Enhancement of electrochemical performance based on symmetrical poly-(3,4-ethylenedioxythiophene) coated polyvinyl alcohol/graphene oxide/manganese oxide microfiber for supercapacitor

ABSTRACT

In this study, a symmetrical poly (3, 4-ethylenedioxythiophene) (PEDOT) coated on poly (vinyl alcohol) (PVA)-graphene oxide (GO)-manganese oxide (MnO_2) microfibers (PVA-GO-MnO_2/PEDOT) supercapacitor was successfully prepared using a combination of two facile techniques; electrospinning and electropolymerisation. The FESEM analysis revealed the uniform distribution of manganese oxide nanoparticles on the surface of cross-linking PVA-GO microfibers and a cauliflower-like morphology was observed upon deposition of PEDOT on the surface of PVA-GO-MnO_2 microfibers. The chemical composition of PVA-GO-MnO_2/PEDOT and oxidation state of manganese were characterised using Raman and X-Ray photoelectron spectroscopies. The inclusion of MnO_2 and PEDOT in the microcomposite proved the enhancement of specific capacitance where PVA-GO-MnO_2/PEDOT exhibited a specific capacitance of 144.66 F/g compared to PVA-MnO_2/PEDOT (107.22 F/g), PVA-GO/PEDOT (94.73 F/g) and PEDOT (62.86 F/g). A wide potential window (1.8 V) was achieved for PVA-GO-MnO_2/PEDOT with an excellent capacitance retention of 91.18% suggesting an ideal capacitive behaviour and good cycling stability. PVA-GO-MnO_2/PEDOT microcomposite also showed an improved specific energy and specific power with small equivalent series resistance (34.5 Ω) and charge transfer resistance (0.62 Ω). This demonstrated that symmetric electrode of PVA-GO-MnO_2/PEDOT can offer a great promise in producing high-performance supercapacitors.

Keyword: Microfiber; Graphene oxide; Manganese oxide; Polyvinyl alcohol; Poly(3,4-ethylenedioxythiophene); Supercapacitor