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Capacitive Enhancement of Reduced Titania Nanotubes by Reversed Pulse Electrodeposited Mn_2O_3 and Co_3O_4

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Abstract. Many attempts have been done to improve the capacitive performance of reduced titania nanotubes (R-TNTs) by incorporation of metal oxides via electrodeposition method. In this study, pulse reverse electrodeposition technique has been applied to deposit Mn_2O_3 and Co_3O_4 onto the R-TNTs as this technique has the ability to control the composition of targeted materials while at the same time helps in facilitating the uniformity of deposition and the size of the metal oxides onto the reduced nanotubes. Based on FESEM and TEM analyses, it is proven that both metal oxides were uniformly deposited without covering the nanotubes opening. Besides, Mn_2O_3 and Co_3O_4 with crystallite size of 13.6 nm and 12.4 nm were recorded in XRD analysis. Electrochemical analyses were performed to evaluate the capacitive performance of both deposited metal oxides. The CV profiles of both metal oxides showed similar patterns attributed to simultaneous charge-storage mechanisms of electric double-layer in R-TNTs and pseudocapacitance in the metal oxides. Galvanostatic charge-discharge showed Mn_2O_3/R-TNTs exhibits higher specific capacitance of 37.0 mF cm^{-2} compared to Co_3O_4/R-TNTs of 16.9 mF cm^{-2} at 0.1 mA cm^{-2}. Moreover, these deposited samples also exhibit good electrochemical stability by retaining 87% of the initial capacity over 1000 cycles.

Keywords: Capacitive; pulse reverse electrodeposition; reduced titania nanotubes; Mn_2O_3; Co_3O_4