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Research Article

Fabrication of $SrWO_4$/PPy composite as electrode material for high-performance supercapacitors

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ABSTRACT

The societal major concern of the moment is energy storage, energy production and global warming. Researchers are striving to create novel, highly efficient energy storage materials for developing faster, safer as well as more effective energy storage systems. One effective method to improve the electrochemical performance of supercapacitors (SCs) is the construction of highly efficient electro active materials, employing multivalent binary transition metal oxides (BTMOs) with electrical conducting polymers (CPs). For the first time, we report $SrWO_4$/PPy composite synthesized by In-situ chemical polymerization route. The physio-chemical characteristics of the synthesized material was extensively examined with spectral and analytical techniques. $SrWO_4$/PPy composite on Ni foil was fabricated as an alternate electrode material and was investigated for its capacitive behaviour. $SrWO_4$/PPy electrode achieved a high specific capacitance of 747 Fg^{-1} at 5 mVs^{-1} and a remarkable cyclic stability of 93.8% even after 5000 cycles at 1 Ag^{-1}. The notable electrochemical property of the electrode was attributed to its distinctive composite morphology, which is crucial in facilitating high conductivity, quick electron transfer, short ion diffusion distance and excellent active sites for enhanced electrochemical performance. The substantial capacitive behaviour can be attributed to the synergetic effect of $SrWO_4$ and PPy. This work introduces platform to design efficient electrodes for the energy storage devices as well as for wearable electronics.

1. Introduction

The need for affordable, environmentally friendly energy conversion and storage systems has increased tremendously and smart gadgets that include both energy conversion and storage have drawn increasing attention as a major innovation for effective energy consumption [1–4]. Therefore, it is still important and essential for researchers to find solutions to address the problem of converting and storing renewable energy. Rechargeable batteries and electrochemical capacitors (ECs) are two common types of energy storage devices that are recognized as appropriate options for storing energy by converting chemical energy into electrical energy. Due to their high energy density, rechargeable batteries, especially lithium-ion batteries, have received lot of attention. However, these batteries have persistent performance issues, including short cycle life, relatively slow charging-discharging rate and lower power density [5–9].

Supercapacitors (SCs), often referred to as ECs or ultracapacitors, have become a significant alternative choice to batteries and provide a number of possible unique advantages, including superior working lifetime, rapid charging-discharging rate, high power density and so forth [10–12]. The three forms of SCs that can be categorized based on their charge storage mechanisms are electrical double layer capacitors (EDLC), pseudocapacitors (PCs) and hybrid capacitors [13–15]. While PCs use quick, reversible Faradaic processes at the surface to store charge, EDLCs adsorb electrostatic charges at the electrode-electrolyte interface. Hybrid capacitors combine the electrodes of an EDLC or PCs and a battery [16,17].

SC performance is significantly influenced by the characteristics of

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