Chemical Vapor Depostion (CVD) - Driven Cu2O@Cu3P Heterostructure electrode for Energy Storage Applications

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To address the growing demand for high-performance energy storage systems, innovative electrode designs are essential. In this study, we introduce a solution-free chemical vapor deposition (CVD) approach to synthesize Cu_2O@Cu_3P heterostructure electrodes for supercapacitor applications. The use of CVD, a solvent-free technique, enabled precise control over the growth of hierarchical Cu_2O@Cu_3P nanostructures on conductive Cu foam substrates without the need for binders or additives. The integration of Cu_2O and Cu_3P in this composite structure provided complementary benefits, with Cu_2O contributing to stable capacitive behavior and Cu_3P enhancing electronic conductivity and electrochemical activity. By adjusting key CVD parameters such as phosphorus content, argon gas flow, and reaction time, we optimized the electrode morphology for enhanced energy storage performance. Electrochemical evaluations, including cyclic voltammetry (CV), galvanostatic charge-discharge (GCD), and electrochemical impedance spectroscopy (EIS), revealed significant improvements in charge storage capability, cycling stability, and overall efficiency. Structural analyses using X-ray diffraction (XRD) and scanning electron microscopy (SEM) confirmed the uniform deposition and robust heterostructure formation. The solution-free nature of the CVD process, combined with the superior ion/electron transfer characteristics of the Cu_2O@Cu_3P heterostructure, positions this electrode as a promising candidate for advanced supercapacitor technologies.

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