



HAL
open science

Study of the kinetic reactions of formate dehydrogenase within an electrode

Feina Xu, Gaël Maranzana, Christophe Innocent

► **To cite this version:**

Feina Xu, Gaël Maranzana, Christophe Innocent. Study of the kinetic reactions of formate dehydrogenase within an electrode. Rencontres de Chimie Physique 2021- SCF 2021 (RCP21) 20-23 septembre 2021, Sète (34), Sep 2021, Sète, France. hal-03461628

HAL Id: hal-03461628

<https://hal.science/hal-03461628v1>

Submitted on 1 Dec 2021

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

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

Feina Xu¹, Gaël Maranzana¹, Christophe Innocent²

1 : Université de Lorraine, CNRS, LEMTA, F-54000 Nancy, France

2: IEM, Université de Montpellier, Montpellier, France

feina.xu@univ-lorraine.fr

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.

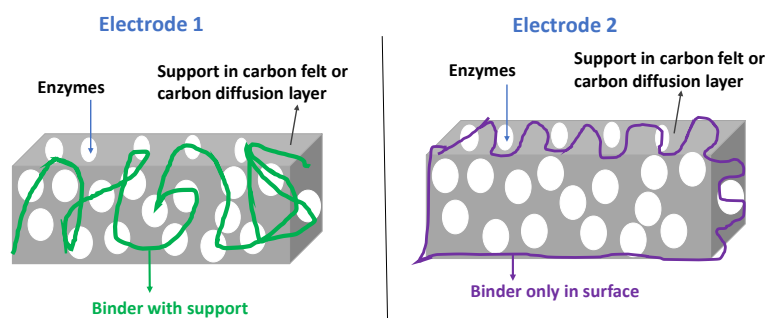


Figure 1: Schema of enzyme immobilization

[1] U. Ruschic, U. Muller, P. Willnow, T. Hopnereur, Journal of Biochemistry.70 (1976), 325–330.

[2] S. Schlager, L. M. Dumitru, M. Haberbauer, A. Fuchsbauer, H. Neugebauer, D. Hiemetsberger, A. Wagner, E. Portenkirchner, N. S. Sariciftci, Chemsuschem. 9 (2016), 631–635.

[3] P. K. Addo, R. L. Arechederra, A. Waheed, J. D. Shoemaker, W. S. Sly, S. D. Minteer, Electrochemical and Solid-state Letters 14(4) (2011) E9–E13