

Preparation of Electrode Materials for EDLC with High Energy Density by Modification of Carbon Surface

Gaku Ogura, Jun Kametani, Satoshi Mitani, Yozo Korai
Institute for Material Chemistry and Engineering, Kyusyu University
Kasuga, Fukuoka 816-8570

Abstract

Electric double layer capacitors (EDLCs) have attracted much research, since they are expected to solve energy problem for automobile. EDLC has been recognized as an efficient storage device for the electric power because of its better rate capability and longer cycle life as compared to secondary batteries. Surface area and pore size distribution of activated carbon are believed to be one of the important factors for high performance EDLC. However, many researchers overlooked surface reaction of activated coke some points which improve. In this study, we tried to measure cyclic voltammetry of activated carbons in low concentration of electrolyte in order to clarify surface reaction

Introduction

EDLC has been recognized as an efficient storage device for the electric power because of its better rate capability and longer cycle life as compared to secondary batteries. However, energy density is relatively small. Energy density, E of EDLC is calculated by a following equation [1], where C [F] and V [V] are capacitance and applied voltage.

$$E = \frac{1}{2} CV^2 \quad [1]$$

Both capacitance and applied voltage should be increased for the improvement of EDLC. This research is focus on the increase of applied voltage. The applied voltage is determined by oxygen functional group and carbon surface structure. In this study, effects of the former was examined to improvement energy density, respectively.

Experiment

2.1 Sample

Commercial Maxsorb (surface area was 2430m²/g), which activated carbon was used to electrode carbon.

2.2 Preparation of electrode

The electrode was composed of activated carbon, carbon black as an electric conductor (Ketjen-black E) and polytetrafluoroethylene (PTFE) as a binder at a mixing ratio of 8:1:1 by weight.

2.3 Cyclic voltammetry

The surface reaction was measured by cyclic voltammetry using tetraethylammoniumtetrafluoroborate (Et_4NBF_4 1, 0.5, 0.1 and 0.02M) in propylenecarbonate (PC) as an electrolyte. Ag/Ag^+ in propylene carbonate and disc-shaped electrode with twice weight of working electrode were used as the reference and counter electrode, respectively. CV was measured using a potentiostat (Hokuto Denko, Model HZ-3000) at a scan rate of 3,5,10 and 20 mV/s in the range of -1.5 to 1.7 V (vs. Ag/Ag^+).

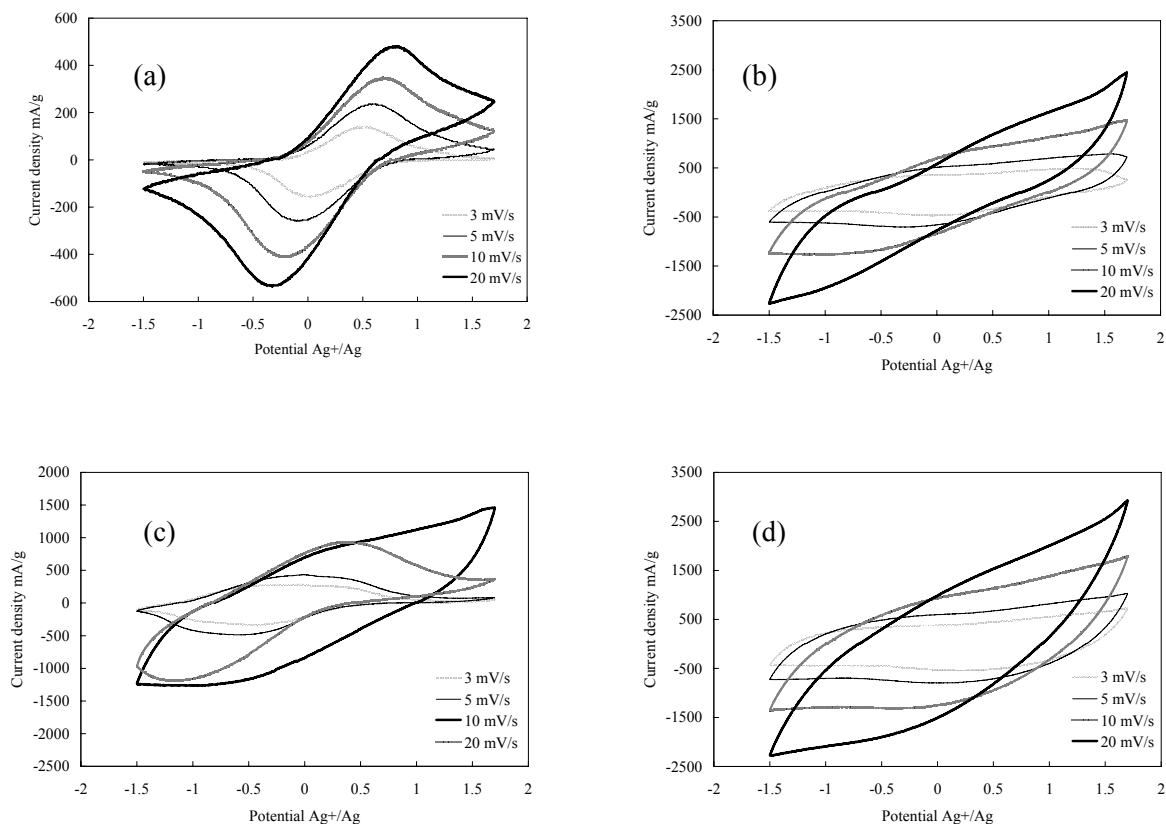


Fig.1. Cyclic voltammograms at different concentration electrolyte (a)1M, (b)0.5M, (c)0.1M, (d)0.02M

Results and Discussion

Fig.1 showed cyclic voltammetry at different electrolyte concentration (1, 0.5, 0.1 and 0.02M). The profile of 1M concentration electrolyte was shown typical rectangular shape of EDLC in Fig.1 (a). The profiles of 0.5 and 0.1M concentration electrolyte was shown broken rectangular shapes of EDLC in Fig (b) and (c). However, Fig.1 (d) showed a typical redox reaction (chemical reaction) profile with the maximum current, which increased with the Square-root of scan rate. Redox reaction reflects pseudo capacitance. The pseudo capacitance was included in the profile of 1M concentration of electrolyte. AS a result, we thought Fig.1 (d) with redox reaction might be includes factor which is increased voltage endurance. Future study is necessary to examine the other factor such as functional grope, micro structure, pore size, and so on