Optimization of Activated Carbon for EDLC on Negative or Positive Electrode by using CNF

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Abstract

General activated carbon for electric double layer capacitor (EDLC)was used for same activated carbon between positive and negative electrodes. EDLC should be optimized to correspond to positive or negative electrode because the size of anion or cation is very different. In this study ,we attempt to apply for carbon nanofiber（CNF）in EDLC electrode. And then, the electrode was consisted of activated carbon fiber（ACF）or ACF/CNF, respectively. The combined electrode was achieved to decrease inner resistance.

1. Introduction

EDLC is expected to be widely used in near future for electric vehicle, portable electronics, actuators, and electric storage of load leveling. It is necessary to develop a particular activated carbon of much higher energy densities per both weight and volume than those of the conventional ones. Activated carbon for EDLC should be optimized to correspond to positive or negative electrode because the size of anion or cation is very different. Furthermore, many researchers of activated carbon for EDLC pointed out that surface area, pore size distribution interaction of carbon wall and solvent or electrolyte are the important factors for EDLC. The structure of the pore wall can be also influential on the capacity efficiency. Recently, carbon nanofibers (CNFs) have been attracting an attention of research due to their potential for broad applications because of the specific structure. This is why, we attempt to apply for CNF in EDLC electrode. In this study, optimization of activated carbon for positive or negative electrode will be proposed by using CNF.

2. Experimental

2.1. Material

ACF derived from coal tar pitch was provided by Osaka Gas Co. Ltd, and its surface area and pore volume was 1530m^2/g and 0.57ml/g, respectively

2.2. Preparation of CNF

Iron and nickel alloy catalyst used in this study were prepared by precipitation of iron and nickel carbonate from corresponding nitrate solution using ammonium bicarbonate as described in detail by Best and Russell [1].

2.3. Measurement of capacitance

The electrode was a roll-pressed disc (ACF:20mg, ACF/CNF:20mg) prepared from a mixture of ACF or ACF/CNF, carbon black conductor (Ketjen-black E) and polytetrafluoroethylene (PTFE) binder (8:1:1 weight ratio). The specific capacitance was measured by the two-electrode system using tetraethylammonium tetrafluoroborate (Et_4NBF_4 1M) in propylenecarbonate (PC) as an electrolyte. The test cell was charged to 2.7 V at a constant current (100mA/g) and voltage, and then discharged at a constant current to 0 V. Furthermore, the monitoring system of positive and negative electrode was shown in Fig. 1in order to measure separately positive or negative electrode.

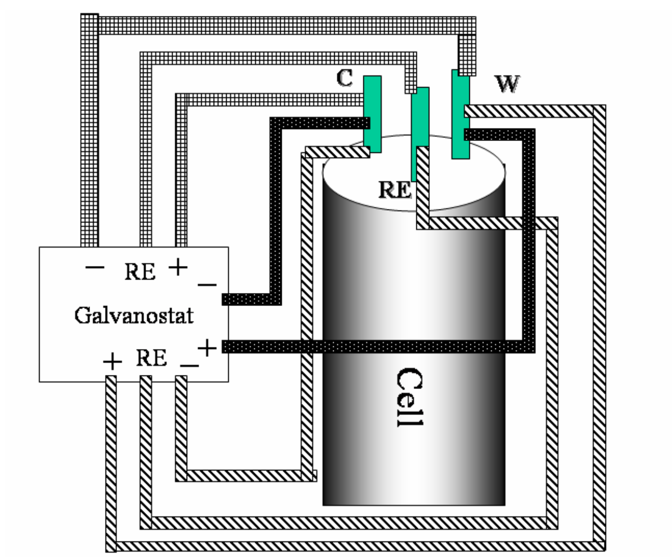


Fig.1 Monitoring system of positive and negative electrode.

W: Working electrode, C: Counter electrode RE: Reference electrode

3. Results and discussion

Fig. 2 and 3 showed charge and discharge profile of ACF and ACF/CNF, respectively ACF/CNF showed steady increase of voltage with the time. Linear increase of voltage with time of ACF/CNF indicates proportional increase of adsorption with the charged voltage. In contrast, ACF showed rapid increase of charged voltage to 2.5V and then very gradual increase above 2.5V to 2.7V. It was implied that ACF have high inner resistance.

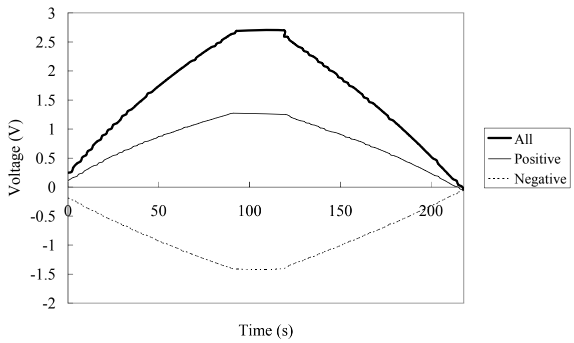


Fig. 2 Charge and discharge profile of ACF/CNF

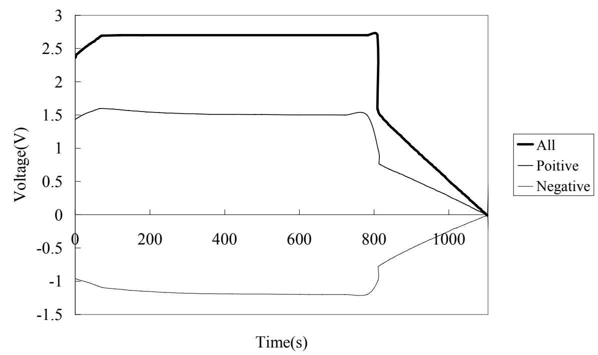
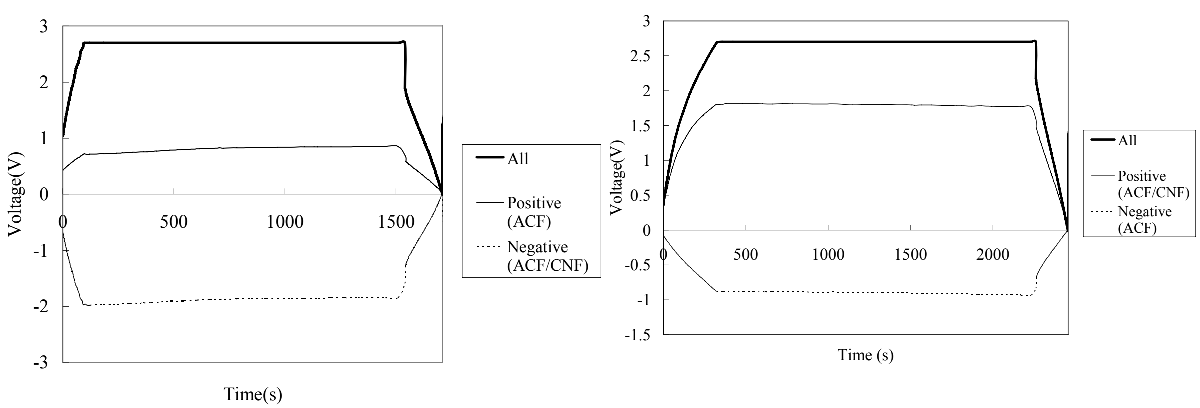


Fig. 3 Charge and discharge profile of ACF

Fig. 4 shows charge and discharge profiles combined electrode. In Fig. 4(a), positive or negative electrode was consisted of ACF or ACF/CNF, respectively. In contrast; in Fig. 4(b), positive or negative electrode was consisted of ACF/CNF or ACF respectively. The profile of Fig. 4(a) was shown high inner resistance rather than Fig. 4 (b).While, the profile of Fig.4 (b) suggested stable charge and discharge. The inner resistance of EDLC was decrease by using ACF/CNF electrode. In addition, optimization of activated carbon for positive or negative electrode achieved to get much further low inner resistance.



(a)Positive (ACF)   Negative (ACF/CNF)

(b)Positive (ACF/CNF)   Negative (ACF)

Fig. 4 Charge and discharge profile of combined electrode with CNF

Reference

[1]Best RJ, Russell WW. Nickel and some of their alloys as catalysis for ethylene hydrogenation. J.Am.Chem.Soc.1954.;76:838-842.