Preparation and characterization of electronically conducting polypyrrole-montmorillonite nanocomposite and its potential application as a cathode material for oxygen reduction

Rajapakse, R.M.G., murakami, K., Bandara, H.M.N., Rajapakse, R.M.M.Y., Velauthamurti, K. And Wijeratne, S.

Abstract

Simple wet chemical processes were deployed to prepare low-cost conducting nanocomposites based on natural clays with 2:1 layered structures such as sodium montmorillonite (MMT). Ce(IV) modified MMT was used for the spontaneous polymerization of pyrrole within clay interlayers. The resulted clay-conducting polypyrrole nanocomposites containing the reduced form of the oxidising agent, have been extensively characterized by X-ray diffraction (XRD) technique for interlayer spacing variations and by Fourier transform infra red (FT-IR) spectroscopy to study the interactions between the clay and polymer functional groups. DC polarization technique with both blocking and non-blocking electrodes was used to distinguish between the ionic and electronic transport numbers and to recognize the type of mobile ionic species. AC impedance analysis further resolved the electrical conduction of these materials. Bulk conductivity analysis implied that the polypyrrole (PPY) formed within Ce(IV) modified MMT posses dominant electronic conductivity. The low-cost, light-weight and stable polymer–clay nanocomposite prepared by Ce(IV) intercalated MMT, [Ce(III)-PPY-MMT], seems to be a promising cathode material for oxygen reduction and hence may find applications in fuel cell industries.