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Carbon Supported Silver Nanostructures for Electrochemical Carbon Dioxide Reduction

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Abstract : Electrocatalytic reduction methods hold significant promise in addressing the urgent need to mitigate excessive greenhouse gas emissions, particularly carbon dioxide (CO_2). A highly effective catalyst is essential for achieving the conversion of CO_2 into valuable products due to the complex, multi-electron, and multi-product nature of the CO_2 reduction process. The electrochemical reduction of CO_2, driven by renewable energy sources, presents a valuable opportunity for simultaneously reducing CO_2 emissions while generating valuable chemicals and fuels, with syngas being a noteworthy product. Silver-based electrodes have been the focus of extensive research due to their low overpotential and remarkable selectivity in promoting the generation of carbon monoxide (CO) in the electrocatalytic carbon dioxide reduction reaction (CO_2RR). In this study, we delve into the synthesis of carbon-supported silver nanoparticles (Ag/C), which serve as efficient electrocatalysts for the reduction of CO_2. The as-prepared catalyst, Ag/C, is not only cost-effective but also highly proficient in facilitating the conversion of CO_2 and H_2O into syngas, which is a customizable mixture of hydrogen (H_2) and carbon monoxide (CO). The highest faradic efficiency for the production of CO on Ag/C was calculated to be 56.4% at -1.4 V vs Ag/AgCl. The maximum partial current density for the generation of CO was determined to be -9.4 mA cm-2 at a potential of -1.6 V vs Ag/AgCl. This research demonstrates the potential of Ag/C as an electrocatalyst to enable the sustainable production of syngas, contributing to the reduction of CO_2 emissions and the synthesis of valuable chemical precursors and fuels.

Keywords : CO_2, carbon monooxide, electrochemical, silver
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