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Study of the kinetic reactions of formate dehydrogenase within an electrode.

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In nature, there are different types of enzymes that catalyze specific reactions. For example, formate dehydrogenase (FDH) is an enzyme capable of catalyzing CO₂ to formic acid [1]. It is also possible to produce methanol from CO₂ by cascade reactions with specific enzymes [2, 3]. However, enzymatic reactions require an electron and proton donor coenzyme to work. Generally, nicotinamide adenine dinucleotide (NADH) is the coenzyme used in these enzymatic reactions.

Moreover, enzymatic reactions are catalytic reactions. If we can increase the enzymatic active surface through a better design of the electrode, we could then promote the electro-reduction of CO₂. Thus the objective of the FAME project is to manufacture membrane electrode assemblies with enzymes by mimicking PEMFC (Proton Exchange Membrane Fuel Cell) technology to promote the electro-reduction of CO₂.

In this work, our first attempt is to study the FDH activity with and without immobilization within a support in carbon felt by studying the kinetic reactions described by equations (1) and (2). According to literature [2, 3], the enzyme activity is defined and measured through equation (1), however the consumption of CO₂ (in equation (2)) is the goal of our project. Here, we have tested two types of electrodes (Figure 1), where the binder is embedded inside the support or only on the surface.

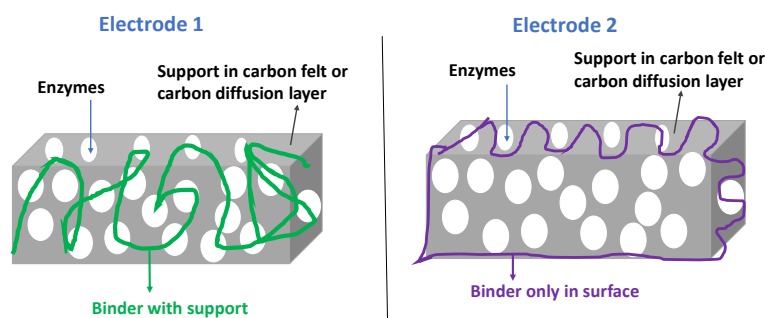
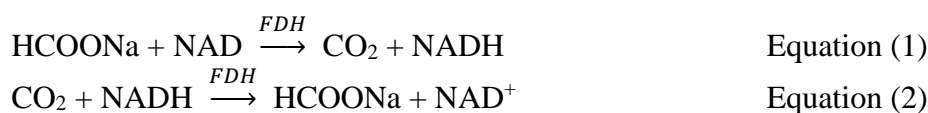


Figure 1: Schema of enzyme immobilization

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