Electrochemically Prepared Manganese Oxides on 3-D Carbon Substrates for Supercapacitors and Their Charge Storage Mechanism

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Electrochemical capacitors are becoming attractive energy storage systems particularly for applications involving high power requirements. Potential applications of electrochemical capacitors include power enhancement and cycle life improvement of primary power sources such as batteries and fuel cells with a hybrid form pursued for electric vehicle propulsion. Electrochemical capacitors are also attractive for other applications such as power sources for camera flash equipment, lasers, and pulsed light generators and as back up power sources for computer memory.

Among the various materials investigated over the years, amorphous $RuO_2 \cdot xH_2O$ prepared by the sol-gel process has become the leading electrode material for supercapacitors as it exhibits a high specific capacitance (720 F/g) within a 1.4 V potential window.[1] However, the high cost of ruthenium and environmental problem of electrolyte such as strong acidic media have limited its commercial use. Accordingly, there is a strong incentive to find alternative electrode materials, which are inexpensive and exhibit pseudocapacitive behavior similar to that of hydrous RuO_2. Much attention is now focused on the oxides of manganese, nickel, cobalt, and vanadium as candidate electrode materials for supercapacitors.[2~5]

In this study, we report the synthesis and electrochemical properties of manganese oxide electrodes for supercapacitors. In order to increase the energy density and power density, the manganese oxide electrodes on 3-D carbon substrates were fabricated by electrodeposition. Rate capability and specific capacitance were estimated through cyclic voltammetry.

Charge storage mechanism of manganese oxide electrodes in neutral electrolytes were also studied by electrochemical quartz crystal microbalance (EQCM). Detailed results and discussions will be presented at the meeting.

References

1. Z. P. Zhang, *Electrochem. Solid-State Lett.*, **2**, 359 (1999).

2. S. C. Pang, M. A. Anderson, and T. W. Chapman, *J. Electrochem. Soc.*, **147**, 444 (2000).

3. K. W. Nam and K. B. Kim, *J. Electrochem. Soc.*, **149**, A346 (2002).

4. C. Lin, J. A. Ritter, and B. N. Popov, *J. Electrochem. Soc.*, **145**, 4097 (2002).

5. H. Y. Lee, and J. B. Goodenough, *J. Solid State Chem.*, 148, 81 (1999)

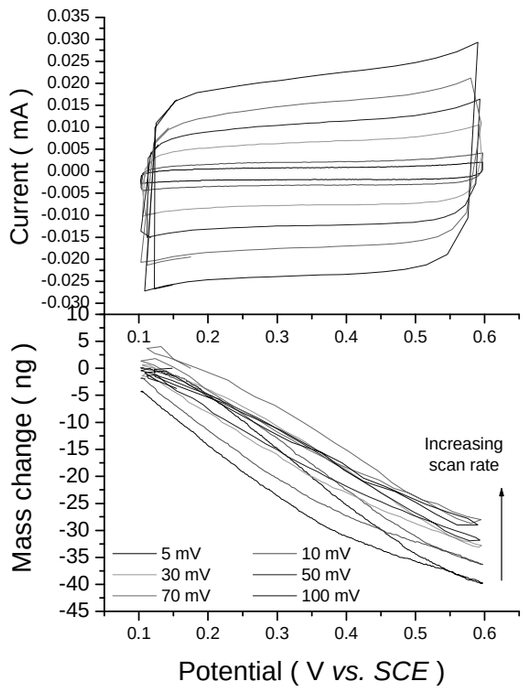

Fig. 1. (a) Cyclic voltammograms and (b) voltammasograms of manganese oxide electrode thin films in 0.1M Na_2SO_4 solution..