Abstract

Contamination-free PAni with improved electrical and supercapacitive performance was electrochemically synthesized in acidic medium using copper counter electrode without significant corrosion of the electrode. Plausible mechanism of the corrosion-free synthesis of PAni from aniline sulphate has been proposed. Electrochemical synthesis of supercapacitive PAni at suitable reaction conditions exhibits graphene-like ultra-thin layered structure. The mechanism of the structural transformation of PAni from nanosheet to macrotube has been proposed. Hydrophobic nanosilica was coated with the PAni nanosheets in simple ultrasonication method. The nanocomposite of the PAni-coated nanosilica in polysulfone matrix improves the hydrophobicity of the composite synergistically compared to the nanocomposites of pristine PAni or nanosilica at the same filler loading. Simultaneously dual doped PAni has been investigated in electrochemical synthesis in protic and aprotic polar reaction medium maintaining the total dopant concentration unchanged. Synergistic improvement in conductivity as well as in specific capacitance has been observed for the use of suitable combinations of sulfuric acid and *p*-toluenesulfonic acid as dopants. The formation of different nano and macrostructures and their transformations have also been studied. The synergistic improvement in conductivity and supercapacitive behaviour for solid state synthesized PAni simultaneously doped with citric acid and camphorsulfonic acid is comparable with the composites of PAni with multiwalled carbon nanotube. Ultra-thin hairy PAni nanowires with enhanced supercapacitive performance were produced via solid state synthesis method. Plausible mechanism of directional joining of smaller nanoparticles has been proposed. The effect of unsaturation in the dopant structure on the electrical, electrochemical, optical and structural characteristics has been investigated for doping with oxalic acid, fumaric acid and *trans,trans*-muconic acid. Unsaturation in dopant structure facilitates charge carrier transport and hopping, but it decreases supercapacitive performance. High crystallinity has been observed for muconic acid doped PAni. Preferential distribution of PAni in particular phase of ABA triblock acrylate copolymer poly(methyl methacrylate)-*b*-poly(butyl acrylate)-*b*-poly(methyl methacrylate) (PMMA-*b*-PBA-*b*-PMMA) has also been investigated.

Keywords: Polyaniline, conducting polymer, electrochemical synthesis, electrical properties, solid state synthesis, conductivity, supercapacitor, hydrophobic, morphology, polysulfone, acrylic triblock copolymer.