Tuning Cathode Porosity for Electrochemical Reduction of CO_2 at High Pressure

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The development of active and stable catalytic cathodes is critical for advancing electrochemical carbon dioxide reduction into fuels and chemicals from Lab to market. This is a technology with a high potential to contribute to combat climate changes by using captured CO_2, water and renewable energy [1]. The use of pressures higher than atmospheric pressure to carry out the co-electrolysis of CO_2 and water has been recognized as an important process intensification parameter to increase productivities and energy efficiency [2]. Ongoing work addresses the preparation of aerogels by the sol gel method and impregnation with zinc and copper metallic particles to be used as cathodes for the co-electrolysis of CO_2 and water to produce syngas at temperatures near room temperature and high-pressure. Ionic liquid-based electrolytes are used to increase CO_2 concentration at the surface of the electrode and consequently productivities, as some ionic liquid families are known to solubilize high amounts of CO_2. Aerogels have been investigated for many different applications including as catalyst supports, due to their high surface area, stability in gaseous or liquid phases, and efficient transport through large meso and macropores. The present work reports a strategy to tune the pore sizes of the catalytic electrodes by the use of reticulating agents and supercritical CO_2 drying. Productivities and faradaic efficiencies of the porous materials with the different reticulating agents are compared and interpreted in respect to their surface characterization e.g. BET surface areas and morphologies determined by SEM. The potential of new aerogel-based catalytic cathodes on the efficiency of the electrochemical CO_2 reduction will be discussed and its impact in fostering supercritical fluids technology through its use in processes for the mitigation of climate changes.

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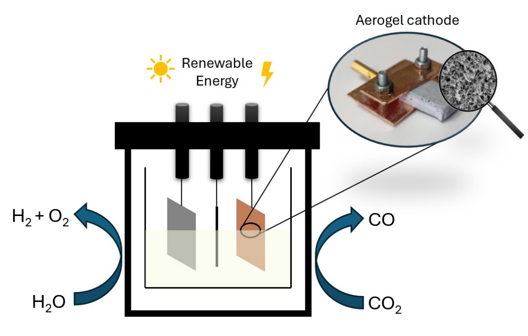

Figure 1. Electrochemical reduction of CO_2

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