap

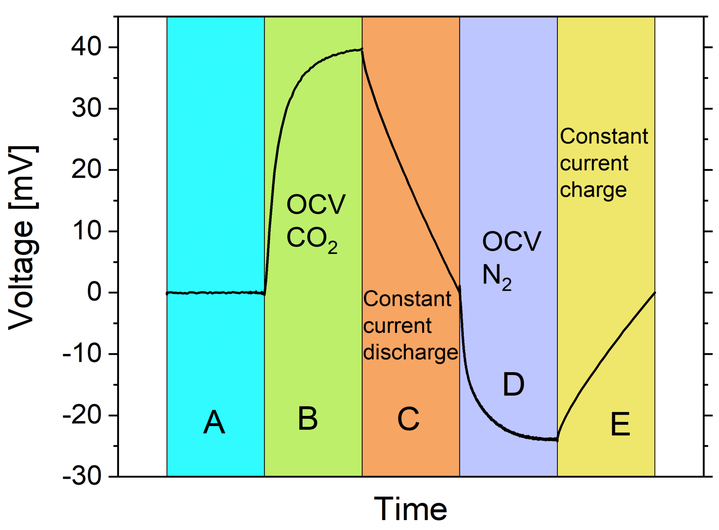


The reaction between the ionic liquid and CO_2 **happens only on one electrode**, producing a junction across which a voltage difference is created

Adopted methodology

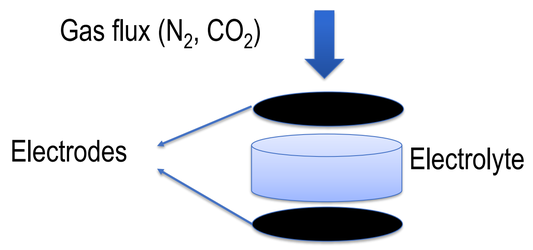
Procedure: inspired from Capmix, but avoiding the polarization of the device used to store charges at the electrodes interfaces.

- A: 5' short circuit
- B: OCV + CO_2 flush (50 ml/min)
- C: Constant current discharge (energy recovery)
- D: 15' OCV + N_2 flush (50 ml/min) (regeneration of the electrolyte)
- E: Constant current charge (energy recovery)



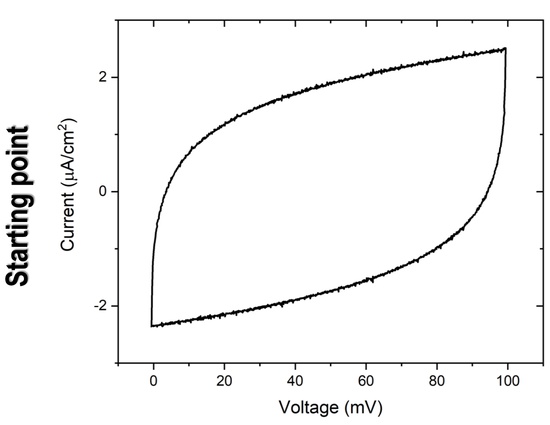
Results

- 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 CO_2 and N_2.

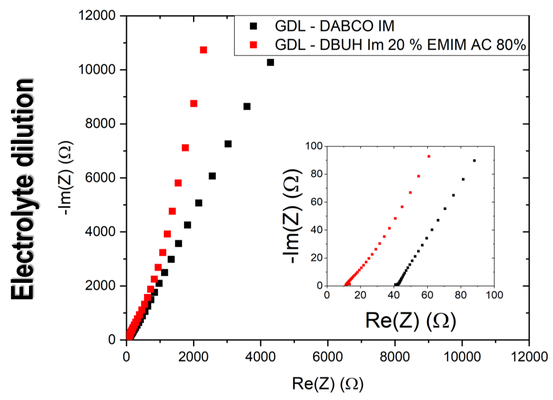


3 tested configurations		
Electrodes: GDL **Electrolyte:** Dabco Imidazolide	**Electrodes:** GDL **Electrolyte:** 20% Dabco Im 80% Emim AC	**Electrodes:** Act. Carbons **Electrolyte:** 20% Dabco Im 80% Emim AC

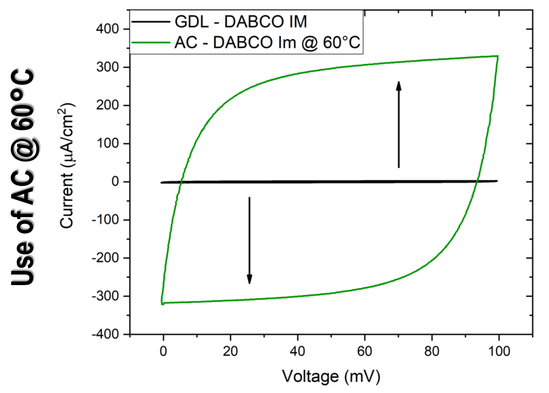
EC characterization



C= 0.3 mF/cm² η= 91.3% ESR= 40 Ω

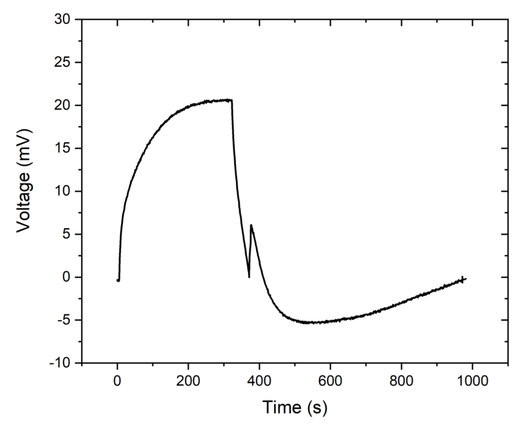


C= 0.4 mF/cm² **η= 96% ESR= 12 Ω**

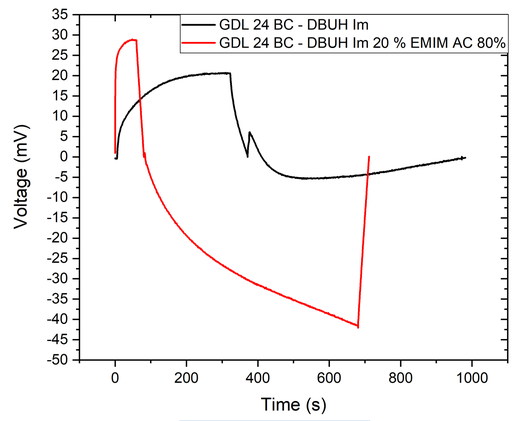


C= 50 mF/cm² η= 98% ESR= 3 Ω

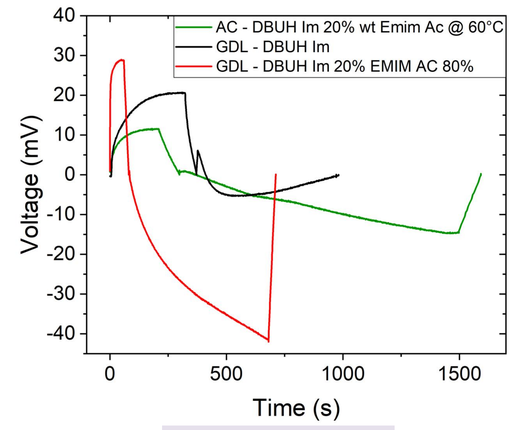
Capmix performances



E=0.1 μWh/m²



E= 2.4 μWh/m²



E=30.4 μWh/m²

Future work

- **Use of new ionic liquids** more selective for CO_2 capture
- Improve ionic mobility, reducing ion pairing by **polar aprotic solvent**, such as Propylene carbonate
- Enhance conducibility of the electrolyte by inserting a **supporting salt**
- Increase the voltage rise due to the adsorption of CO_2 by exploiting **functionalized electrodes**, able to autonomously accumulate specific charges at their surface

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EARN&ST Energy Harvesting & Storage devices

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