EDLC capacitances of carbons with very different surface areas prepared though KOH activation

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1.Introduction

Electric double layer capacitor has been extensively studied since it is equipped to electric hybrid cars. Larger capacitance and power density are strongly needed from anisotropic coke with KOH. The activated carbon from anisotropic coke with KOH is currently examined to increase the capacitance. The largest surface was the target to be achieved for high capacitance. New optimum surface area is looked for with respective carbon precursor. In addition, some activated carbon has been reported to show higher capacitance when charged at higher voltage. In the present study coal tar derived needle coke and mesophase pitch AR derived carbon were activated with KOH after the calcinations at 500~1100℃ to compare the surface areas and capacitance obtained. In addition, high voltage charge was examined to clarity by the roles of carbon structure with capacitance increase.

2.Experimentals

2.1 Material

Raw needle coke derived from coal tar pitch was provided by Nippon Steel Chemical Co. Ltd. AR resin coke derived from naphthalene pitch was provided by Mitubishi gas chemical Co. Ltd. The two cokes were calcined at 500^{o}C and 725 ^{o}C, respectively.

2.2 KOH activation

The calcined coke was activated with KOH at 800^{o}C for 2h in Ar flow in a nickel holder which was inserted into the stainless steel tube. Coke / KOH ratio was fixed at 1/4 by weight. Activated coke was washed thoroughly with water and dried.

2.3 Determination of specific capacitance

The electrode for EDLC was prepared from activated coke, KB (Ketjenblack-E) and PTFE (polytetrafluoroethylene) at their mixing ratio of (Coke/KB/PTFE=8/1/1, by weight). The specific capacitance was measured by 2-electrede system using Et_4NBF_4(1M) in PC(propylene-carbonate) as an electrolyte. The test cell was charged to 2.7 or 3.7V at constant current, and then discharged at a constant current to 0V.

4. Results and Discussion.

Table1 summarizes capacitance and the surface area of the activated cokes. A1 accomplished 50.5F/g, 95Wh/kg at 3.7V which is comparable to that of Li-ion secondary battery. It must be noted that higher voltage of charge increased the capacitance. In contrast, the activated coke derived from needle coke provided capacitance of 42F/g at 2.7V and 44F/g at 3.7V. No significant increase of capacitance was observed at higher voltage.

Fig.1 showed SEM photograph of activated carbons. The activated carbon derived from AR resin showed aggregates of fine particles, while needle coke derived activated carbon showed a number of long-parallel cracks within grains. Such morphology and large surface of needle coke may cause no increase of capacitance at higher voltage.

Reference

1) M. TAKEUCHI, T. Maruyama, K. Koike, A. Mogami, T. Oyama and H. Kobayashi, Electrochemistry, 69(6):487-492 (2001)

Table1 Capacitance and surface area

	Precursor	Heat-treatment	F/g(2.7V)	F/g(3.7V)	Surface Area(m^2/g)
N1	Needle Coke	500	42.0	44.0	2500
A1	AR resion	725	42.3	50.5	1350
A2		800	32.2	38.4	780
A3		900	29.3	38.5	310
A4		1100	9.8	20.5	40

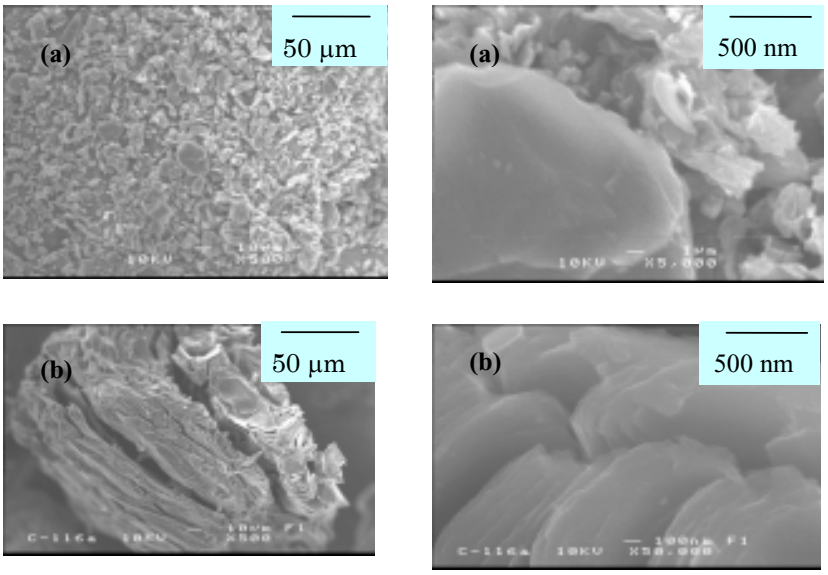

Fig.1 SEM photography of activated carbon derived from AR resin (a) and needle coke (b)