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Enhanced Supercapacitor Performance of Graphene/V_2O_5 Nanocomposites

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With increasing energy and power demands in high power applications such as, electric vehicles, hybrid electric vehicles and mobile electronics have stimulated significant research efforts on the development of new electrode materials for advanced energy storage devices [1]. Among them supercapacitor is an important energy storage device mainly due to their high power densities, fast recharge capability and long cycle life than secondary batteries [2]. Nowadays many researchers have been focused on the supercapacitor to increase their energy densities as well as decrease the fabrication costs. The electrode materials play an important role in the development of high performance supercapacitors in terms of the morphology, size, porosity and so forth. Among various electrode materials, graphene (electrochemical double layer) and vanadium pentoxide (V_2O_5, pseudocapacitors) are considered to be promising electrode materials for supercapacitor applications due to their intriguing characteristics such as low cost, and natural abundance [3]. Graphene exhibited high surface area, electrical conductivity and extraordinary thermal, mechanical, and electrical properties [4]. On the other hand V_2O_5 has layered structure, modest electronic conductivity and the satisfactory charge storage capacity [5]. By combing the attractive features of the graphene and V_2O_5 materials to enhance the electronic conductivity of V_2O_5 and maintain high electrolyte penetration/diffusion rates which leads to the improved capacitance.

In the present study, graphene/V_2O_5 nanocomposites were synthesized by a facile, fast and scalable microwave-assisted method for electrochemical supercapacitor applications. The structural, composition and morphological properties of the as prepared graphene/V_2O_5 nanocomposites were characterized by X-ray diffraction (XRD), laser Raman microscopy, X-ray photoelectron spectroscopy (XPS), field emission scanning electron microscopy (FE-SEM), and transmission electron microscopy (TEM). The electrochemical properties were examined by cyclic voltammetry (CV), galvanostatic charge- discharge and electrochemical impedance spectroscopy (EIS) measurements in 1M Na_2SO_4 aqueous solution.

Fig.1. shows the FE-SEM image of the as prepared graphene/V_2O_5 nanocomposites. It can be observed that the V_2O_5 nanoparticles are uniformly disturbed on the surface of graphene nanosheets. The size of the nanoparticles was in the range of 20-30 nm. CV curves (**Fig.2.**) of V_2O_5, reduced graphene oxide and graphene/V_2O_5 nanocomposite electrodes exhibited similar and ideally rectangular shape, confirming an ideal capacitive behavior of the electrode. In addition, it can be seen that the graphene/V_2O_5 nanocomposites electrode show higher integrated area than other electrodes, which indicates that the graphene/V_2O_5 nanocomposites electrode shows an excellent electrochemical performance.

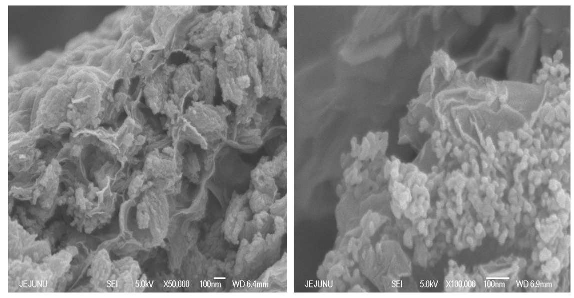

Fig.1. FE-SEM images of graphene/V_2O_5 nanocomposites.

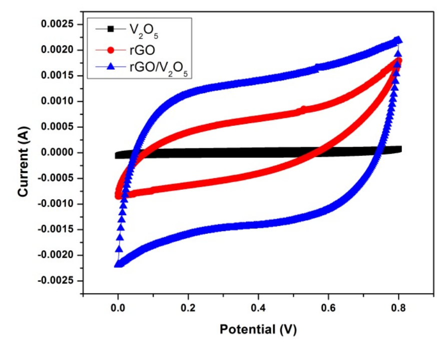

Fig.2. CV curves of V_2O_5, reduced graphene oxide and graphene/V_2O_5 nanocomposites at a scan rate of 5 mV s^{-1}.

Detailed results and discussion will be presented in the meeting.

Acknowledgements

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