MnO_2 AS A ELECTRODE MATERIAL FOR ELECTROCHEMICAL CAPACITORS

Ravinder N Reddy [*] and Ramana.G. Reddy[**]
[*]Graduate student, [**] ACIPCO Professor
Department of Metallurgical & Materials Engineering
The University of Alabama, Tuscaloosa, AL 35487-0202

Abstract

Electrochemical capacitors are of high interest in hybrid electric vehicle in conjection with batteries and fuel cells and as backup memory application in many electronic devices due to its high cycle life and short term pulse[1-3]. Electrochemical capacitors can be classified into two types, electrochemical double layer capacitors (EDLC`s) and capacitors based on psuedocapacitance. RuO_2 xH_2O has been found to be an ideal material in the pseudo capacitance category. However, hydrous ruthenium oxide is very expensive. Therefore efforts are being made to replace ruthenium oxide by other oxides such as MnO_2.

This study essentially deals with the use of MnO_2 as a potential electrode material for electrochemical capacitors. MnO_2 was synthesized in our laboratory by heating of $KMnO_4$ and $NaMnO_4$ at 300°C in air [4]. The resulting product was washed with distilled water in which water soluble potassium manganate was separated and the resulting MnO_2 had a non stochiometric amount of potassium and sodium respectively. Cyclic Voltametry (CV) experiments were carried out using the three electrode system, saturated calomel electrode as reference electrode, platinum mesh as a counter electrode, and MnO_2 composite material mounted in a platinum mesh as a working electrode. Two kinds of composite working electrode materials were used, one was mixture of MnO_2 and 25 wt% acetylene black and the other was MnO_2, 25 wt% acetylene black and 25 wt% carbon. All the experiments were carried out at 25°C. A maximum capacitance of 130 F/g was observed at the scan rate of 2 mV/s in 1M KCl for composite electrode containing MnO_2 with non stochiometric potassium made with carbon. 107 F/g was observed at the scan rate of 2 mV/s in 1M NaCl for composite electrode containing MnO_2 with non stochiometric sodium made with carbon.

References:

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3. B.E. Conway, “Transition from supercapacitors to battery behavior in electrochemical storage,” Journal of Electrochemical Soc. 138 (6) (1991),1539-1548.

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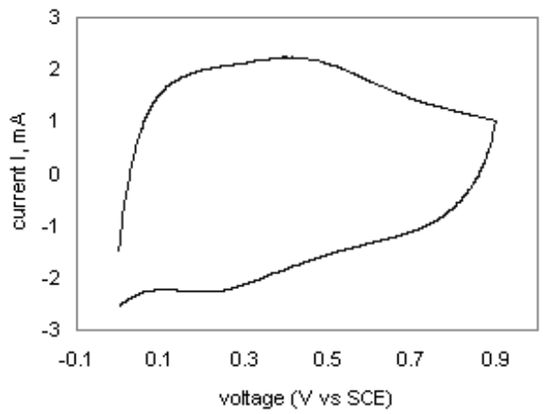

Fig. 1. CV curve of 7.5 mg of layered MnO_2 with non stochiometric potassium with carbon at 2 mV/sec scan rate in 1M KCl

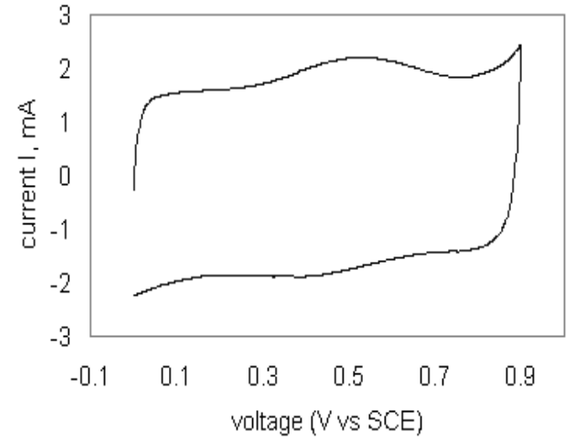

Fig. 2. CV curve of 10 mg of composite electrode containing layered MnO_2 with non stochiometric potassium with carbon at 2 mV/sec scan rate in 1M KCl.

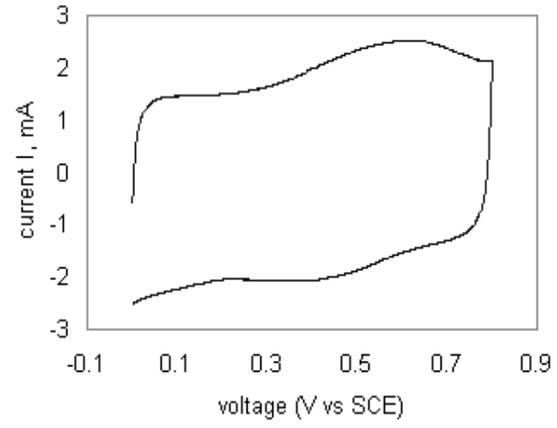

Fig. 3. CV curve of 9.1mg of composite electrode containing layered MnO_2 with non stochiometric sodium with carbon at 2 mV/sec scan rate in 1M NaCl