

عنوان مقاله:

Electrochemical Study of a Novel High Performance Supercapacitor Based on MnO₂/Nitrogen-Doped Graphene Nanocomposite

محل انتشار:

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خلاصه مقاله:

Supercapacitors as energy storage devices have advantages in comparison to the batteries such as higher power densities, fast charging/discharging rates, and excellent cycling stabilities. Supercapacitors are used particularly for the applications involving in high power electronics, electrical utilities, transportation, medical electronics and military defense systems [1]. MnO₂ as a supercapacitor electrode has attracted many attentions due to its relatively low cost, and being environmental friendly as neutral aqueous electrolytes [2]. However, the low electrical conductivity (10–5–10–6 S cm⁻¹) and low electrochemical kinetic of MnO₂ limit its charge storage and thus its commercial usage. The electrical conductivity of MnO₂ could be improved by incorporating various types of carbonaceous compounds such as graphite, graphene oxide, graphene, carbon nanotube, mesoporous carbon, and carbon black by various methods [1–3]. Nitrogen doped reduced graphene oxide (NRGO) can increase the conductivity of metal oxide based supercapacitors. In the present study, a simple method for preparation of MnO₂/NRGO as the supercapacitor electrodes is introduced using ultrasonic vibration. Applying ultrasonic waves is a simple method for the synthesis of nanostructures [23]. The process, known as cavitation, is based on incorporating bubbles in the liquid, where they grow up and finally collapse. The bursting of bubbles results in very high local temperature and pressure leading to reactions in the solution [4]. The structure and morphology of MnO₂/NRGO nanocomposites are characterized by X-ray diffraction, X-ray photoemission spectroscopy (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM) and Raman spectroscopy. The electrochemical supercapacitive performance of the nanocomposite was investigated by cyclic voltammetry (CV), FFT Continuous cyclic voltammetry (CCV), galvanostatic charge/discharge, and electrochemical impedance spectroscopy (EIS) methods. The supercapacitive performance of the RGO, NRGO, pure MnO₂, MnO₂/RGO and MnO₂/NRGO electrodes were studied by CV method, using a three-electrode system using Ag/AgCl as the reference and platinum foil as the counter-electrode. Fig. 1a illustrates the typical CV curves of the MnO₂, RGO/MnO₂ and NRGO/MnO₂ electrodes were measured at 50 mV s⁻¹ in 0.5 M Na₂SO₄. The results show that the CV curves of the RGO/MnO₂ and NRGO/MnO₂ electrodes are symmetrical respect to the zero-current line and a rapid current change around the potential reversal at the end each ... scan. In fact, existing a quasi-rectangular shapes

