Power Sources Using Polyaniline Doped with Nucleophilic Dopant as Electrode

K. S. Ryu, Y. G. Lee, X. Wu, Y. J. Park, Y. S. Hong, M. G. Kang, N. G. Park, K. M. Kim, S. J. Lee*, and S. H. Chang

Electronics and Telecommunications Research Institute (ETRI), Daejon 305-350, Korea
** Lab. Solution NKIC, Seoul120-100, Korea*

Introduction

Lithium secondary battery is one of the most important applications of conducting polymers. Polyaniline, polypyrrole, and polythiophene are particularly expected to be active electrode materials for lithium secondary battery because they are stable in air and have good electrochemical properties. On the other hand, the conducting polymers have been regarded as another promising pseudo-capacitive materials. The use of conducting polymer materials for redox supercapacitors has several advantages over other systems [1].

The Pani synthesized with electrochemical method was already investigated through the performance as the electrode material of battery and redox supercapacitor. However, the Pani synthesized with chemical method and doped with nonprotonic acid has been rarely studied. Recently, we reported the lithium salt-doped Pani and the performance of Pani powder doped with lithium salt as electrode in polymer based battery and redox supercapacitor [2, 3].

In this paper, we adopt the polyaniline powder doped with nucleophilic dopant as the electrode material in polymer based battery and supercapacitor. These cells were fabricated by laminating method with two electrodes and polymer electrolyte. We investigate the performances of nucleophilic doped polyaniline as electrode in battery and supercpacitor by various electrochemical measurements.

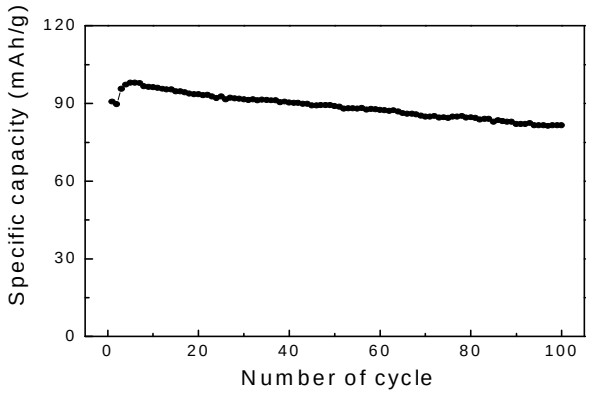
Experimental

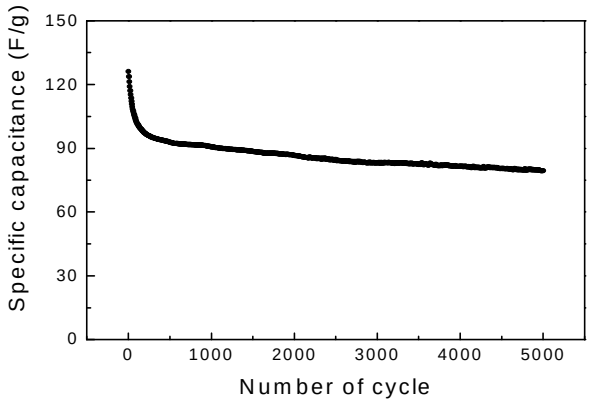
Emeraldine base form of polyaniline powder was synthesized as described elsewhere. Especially we fabricate the electrode sheets, which were laminated on Al EXMET on both sides, and the polymer electrolyte as separator with coating method on laminating film. For assembling the redox supercapacitors using polymer electrode and polymer electrolyte, we use fabrication methods of lithium ion polymer batteries. The laminated battery and capacitor have unitary shape that is not need any holder. These cells consist of the Pani-R(alkyl group) electrode, polymer electrolyte, 1M $LiPF_6$ (battery) or 1M Et_4NBF_4 (supercapacitor) electrolyte solution, and Pani-R electrode. After that, this cell was enveloped in an aluminum pauch in a dry room.

Cyclic voltammogram (CV) and electrochemical impedance spectroscopy were performed for investigating their electrochemical properties. The polymer electrode based battery and supercapacitor were tested using a Maccor galvanostatic charge/discharge cycler.

Results and Discussion

In case of battery, the specific capacity is approximately 10mAh/g at an initial state. After 100 cycles, the specific capacity is approximately 85 mAh/g. In case of supercapacitor, the specific capacity is approximately 130 F/g at an initial state. After 5,000 cycles, the specific capacitance is approximately 85 F/g. From this result, polyaniline doped with nucleophilic dopant has a good possibility as polymer electrode in power source devices.





References

[1] C. Arbizzani, M. Mastragostino, B. Scrosati, in: H. S. Nalwa (Ed.), Handbook of Organic Conductive Molecules and Polymers, John Wiley & Sons Ltd, 1997, Ch. 11.

[2] K. S. Ryu, K. M. Kim, S. G. Kang, J. Joo, S. H. Chang, *J. Power Sources*, 88(2) (2000) 197.

[3] K. S. Ryu, K. M. Kim, N. –G. Park, Y. J. Park, S. H. Chang, *J. Power Sources*, 103(2) (2002) 305.