Highly Selective Carbon Nanosheets Decorated With Ag-Cu Nano Alloys for Enhanced Electrochemical CO2 Reduction to C2 Products

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Electrochemical CO2 reduction to C2 hydrocarbons has been intensively studied as a promising approach for utilizing CO2 emissions and meeting the high demand for ethanol and ethylene as valuable chemical feedstocks. However, the selectivity of current Cu-based electrocatalysts is hindered by the competing hydrogen evolution reaction (HER) and the formation of undesired byproducts. In this work, facile carbon nanosheets were incorporated to fabricate a novel and cost-effective carbon-based electrocatalyst. CNs were synthesized using single-step pyrolysis of sodium citrate and were incorporated into the MOF-derived Ag-Cu nanoalloys. Their morphological and structural analysis was done through XRD, SEM, TEM, and EDX. Afterward, they were prepared as working electrodes for investigation in electrochemical reactors. LSV, EIS, and CV analysis performed in the H-cell had proven the high current density, charge transfer resistance, and electrochemical surface area of Ag-Cu/CN. Reduction products were evaluated in the flow cell electrolyzer, in which (10% Ag) Ag-Cu/CN exhibited a superior faradaic efficiency of 70% for C2 products (39% to ethylene and 31% to ethanol) at a potential of -1.4 VRHE and a current density of 250 mA/cm2. It had surpassed the competing reaction HER, proven to be ~20% more selective than before the incorporation of CNs. A stability test showcased its excellent durability for 12 hours. This study offers insights into the design of carbon-based electrocatalysts incorporated with readily prepared CNs that have the potential to be applied to large-scale electrolyzers, opening a path for a sustainable resource for ethanol and ethylene production.

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