

Gold-like activity copper-like selectivity of heteroatomic transition metal carbides for electrocatalytic carbon dioxide reduction reaction

An overarching challenge of electrochemical carbon dioxide reduction reaction (eCO₂RR) is to find a highly active catalyst that can produce hydrocarbons at a high current density and a relatively low overpotential. In a recent study published in *Nature Communications*, Prof. Asadi and [his research team](#) at Illinois Tech have discovered a new class of catalysts that effectively converts CO₂ to hydrocarbons such as methane (CH₄), ethylene (C₂H₄), methanol (CH₃OH), and ethanol (C₂H₅OH) at remarkably high current density (reaction rate) and faradaic efficiency (selectivity) beating the performance of gold in activity and copper in selectivity known to be state-of-the-art catalysts for eCO₂RR

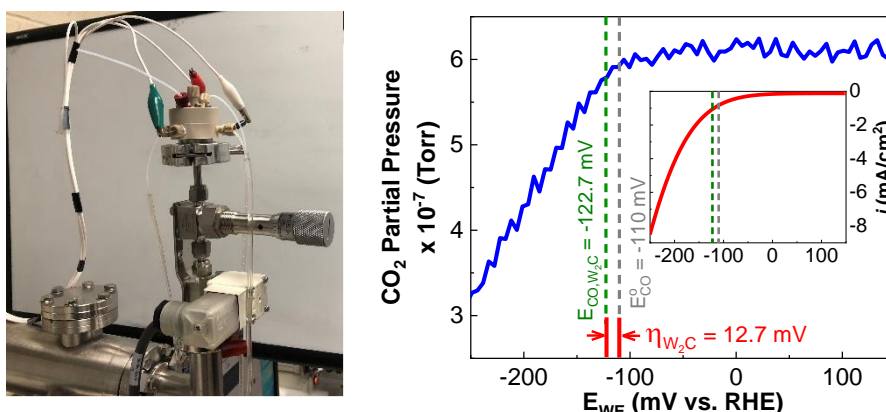


Figure: Left: In-situ differential electrochemical mass spectrometry (DEMS) setup used in this study. Right: The CO₂ partial pressure as a function of potential and corresponding LSV result (inset) are shown for W₂C nanoflakes as the catalyst for eCO₂RR.

They have developed a zero-gap flow electrolyzer for eCO₂RR using di-tungsten carbide (W₂C) nanoflakes as the cathode catalyst with superior current density of 548.89 mA/cm² at 2.3 V, CH₄ selectivity of 82.7 and long-term stability of 700 hours. A CO₂RR onset potential of 12.7 mV is also obtained by using a real time differential electrochemical mass spectroscopy (DEMS; HPR-40 purchased from Hidden Analytical).

A combined experimental and computational study in collaboration with scientists at *Molecular Foundry, Lawrence Berkeley National Laboratory* revealed that chemisorption of CO₂ and cleavage of the C-O bond at the tungsten surface atoms become nearly spontaneous resulting in the observed superior electrocatalytic performance of the W₂C catalyst.

Project summary by:

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Hidden Product: [HPR-40 DEMS](#)