An Electrochemical Capacitor System using Polymeric Electrodes of Aminoquinoxalines

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1. Introduction

Many π–conjugated compounds have specific optical and electrochemical features, and have attracted various notices in their theoretical aspects. Aminoquinoxalines (AQX: Figure 1), possessing both electron-withdrawing and electron-donating groups at near position within the molecule, are expected to reveal peculiar electrochemical characteristics.

We have examined the polymerization of AQX compounds and their electrochemical characteristics, and reported that they have attractive performances as the electrode material for electrochemical capacitors [1]. In the present work, we have constructed a prototype capacitor using the AQX polymers, and investigated their charge and discharge characteristics.

2. Experimental

We have synthesized polymeric films of AQXs by an electro-polymerization method [1]. The polymerization was performed by potentiostatic or potential-scanning anodization, using a conventional three-electrode cell system. The cell was equipped with a Pt-sheet for the working, Pt-gauze for the counter, and Ag/Ag^+ for the reference electrode. Organic solvent solutions of AQXs, added with small amounts of $HClO_4$ or other acids, were used for the electrolyses.

A prototype capacitor was constructed with a separator and two electrodes which were covered with AQX polymers. The organic solution of 0.1M tetraethylammonium tetrafluoroborate ($TEABF_4$) dissolved in propylene carbonate (PC) was used as the electrolyte.

3. Results and Discussions

The electrochemical activity and polymerization characteristics of AQXs were dependent on the substituting groups, R_1 and R_2. The anodic oxidation of two AQX monomers with R_1=R_2=C_6H_4 (Figure 2) gave a black-colored film on a Pt working electrode.

Prototype capacitors were constructed by using these electrodes covered with AQX polymers, and their charge and discharge capacitances were measured as a function of the cycle.

For the cell using AQX-02, the initial charge and discharge capacitances were about 30 Fg^{-1}, and its cycle performance was stable, especially after the 10th cycle (Figure 3). The cell using AQX-02A gave higher initial charge capacitance (77 Fg^{-1}), but showed less cycle performance.

The factors affecting the cycle performances are investigated, and the details of the results will be presented at the meeting.

References

[1] Morita, et al, 205th Meeting of The Electrochemical Society, San Antonio, TX, USA (Paper No. S3-0782).

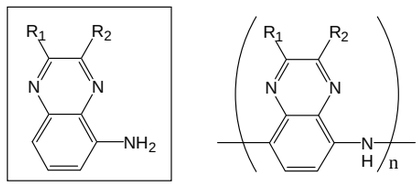
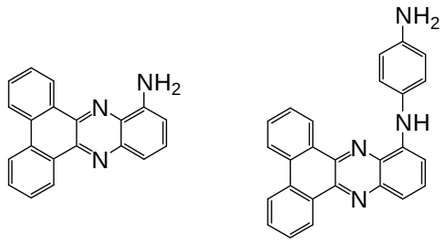


Figure 1. Structure of Aminoquinoxaline (AQX) and AQX polymer



AQX-02 AQX-02A

Figure 2. Structures of AQX-02 and AQX-02A monomers

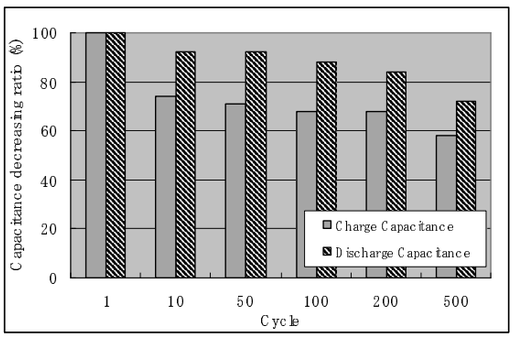


Figure 3. Variation of the capacitance with cycling for the test capacitor using AQX-02 polymer.