

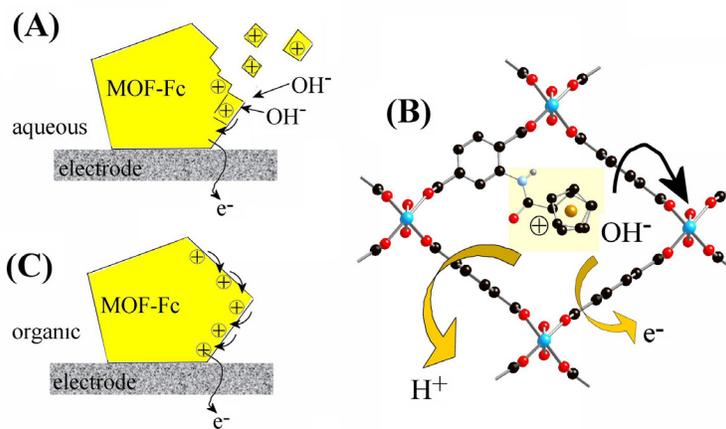
Electrochemical Conversion of CO₂ in Porous Media

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The conversion carbon dioxide back into a fuel or into another useful energy-rich molecule is a big challenge because it requires a multi-step process (at least 6 electron transfers) to occur with every single step running smoothly. This is a bit like operating a football team where every single player has to perform to allow goals to be shot. A single weak player (or a slow reaction step) can completely change the result.

In our project we are exploring ways of getting the CO₂ conversion reaction accelerated by design of the appropriate reaction environments in porous hosts. The concentration of CO₂ can be increased by absorption into a suitable porous host material. Imagine the game of football is played with 10 balls rather than with one with each goal shot representing product formation. This will substantially increase the rate of goals (or product formation). We also have to pick the best players (or here catalysts). Next, the space for the reaction is limited to smaller pores (the football field is made smaller) and again a faster rate should be observed. Finally, catalysts are embedded into the porous host to provide an active membrane where CO₂ is bound at one side and the product is formed on the way through the membrane.

The porous host used in this study is based on metal-organic-frameworks or MOF materials. The reactivity of this type of material is depending on solubility (A), the reaction space in pores (B), and charge transport (C).



Finally, the energy efficiency needs to be accounted for. Electrochemical techniques allow us to directly “see” the CO₂ reduction as a current and to minimise the energy spend on this process by adjusting the applied potential. The overall reaction should run on a minimum of energy to be viable without formation and release of even more CO₂ into the environment.