ENLIVEN - hiErarchical metal-orgaNic framework@covaLent organic framework (MOF@COF) on carbon nanofIbers for electrocatalytic CO2 conVErsioN

Electrocatalytic CO2 reduction (ECR) reaction offers a powerful strategy to enable a circular economy that converts CO2 from a waste to a useful resource. Among the possible catalysts for the ECR, metal-organic frameworks (MOFs) offer a tunable porous structure for rapid mass transport and easy access to a high density of catalytic sites, which can be tailored at the molecular level, leading to superior activity. Moreover, copper-based MOFs (Cu-MOFs) show relatively low cost and ability to form C2+ products. However, the low selectivity, poor stability and electrical conductivity set obstacles for ECR applications of these materials. The ENLIVEN project aims to surpass these limits, through the combination of Cu-MOFs with highly stable and conductive covalent organic frameworks (COFs) forming core@shell MOF@COF thin films on mesoporous conductive carbon nanofibers (CNFs). To this aim, CNFs prepared by electrospinning will be covered by a homogenous metal oxide layer and then pyrolysed to produce metal seeds for the solvothermal growth of homogeneous crystalline Cu-MOF-NH2 layers. Then, the NH2 functionalized surface will be modified with aldehyde groups necessary for the growth of a COF layer. To allow tuning the selectivity towards the ECR and decreasing the competing hydrogen evolution reaction, superaerophilic electrodes will be assembled using COF ligands with hydrophobic groups and designing a special morphology. Also, ENLIVEN will study the new confined chemistry that takes place inside the pores of MOF@COF architectures, rationally designed from the molecular- through nano- to meso-scale. This knowledge will provide the blueprints for the development of more durable and efficient electrocatalytic materials. The project will be conducted in UNIPD and DTU (secondment). The fellow (S.A.N.Najafabadi), with expertise in MOF/COF synthesis, will acquire new skills in the synthesis and characterisation of advanced structures for electrochemical applications.

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