

Highly-dispersed Ni Supported by N-doped Carbon Derived from Silk for Electrocatalytic CO₂ Reduction

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Electrochemical reduction of CO₂ using excess electricity from renewable energy sources mitigates environmental problems and provides us with energy-dense fuels. Highly dispersed transition metal (TM) catalysts show distinct catalytic properties from their bulk counterparts and are considered efficient catalysts for CO₂ Reduction Reaction (CO₂RR). Herein, we report the synthesis of an efficient catalyst from cocoon silk for electrochemical CO₂RR — highly dispersed Ni supported by N-doped carbon nanosheet (Ni/Silk). Silk fibroin's rich amino groups coordinated to Ni²⁺, and finely dispersed Ni²⁺ under room temperature. Under high carbonization temperature, supporting material's 2D morphology was maintained, highly dispersed Ni was formed. As N-doped carbon nanosheet (Silk) derived from silk showed no intrinsic activity towards CO₂RR, the active sites were determined to be related to highly dispersed Ni. The Ni/Silk catalyst demonstrated excellent activity and selectivity for CO₂RR, and the Faradaic Efficiency (FE) for CO₂RR towards CO reaches 91% at -0.95 V vs. Reversible Hydrogen Electrode (RHE). The current density of about -4 mA cm⁻² and Faradic Efficiency for CO of over 60% was maintained for 17 hours.

Awards Won:

Intel ISEF Best of Category Award of \$5,000

First Award of \$3,000

Dudley R. Herschbach SIYSS Award