

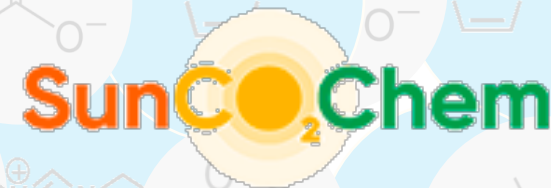


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Horizon2020  
European Union Funding  
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# IONIC LIQUIDS FOR CAPTURE AND ELECTROCHEMICAL CONVERSION OF CO<sub>2</sub>

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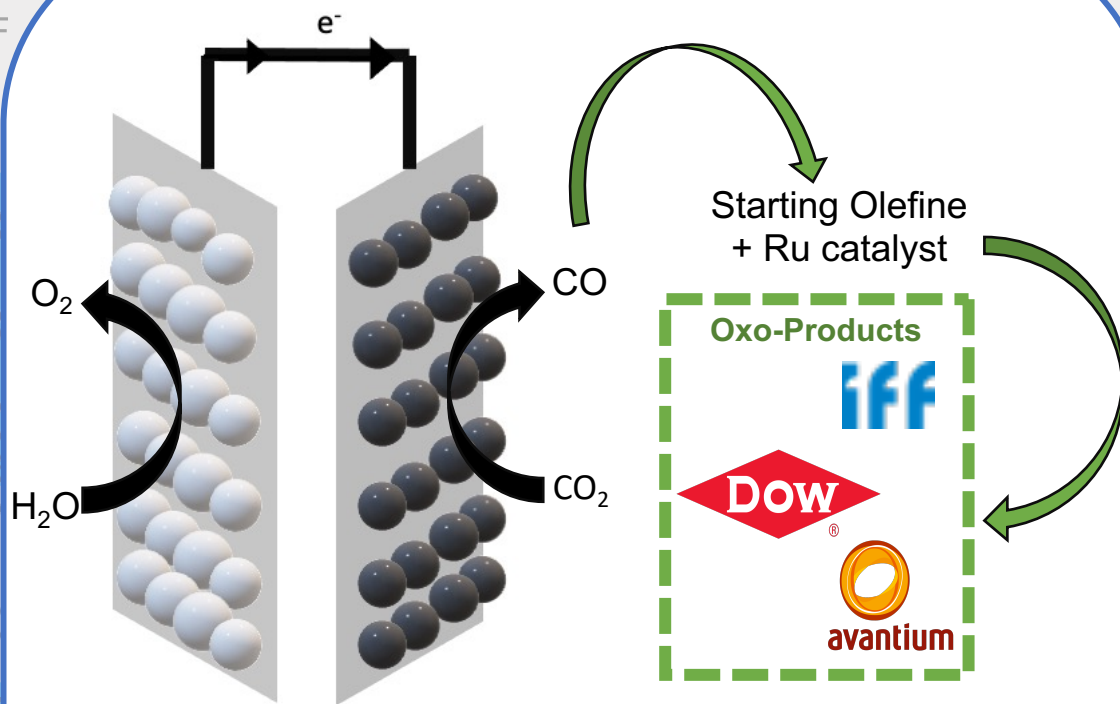
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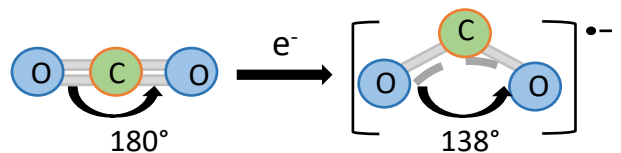
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## Introduction and aim of the work



At high current densities, the RDS involved in the CO<sub>2</sub> reduction to CO is the formation of the reactive CO<sub>2</sub><sup>•-</sup> anion radical.

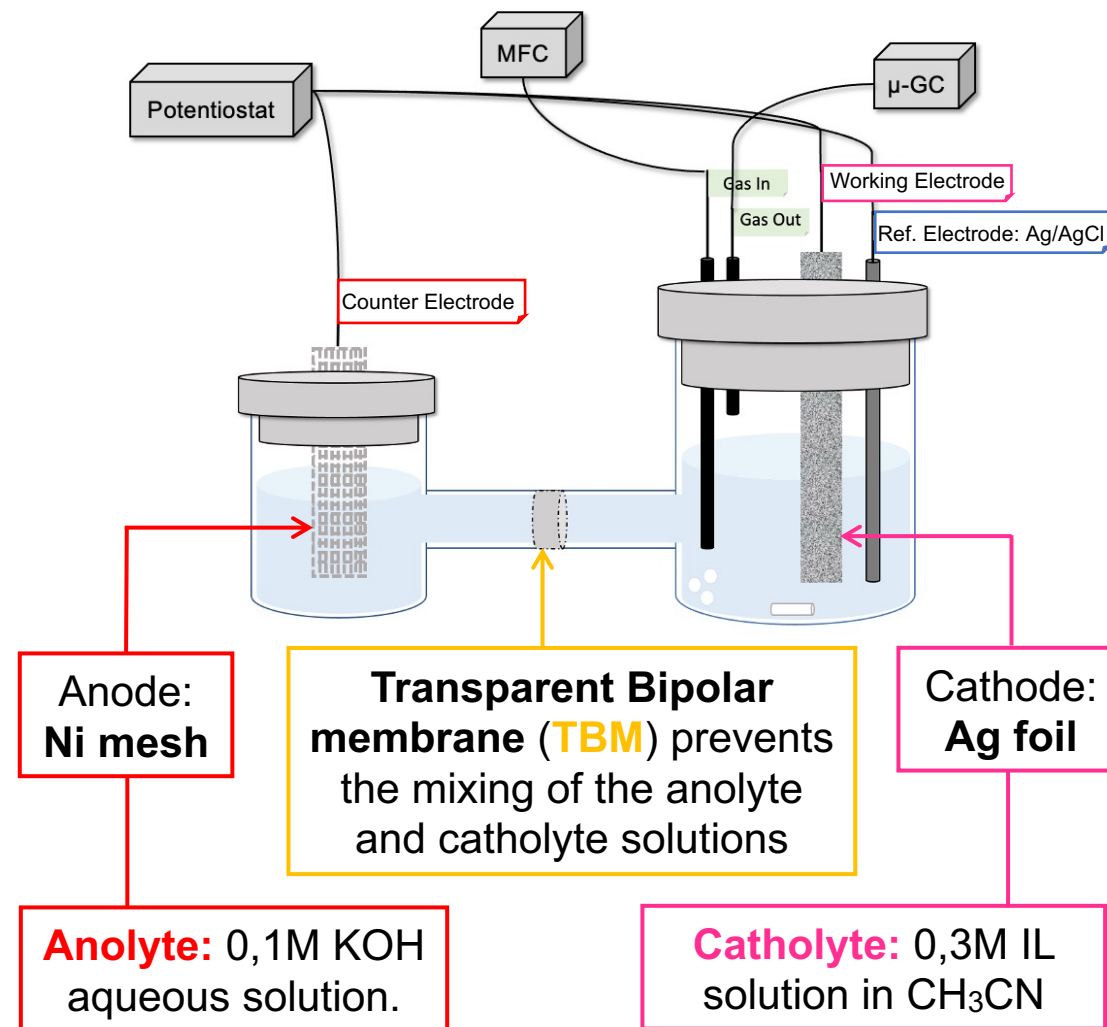


$$E^0 = -1,9\text{V vs NHE}^1 (\sim -2,1 \text{ vs Ag/AgCl})$$

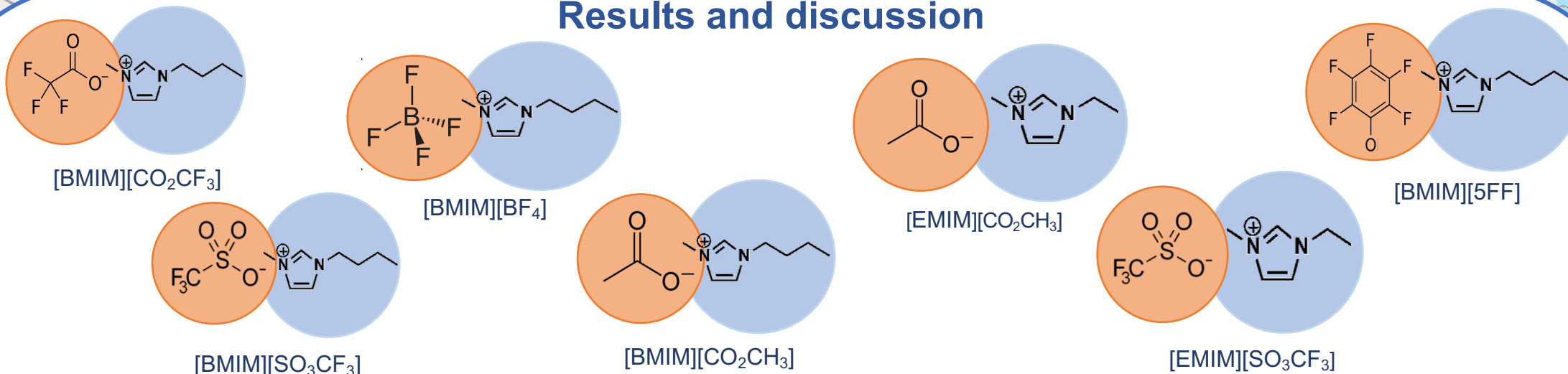
The main objective of this work is to study the influence of different **Ionic Liquids (ILs)** in the performance and selectivity of the electrocatalytic CO<sub>2</sub> reduction to CO.

## Materials and methods

### H-type cell configuration

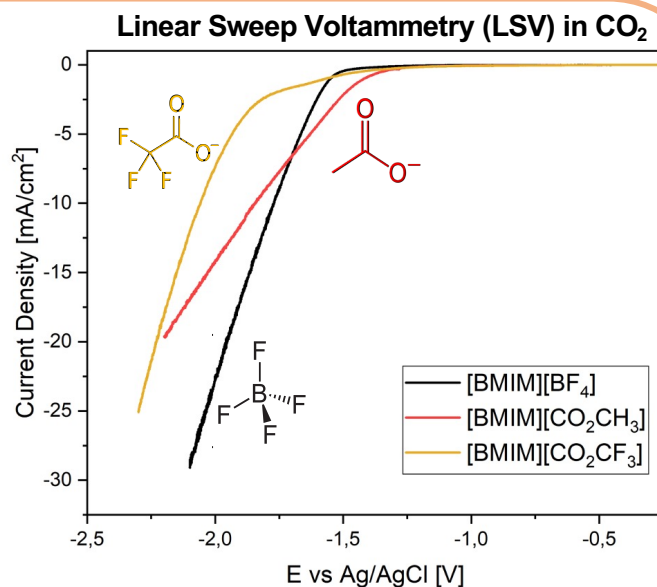


## Results and discussion



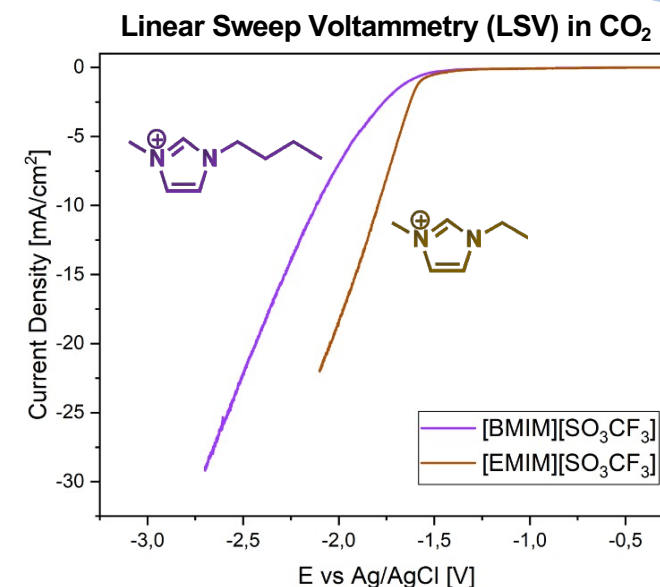
### ANION ROLE of IL

- **CO<sub>2</sub> solubility** strongly depends on the anion influence.
- A higher fluorination degree in the IL leads to a higher CO<sub>2</sub> solubility and current density.
- It might be related to the Fluorine electronegativity.<sup>3</sup>

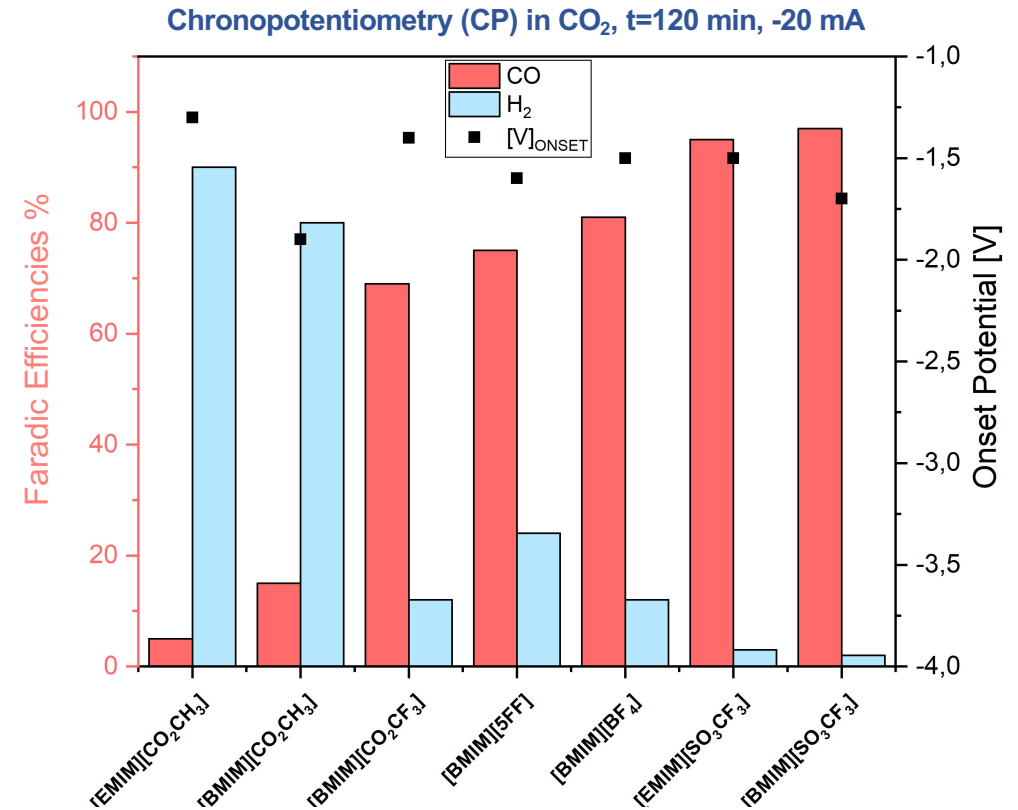
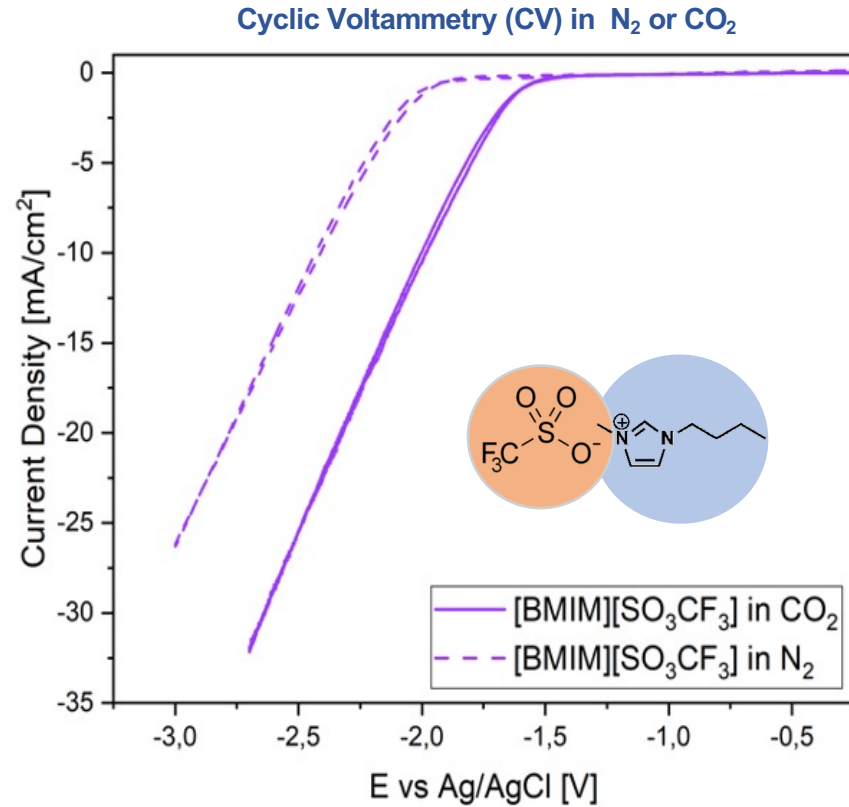


### CATION ROLE of IL

- The alkyl chain of the cation plays an **orientation role**.
- The longer the IL cation alkyl chain, the lesser it allows the anion to approach too closely to the solid charged surface.<sup>4</sup>



# Results and discussion



- ✓ **CVs' highlights:** Onset potential of all the ILs is shifted to less negative potentials when atmosphere is saturated with CO<sub>2</sub>.
- ✓ **[V]<sub>Onset</sub>'s highlights:** Imidazolium salts of [SO<sub>3</sub>CF<sub>3</sub>], [BMIM][5FF] and [BMIM][CO<sub>2</sub>CH<sub>3</sub>] are able to decrease the overpotential for the CO<sub>2</sub>RR to CO with respect to the most used [BMIM][BF<sub>4</sub>].
- ✓ **Selectivity highlights:** The maximum FE% to CO is reached by [BMIM][SO<sub>3</sub>CF<sub>3</sub>]. Ionic Liquids with acetate anion are more selective towards the production of H<sub>2</sub> than CO.

## Conclusions

- ❖ Seven imidazolium salts were tested for the electrocatalytic CO<sub>2</sub> conversion to CO.
- ❖ CO<sub>2</sub> **solubility** depends on the **anion** of the imidazolium salt, which tends to be higher for fluorinated anions.
- ❖ The **cation** has a steric effect and an orientation role. When the **alkyl chain decreases**, the imidazolium ring finds a **more convenient position** in the cathode to reduce and form the complex with the carbon dioxide molecule, which might be translated into a less negative onset potentials, as it was here observed.
- ❖ Imidazolium salts of **acetate** are more selective towards the **production of H<sub>2</sub>**. [BMIM][SO<sub>3</sub>CF<sub>3</sub>] promotes the reduction of CO<sub>2</sub> to CO better than the commonly used [BMIM][BF<sub>4</sub>]. Reaction mechanisms behind these results are being studied.

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