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SOL-GEL DERIVED $CuWO_4$: A PROMISING ELECTRODE MATERIAL FOR ENERGY STORAGE APPLICATIONS

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Abstract

Copper tungstate ($CuWO_4$) nanoparticles were successfully synthesized via the sol-gel method, offering a cost-effective and controllable route for high-purity material fabrication. Structural characterization using X-ray diffraction (XRD) confirmed the formation of a single-phase triclinic crystal structure with well-defined peaks, indicating good crystallinity. The average crystallite size was estimated using the Scherrer equation and found to be in the nanometer range of 35 – 50 nm. Scanning electron microscopy (SEM) revealed a homogeneous morphology with uniformly distributed particles, while energy-dispersive X-ray spectroscopy (EDS) verified the elemental composition and purity. Optical properties were investigated through UV–Vis diffuse reflectance spectroscopy, revealing a strong absorption in the visible region and a direct band gap estimated to be around 2.2–2.4 eV, consistent with its semiconducting nature. Electrochemical characterization was carried out using cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). The $CuWO_4$ electrode exhibited redox activity characteristic of transition metal oxides and demonstrated good stability over multiple cycles. The material showed promising performance for applications in energy storage due to its mixed ionic-electronic conductivity and surface-active sites.

Keywords: $CuWO_4$, Electrochemical, Energy Storage, Sol-gel, Transition Metal Oxide