

Introduction

Development of electrochemical capacitors is an active field of research in many parts of the world. The high power delivery associated with electrochemical capacitors represents an effective complement to the energy storage capacity of secondary battery systems. Engineering of charge storage materials at the nanoscale is an important approach to the development of ionic and electronic conduction mechanisms.

We present results from recent work on electrodeposition of MnO₂ for electrochemical capacitors. We have observed that the addition of acetate salts to MnSO₄ solutions will facilitate a reduction in the deposition potential. This result is comparable to that seen when using manganese acetate [1] solutions for deposition. A notable difference lies in the stability of the MnSO₄ solutions with acetate salts. These solutions are quite stable and will last for many days on the shelf. Solutions of manganese acetate alone will self oxidize within days. We have used this observation as a starting point to examine the effects of a variety of salts on the performance of electrodeposited MnO₂ as an electrochemical capacitor material.

Experimental

Our experimental setup consists of a simple glass tube with a polypropylene plug in the bottom. The plug has an o-ring sealed opening against which the working electrode is spring loaded. Our working electrode consists of either Pt thin films sputtered onto silicon wafers or graphite which is polished using SiC sandpaper. The counter electrode is a coil of Pt wire and the reference electrode is an Ag/AgCl type.

Electrodepositions and electrochemical characterizations are conducted using a CHI660a galvanostat/potentiostat system. A typical experiment consists of an anodic deposition based on mixed electrolyte solutions. When the deposition is complete the electrolyte is swapped for a non-depositing solution to explore the charge storage characteristics. As an example in figure 1 we show results from linear scan voltammetry (LSV) of 20 ml of 1M MnSO₄ with 40 ml of mixed electrolyte onto a Pt working electrode. The mixed electrolyte is composed of varying fractions of 1M Na₂SO₄ with additions of 1M NaC₂H₃O₂. Figure 2 shows a scanning electron microscope (SEM) image of the film deposited using 50% Na₂SO₄ as the supporting electrolyte.

We will present results from other electrolyte combinations we have examined in terms of cyclic voltammetry, specific capacitance and other properties of electrochemical capacitors.

Acknowledgements

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References

1. J.K. Chang, W.T. Tsai, J. Electrochem. Soc. 150 (2003), A1333-A1338

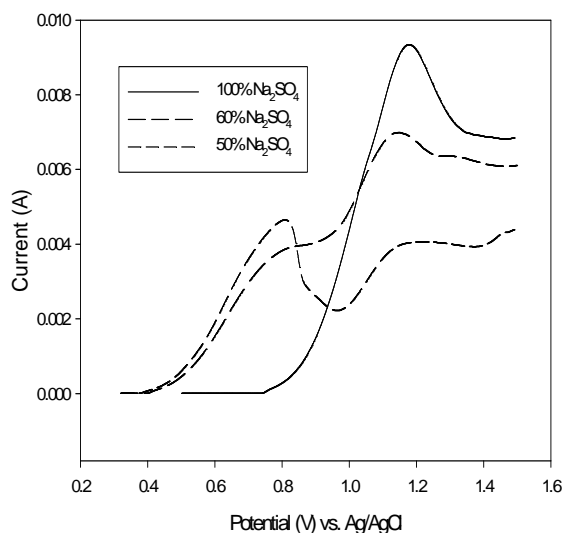


Figure 1 LSV scans for MnSO₄ plus mixed electrolytes

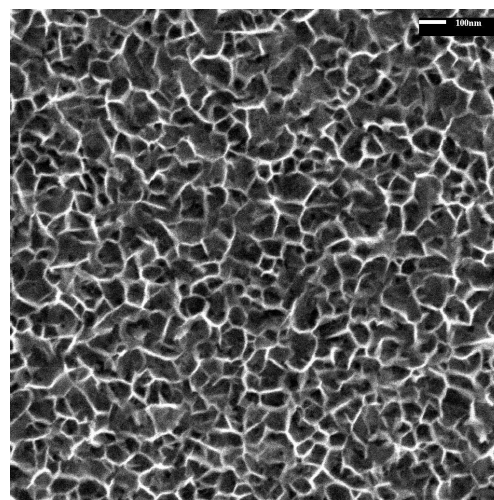


Figure 2 SEM image of electrodeposited MnO₂