Gas Diffusion Electrode based on Cu-clusters for CO_2 electroreduction to C2 products.

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The electrochemical CO_2 reduction (ECR) to valuable chemical products holds immense potential for addressing environmental concerns and societal energy demands. ECR struggles with the lack of catalysts that can provide better selectivity of C_{2+} products. Cu is the only well-known element that facilitates the C-C coupling, required for C_{2+} products from ECR.[1]
In this investigation, we explore the electrochemical CO_2 reduction to ethylene by modifying oxide-derived Cu mesoporous gas diffusion electrodes (Cu_xO GDE). The structural property of these oxide-derived Cu mesoporous foams allows the ECR intermediates to have higher retention time, promoting C-C coupling and increasing the selectivity of C_{2+} product formation.[2] Our study focuses on GDE improvement by depositing Pd clusters on the surface of mesoporous oxygen-rich copper hollow spheres , which enhances the selectivity for ethylene due to the tandem effect of Pd and Cu.[3] Pd clusters are deposited using cluster beam deposition (CBD) technology.[5] The preliminary electrochemical studies show a six-fold increase in CO_2 to C_{2+} with a Faradaic Efficiency (FE_{C2+}) from 6% for the bare mesoporous oxygen-rich Cu electrode to 36% for the Pd-cluster decorated ones. These remarkable performances are likely originating from the uniform accommodation of the metallic Pd clusters that provide a favorable surface for the initial adsorption of CO_2,[6] and induces the Cu electrode morphology continuously, refreshing the electrode surface and thereby maintaining the ECR activity.[4] while mesoporous oxygen-rich Cu component facilitates the reduction of CO_2 to CO and the subsequent hydrogenation of CO to C_{2+}.[7] By elucidating the design principles and optimization strategies for electrocatalytic systems, our findings pave the way for sustainable CO_2 conversion and offer a viable pathway towards addressing global energy challenges while meeting societal needs.

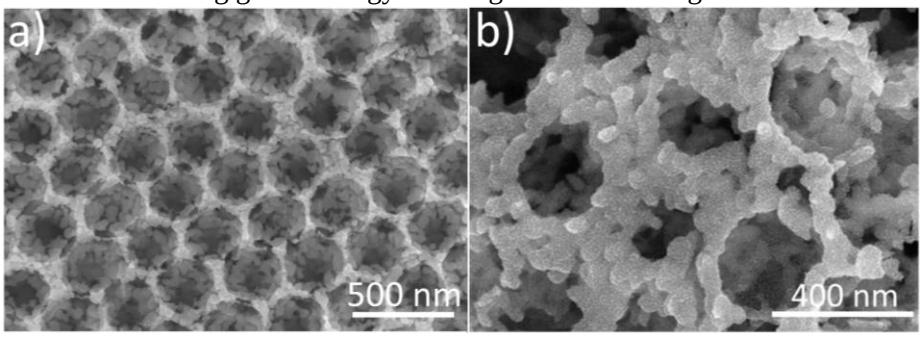

Figure 1. SEM images of a) mesoporous Cu_xO and Cu_xO modified with Pd clustersmo.

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