

**Preparation and Characterization of Hydrous Manganese Oxide Electrodes for Use in Electrochemical Pseudo-Capacitors**

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Hydrous manganese oxide with promising pseudo-capacitive behavior was deposited on carbon substrate at anodic potentials of 0.5 ~ 0.95 V<sub>SCE</sub> in 0.25M Mn(CH<sub>3</sub>COO)<sub>2</sub> • 4H<sub>2</sub>O solution at 25°C. The effects of the deposition potential on the material characteristics and electrochemical performances of the hydrous manganese oxide prepared were investigated. Porous manganese oxide with higher crystallinity was formed at a lower deposition potential. When the deposition potential was 0.8 V<sub>SCE</sub> or higher, the deposited oxide consisted of an inner layer with a laminated structure and a rough outer layer with nodules on the surface. SEM micrographs showing the surface morphologies of various manganese oxides formed at different potentials are given in Fig. 1. X-ray photoelectron spectroscopy (XPS) was also carried out to examine the chemical state of the deposited oxide. Analytical results indicated that the oxide was composed of both trivalent and tetravalent manganese oxides at a deposition potential of 0.5 V<sub>SCE</sub>. However, the tetravalent manganese oxide became the dominant species in the film deposited at above 0.65 V<sub>SCE</sub>. The manganese oxide formed at 0.5 V<sub>SCE</sub> exhibited a specific capacitance as high as 240 F/g, as evaluated by cyclic voltammetry with a potential scanning rate of 5mV/sec in 2M KCl at 25°C. Increasing the CV scanning rate reduced the specific capacitance. Only about 70% of the capacitance at 5 mV/sec could be maintained when the CV scanning rate was increased to 100 mV/sec, for all the manganese oxide electrodes prepared. Moreover, the high deposition potential gave rise to a low specific capacitance of the manganese oxide formed, as revealed in Fig. 2.

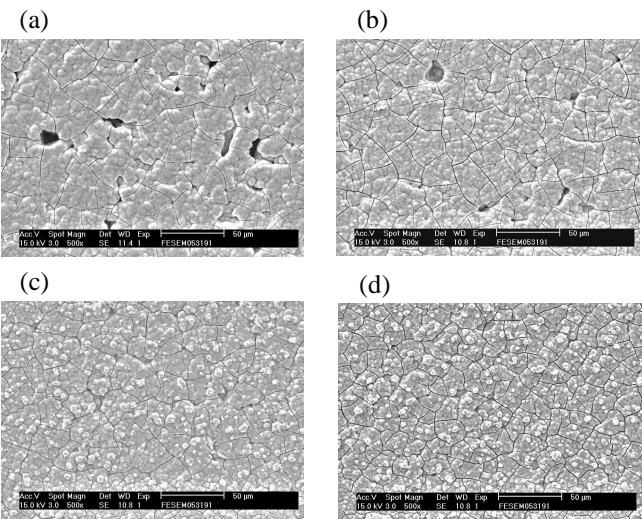


Figure 1. SEM micrographs showing the surfaces of the manganese oxides formed at various deposition potentials: (a) 0.5, (b) 0.65, (c) 0.8, and (d) 0.95 V<sub>SCE</sub>.

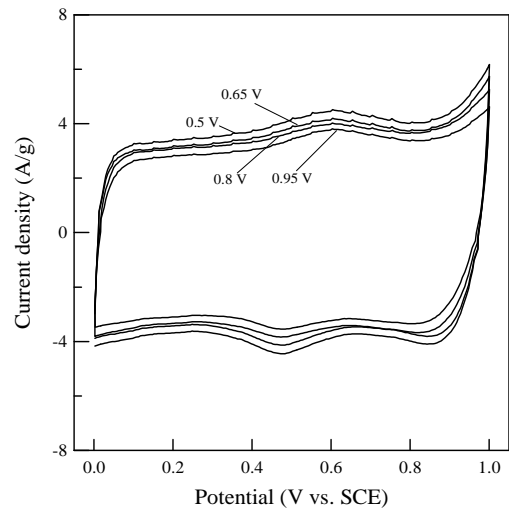


Figure 2. Cyclic voltammograms of the manganese oxides formed at various deposition potentials in 2M KCl solution at 25°C with a potential scanning rate of 20 mV/sec.