Enhancing the Supercapacitive Properties of Iron Oxide Electrode through Cu²⁺-doping: Cathodic Electrosynthesis and Characterization

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Cu²⁺ doped iron oxide nanoparticles (Cu-IONPs) are prepared *via* a one-step facile electrodeposition procedure. In this procedure, Cu-IONPs are electro-deposited in a two-electrode set up from an additive-free aqueous solution of mixed Fe(NO₃)₃, FeCl₂ and CuCl₂ salts. The applied deposition parameters were current density of 10 mA cm⁻², bath temperature of 25°C and deposition time of 30 min. The structural and morphological characterizations through X-ray diffraction (XRD), field emission electron microscopy (FE-SEM) and energy-dispersive X-ray (EDX) confirmed that the fabricated Cu-IONPs sample is composed of Cu²⁺ doped magnetite phase with particles with average size of 20 nm. Magnetic studies by VSM showed that the deposited Cu-IONPs provide proper superparamagnetic characters of saturation magnetization ($M_s=54.47$ emu g⁻¹), remanent magnetization ($M_r=0.41$ emu g⁻¹) and coercivity ($H_{Ci}=10.53$ G). The obtained electrochemical data indicated that Cu-IONPs are enable to exhibit specific capacitance as high as 189.6 F g⁻¹ at a discharging current of 2 A g⁻¹, and 88.8% capacity retention after 2000 GCD cycling. Based on the obtained results, our developed electrosynthesis method is proposed as a facile route for the synthesis of high performance Cu-IONPs.

Keywords: Nanoparticles, Magnetite, Cu²⁺ doping, Electrosynthesis, Supercapacitors

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