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:

Dudley R. Herschbach SIYSS Award

First Award of $3,000

Intel ISEF Best of Category Award of $5,000