Development of Carbon-PTFE Electrode for Electric Double Layer Capacitor

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Introduction

The electrical double-layer capacitor (EDLC) has been considered as a promising high power energy sources for a electric vehicles and a hybrid electric vehicles[1, 2]. The advantageous feature of EDLC are its better capability and longer cycle life as compared to secondary batteries, and these feature are intimately related with the physical interactions between activated carbon and electrolyte solution.

The characteristics of polarizable electrode are strongly affected with the electrode configuration consisted of the activated carbon, conducting material and binder. Several types of carbon-based EDLC electrode, such as carbon cloth electrode, slurry coated electrode and kneaded electrode etc., have been proposed or are presently used in commercial devices.

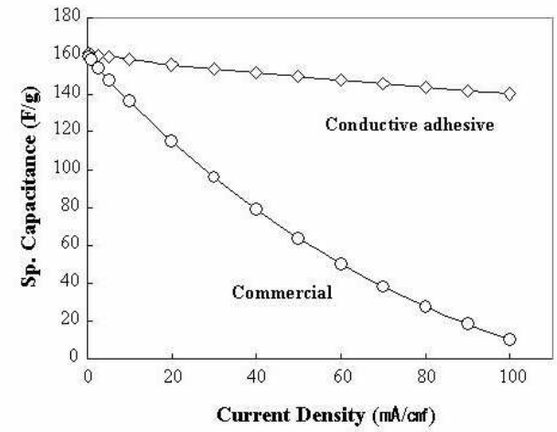

Fig.1 Specific resistance of sheet with various carbon black as a function of the number of kneading.

In this study, the kneaded activated carbon-PTFE electrodes were manufactured, and the electrochemical properties were evaluated.

Experimental

The composite surry were prepared by mixing the activated carbon, conducting material and PTFE binder with less than 10 wt.%, and kneaded through the roll press for the modification of EDLC electrode. The carbon-PTFE sheet with 100μm thickness were bound on alumium current collector with conductive adhesive consisted of carbon black and carboxymethyl cellulose (CMC). The electrodes were cut to 3×4 cm^2 and dried under vacuum at 150°C during overnight.

Unit cell capacitors were constructed with an electrolyte impregnated the separator sandwitched between the electrode. The electrolyte was 1.2M acetonitrile in tetraetyleammonium tetrafluoroborate solution.

The charge-discharge cycle test was conducted galvanostatically with a Maccor test system. The charge curves were obtained at a different current densities to obtain the rate capabilities of the unit cell capacitors. The specific resistances of electrodes were measured using 4 point probe method.

Results and discussion

Three kinds of carbon black (Acethylene black, Super p black and ketjen black) have been tested as a conducting materials. Figure 1 shows the specific resistance of the kneaded sheets, which composition is act. carbon : carbon black : PTFE = 80 : 15 : 5 wt.%, as a function of the number of kneading. In this figure, the sheet with the ketjen black has showed the lower resistance than other carbon blacks, also exhibited the better rated capability between 0.5mA/cm^2~100mA/cm^2 current density in unit cell capacitor.

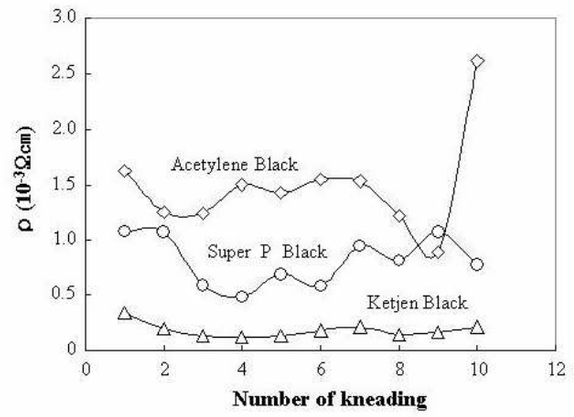

Fig. 2 Comparison of rate capability for unit cell capacitors with conductive adhesive and commercial bond.

The sheets were bound with conductive adhesive on the alumium foil in other to allow the lowest contact resistance between the sheet and the current collector. Figure 2 shows the comparison of the rate capability of unit cells using the electrodes with conductive adhesive and commercial bond. The unit cell capacitor with conductive adhesive has exhibited the better rate capability and the lower internal resistance than those of the unit cell with commercial bond.

References

1. B. E. Conway, J. Electrochemical Soc., **138**, 1539 (1991).
2. S. Sarangapani, B. V. Tilak and C. P. Chen, J. Electrochemical Soc., **143**, 3791 (1996).