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Graphenated tantalum(IV) oxide and poly(4-styrene sulphonicacid)-doped polyaniline nanocomposite as cathode materialin an electrochemical capacitor

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Abstract

Nanostructured poly(4-styrene sulphonic acid) and tantalum (IV) oxide-doped polyaniline nanocompos-ite were synthesised and their electro-conductive properties were determined. The oxide was synthesizedusing a modified sol-gel method and then dispersed in acidic media through sonication and entrappedin-situ into the polymeric matrix during the oxidative chemical polymerization of aniline doped withpoly(4-styrene sulphonic acid). The oxides and novel polymeric nanocomposite were characterised withTEM, SEM, EDX, XRD, FTIR, UV-visible to ascertain elemental and phase composition, successful polymer-ization, doping, morphology and entrapment of the metal oxide nanoparticles. The electro-conductivityof the nanomaterial was interrogated using scanning electrochemical microscopy (SECM) and cyclicvoltammetry (CV). The material was then anchored on activated graphitic carbon and used in the designof an asymmetric supercapacitor cell using 6 M KOH aqueous electrolyte. Characteristically high spe-cific capacitance values of 318.4 F/g with a corresponding energy and power densities of 1.57 kWh/kgand 0.435 kW/kg, respectively, were demonstrated. The cell also showed high coulombic efficiency of94.9% with a long cycle life and good cycle stability making the nanomaterial suitable for constructingsupercapacitor cell electrodes.