STUDY ON ACTIVATED CARBON ELECTRODE FOR ELECTRIC DOUBLE LAYER CAPACITORS

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Introduction

The electric double layer capacitors (EDLCs) are very attractive for delivering high energy with high power in various electric devices, which included electric vehicle(EV) or hybrid electric vehicles (HEV). The mixed metal oxides, activated carbons, and doped conducing polymers have been investigated for use as electrode materials for EDLCs. The most success in developing enegy storage capacitors has been achieved using activated carbons in the form of cloth or particulates with a binder [1-3]. In the present paper three groups of electrode consisting of activated carbon (AC) with various surface area were studied. The aim of the work was determination of the effect of BET surface area and pore size distribution of AC on discharge capacitance of electrode

Experimental

Three types of activated carbons(AC) were used in this work. The specific surface area and pore structure parameters of AC were determined from adsorption isotherm of nitrogen at 77K(ASAP2000, Micromeritic, USA). The BJH method was used to calculated the mesopore distribution. The micropore volume were obtained using the t-plot method.

The vitamin B_{12} (VB_{12}) with a size of 2.09nm was selected to characterized the adsorption properties of the AC.

The AC elevtrode were prepared by addition of 90wt.% AC, 5wt.% conducting powder (MCMB) and 5wt.% PTFE(polytetrafluroethylene) for cyclic voltammetry experiment using an EG & G PAR 263A potentiostat/galvanostat (USA). A saturated calomel electrode (SCE) was used as the reference electrode. The electrodlyte was a 6M KOH solution.

3. Results and Discussion

3.1 The porous structural of AC

The porous structural parameter of activated carbons were given Table 1. It was shown that the AC3 exhibited higher mesopore volume of with BJH method than the AC1, AC2. The AC3 had the largest adsorption capacity for VB_{12} among the three samples. The Fig. 1, 2 was pore size distribution of AC2 and AC3 with DFT method.

Table 1 The porous structural parameter of activated carbons

sample	BET sq. / m•g^{-1}	Total pore volume V/cc•g^{-1}	Mesopore volume V/cc•g^{-1}	Micropore volume V/cc•g^{-1}	Average pore size D/nm	adsorption capacity to VB_{12} W/mg•g^{-1}
AC1	760	0.4935	0.2576	0.1953	1.9	92
AC2	1770	0.8885	0.2974	0.3520	1.5	222
AC3	2280	1.2837	0.6597	0.4796	2.3	231

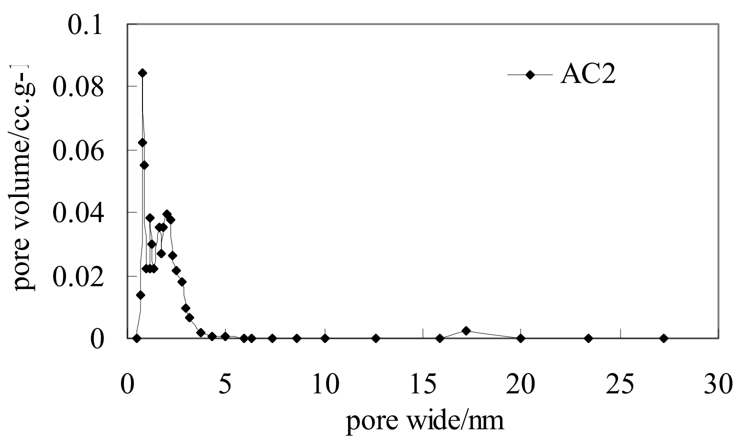

Fig.2 Pore size distribution of AC2 by DFT

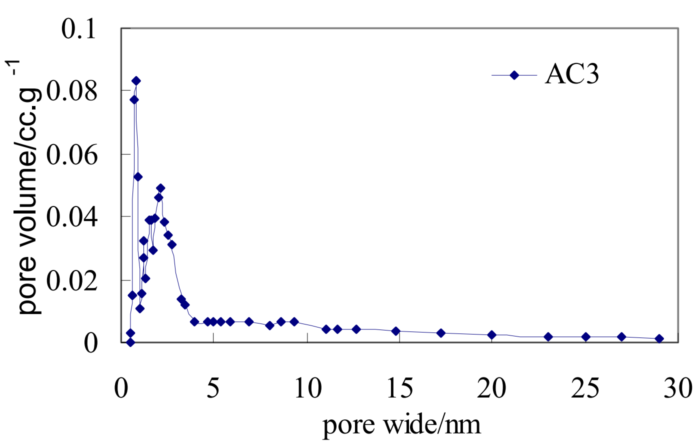

Fig.2 Pore size distribution of AC3 by DFT

3.2 Electrochemical behavior of AC electrodes

Cyclic voltammograms CV) for AC2 and AC3 electrodes at various potential sweep rates were shown in Fig.3 and Fig.4. The AC2 and AC3 electrodes showed a typical capacitive behavior in the cyclic voltammogram. The capacitance were obtained from the CV curves with the equation $C = i / s$ where I was the average current and s was the potential sweep rate. The effect of potential sweep rate on capacitance of electrodes was demonstrated in Fig.4. The specific capacitance decreased with increasing potential sweep rate. The AC3 had largest specific capacitance in the range of potential sweep rate between 2 and 80mV/s because its largest mesopore volume.

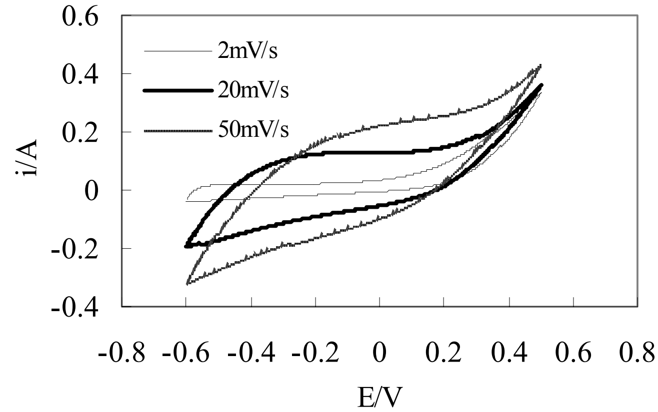

Fig.3 Cyclic voltammograms for AC2 electrode

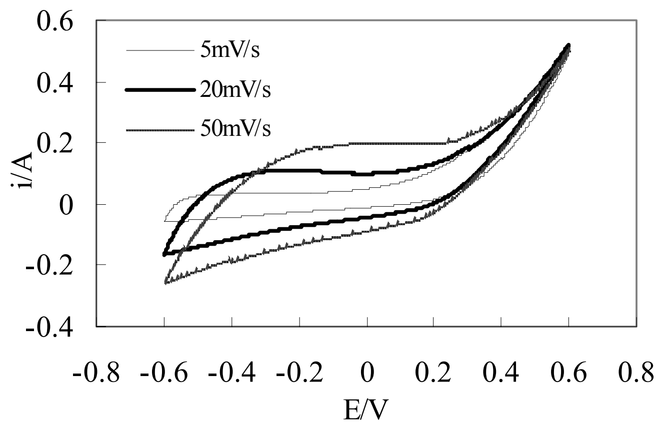

Fig.4 Cyclic voltammograms for AC3 electrode

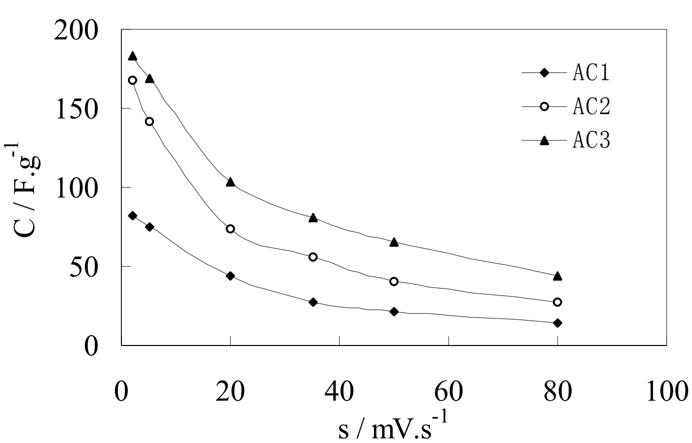

Fig.4 Specific capacitance of AC electrodes as function of potential sweep rate

Conclusions

Three kinds of activated carbon (AC) with various specific surface area were studied. The AC3 had the largest BET surface area and largest mesopore volume, resulting in the largest specific capacitance among the three samples. The specific capacitance of electrode increased with VB12 adsorptive capacity of AC.

References

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