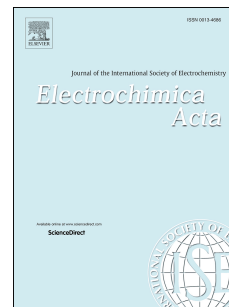


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‘Pillar Effect’ of Chemically Bonded Fullerene in Enhancing Supercapacitance Performances of Partially Reduced Fullerenol Graphene Oxide Hybrid Electrode Material

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Abstract

The electrochemical performances of fullerenol functionalized graphene oxide (FGO) and reduced FGO (rFGO) were evaluated in acid, alkaline and neutral electrolytes at 5-200 mV/s scan rates in cyclic voltammetry (CV) and with galvanostatic charge/discharge (CD) up to 1000 cycles at 1 A/g current density. Typical nucleophilic addition reaction using hydroxyl functional groups of fullerenol [(Fol)ⁿ⁻ anion as nucleophile] with epoxy & carboxyl groups of GO-acyl chloride in pyridine results the formation of FGO nanohybrid. Further reduction of FGO with hydrazine monohydrate in microwave synthesizer for 45 minutes at 80 °C would produce rFGO. XRD analyses of FGO and rFGO demonstrate edge to edge and basal to basal reactions between fullerenol and GO, whereas TEM images indicate the insertion of fullerene inside the graphene flakes. The redox reaction of residual basic electroactive oxygenated functional groups with protons able to produce an increasing trend in capacitance performance up to 300 cycles for rFGO (from 255 to 363 F/g at 1.0 A/g current density) in 1.0 M H₂SO₄ electrolyte and can retains its highest capacitance value (368 F/g) even after 1000 cycles. Whereas, significantly lower capacitance values even in highly concentrated alkaline electrolytes (55.6 and 85.7 F/g at 5 mV/s scan rate in 1 & 6 M KOH for rFGO) reconfirm the GO-COOH participation towards the chemical reaction with fullerenol-OH groups. This capacitance value in acid electrolyte is much higher than the nanocomposites

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