Electroanalysis 2015, 27, 1707 – 1718

Nanostructured Cobalt(II) Tetracarboxyphthalocyanine Complex Supported Within the MWCNT Frameworks: Electron Transport and Charge Storage Capabilities

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Abstract

The electrochemical redox properties of a surface-confined thin solid film of nanostructured cobalt(II) tetracarboxyphthalocyanine integrated with multiwalled carbon nanotube (nanoCoTCPc/MWCNT) have been investigated. This novel nanoCoTCPc/MWCNT material was characterized using SEM, TEM, zeta analysis and electrochemical methods. The nanoCoTCPc/MWCNT nanohybrid material exhibited an extra-ordinarily high conductivity (15 mScm(sup-1)), which is more than an order of magnitude greater than that of the MWCNT-SO3H (527 mScm(sup-1)) and three orders of a magnitude greater than the nanoCoTCPc (4.33 mScm(sup-1)). The heterogeneous electron transfer rate constant decreases as follows: nano-CoTCPc/MWCNT (kapp 19.73×10(sup-3) cms(sup-1))>MWCNTSO3H (kapp 11.63×10(sup-3) cms(sup-1))>nanoCoTCPc (kapp 1.09×10(sup-3) cms(sup-1)). The energy-storage capability was typical of pseudocapacitive behaviour; at a current density of 10 mAcm(sup-2), the pseudocapacitance decreases as nanoCoTCPc/MWCNT (3.71×10(sup-4) Fcm(sup-2))>nano-CoTCPc (2.57×10(sup-4) Fcm(sup-2))>MWCNT-SO3H (2.28×10(sup-4) Fcm(sup-2)). The new nanoCoTCPc/MWCNT nanohybrid material promises to serve as a potential material for the fabrication of thin film electrocatalysts or energy-storage devices.