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ORIGINAL PAPER

Conducting poly(*o*-anisidine)-coated steel electrodes for supercapacitors

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Conducting poly(*o*-anisidine) coatings were obtained on low carbon steel in aqueous oxalic acid solution by using the galvanostatic technique. The coatings were characterised by potential-time relations, UV-VIS absorption spectroscopy, scanning electron microscopy, and X-ray diffraction measurements. The electrochemical performance of coated steel electrodes was evaluated on the basis of galvanostatic charge–discharge performance and electrochemical impedance spectroscopy in 0.5 M H_2SO_4. Maximum charging current was found in the case of the coating obtained at a current density of 8 mA cm^{-2} for 600 s duration at the supply voltage of 0.5 V. The estimated capacitance of the coated steel electrode for charging is 42.67 mF and 7.2 mF for discharging. It was also found that there was an increase in capacitance as a function of supply voltage and the maximum value was obtained at 0.5 V. The study reveals the possibility of using conducting poly(*o*-anisidine)-coated low carbon steel from oxalic acid medium as supercapacitor electrode materials.

Keywords: conducting polymer based super capacitor, conducting poly(*o*-anisidine), supercapacitor electrode materials

Introduction

Supercapacitors, also known as electrochemical capacitors or ultracapacitors, have attracted much attention in recent years due to their pulse power supply, long cycle life ($> 10^5$ cycles), high power capacity (60–120 s), excellent reversibility (90–95 % or higher), and simple operation. Supercapacitors typically exhibit 20–200 times higher capacitance per unit volume or mass than conventional capacitors. Supercapacitors can improve battery performance in terms of power density when combined with batteries. Their applications include electric vehicles, digital communication devices and cameras, cell phones, electric hybrid vehicles, tools, pulse laser techniques, uninterrupted power supply, and energy storage for solar cells (Cheng et al., 2011; Zhang et al., 2009; Peng et al., 2008). Of all the materials investigated as supercapacitor electrodes, conducting polymers are the most promising as they possess good electrical conductivity, redox pseudocapacitance in addition to double layer capacitance, and relatively low cost (Peng et al., 2008). Within the class of conducting polymers, conducting polyaniline (PANI) occupies an important place due to its low cost, ease of synthesis, and good stability (Trivedi, 1997). It can be positively charged (*p*-doped polymer) and the double layer capacitance along with the pseudocapacitance contribute to the total capacitance (Zhou et al., 2005). Rajendra Prasad et al. (2002) investigated conducting PANI as an active material for electrochemical capacitors. In their work, it was found that PANI deposited on stainless steel at a sweep rate of 200 mV s^{-1} yielded a specific capacitance of approximately 815 F g^{-1} at a power density of

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