PREPARATION AND CHARACTERIZATION OF SUPERCAPACITOR ELECTORODE FROM PAN BASED CF AND PITCH

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Introduction

Electric double-layer capacitor have been widely used because of their advantages such as large capacitance, high specific power density and free from toxic materials [1],[2]. There are three different types of supercapacitors according to the electrode materials like as carbon/carbon metal oxide and conducting polymeric materials[3]. Usually, for the electrode materials, it is required the high specific surface area and suitable pore size distribution.

The surface characteristics of carbon electrode also influence the capacitance, then some researchers report the effects of surface characteristics of electrode materials.[4],[5]

In this work, we prepared the activated carbons from pan-fibers and pitch materials and characterized their properties as electrodes for supercapacitor in accordance with their properties

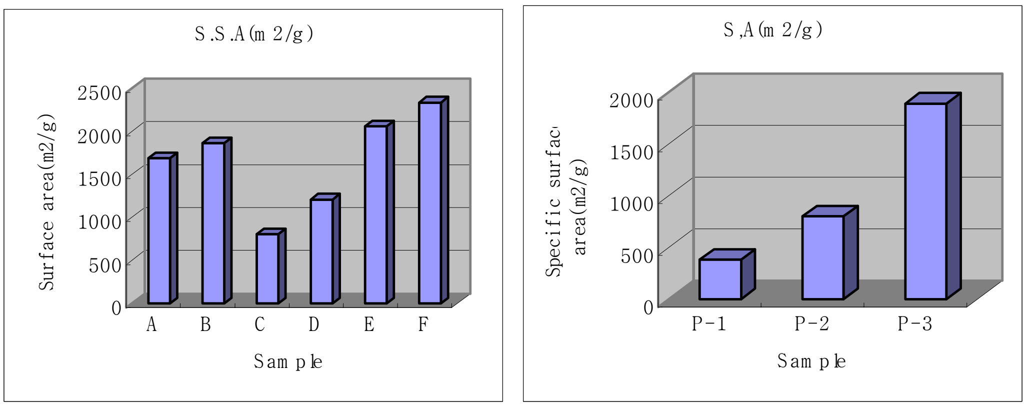
Experimental

Activated carbons from pan-fibers and pitch powers were stabilized in oxidation conditions at 250℃for 4hrs. The stabilized raw materials were immersed in 3.5M KOH solution for 24hrs and dried at 110℃ for several hours. The dried samples were activated at 800℃.

The prepared activated carbons were characterized by pore size distribution, specific surface area. Some samples are oxidized again to modify their surface properties. Their electrode properties were measured by nickel foam current collector and the prepared activated carbons.

Results and Discussion

The specific surface area of prepared samples are shown in Fig.1.



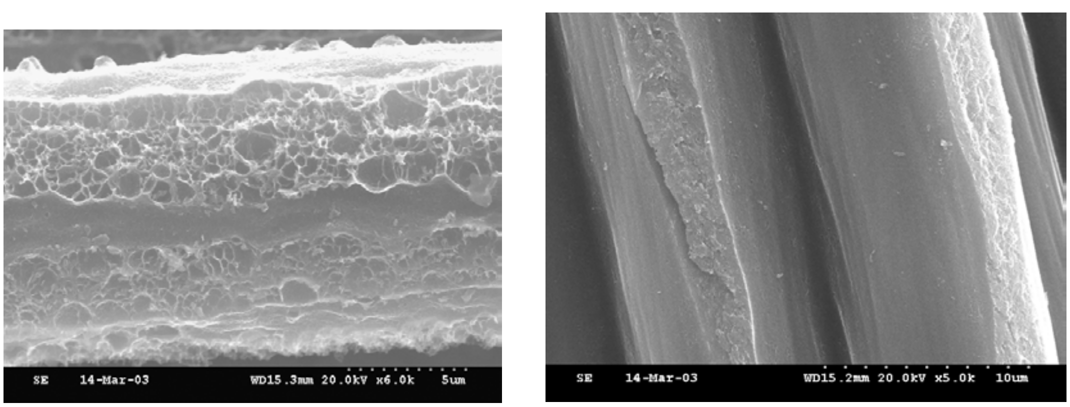
Pan-based AC　　　　　　　　　　　Pitch base AC

Fig.1 specific surface area of prepared samples

A:700℃,30min, B;700℃,30min+10min(steam) ,C;600℃,1hr , D;650℃,1hr

E:750℃,30min, F;800℃,30min

Sample B was activated with steam for 10min after chemical activation to improve the mesopore, however , mesopore was not developed as expected. The surface of A and B samples were changed very much as shown in Fig.2

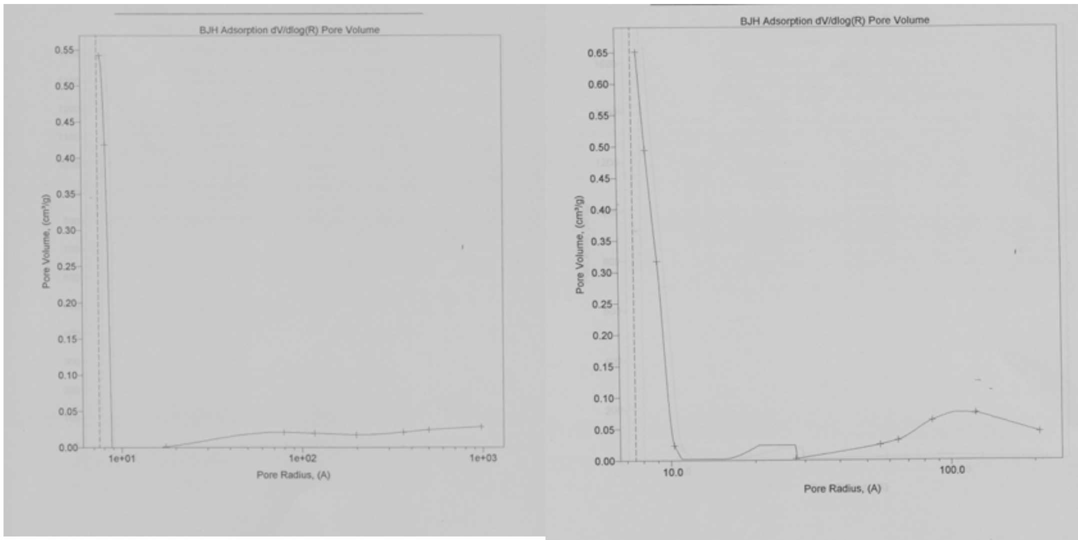


Sample A　　　　　　　　　　　Sample B

Fig. 2 SEM of sample A and sample B

Fig. 3 shows the pore size distribution of sample E and F.

With the change of activation time and temperature, the pore size distribution was changed. The increase of mesopores may be the results of the coalescence of micropores which is formed at early stage of activation.



Sample E Sample F

Fig.3 pore size distribution of sample E and F by BJH method

Table 1 shows the measurement results of various samples as elecrtrode.
In this table, the test results of pan-based AC was given.
As shown in table 1., the specific capacitance of samples increase with the specific surface area. Capacitance parameters of carbon materials in sulphuric acid and potassium hydroxide were determined, using the Ni-foam electrode.

Table 1 Capacitance parameters of various samples

Sample	BET (m2/g)	Pore radius(nm)	Specific capacitance (F/g)	Capacitance Per unit area(F/cm2)	Capacitance @10mA/cme(F)	ESR (Ohm.cm2)
A	1438	0.95	70	0.1095	0.495	0.7578
B	1346	0.91	150	0.7993	2.882	0.6147
E	2061	0.86	173	0.2481	2.088	1.3935
F	2336	1.49	193	0.3748	3.006	1.0763

The specific capacitance increased with the surface area, but the resistance was shown slightly high value.
Some samples modified in oxidation conditions to see the effect of the functional group of oxygen revealed that the capacitance decreased with the

oxygen content on the surface. This may be the reason of the binder materials, which is selected for the unoxidized carbon materials.

For the preparation of same binder materials, the oxidized samples were difficult to make an electrode. To search a precise effect of the functional groups of surface, it should be controlled the suitable composition of binder materials.

This will be continued and reported later the results.

Conclusion

Several activated carbons derived from pan based cf and pitch materials were characterized and tested as supercapacitor electrode. The specific capacitance increased with the specific surface area of activated carbons.

In this work, the sample of wide pore showed higher specific capacitance, how ever, the relation of thee pore size distribution and the specific capacitance was not clearly shown due to the prepared samples have not various type of pore size distribution.

The modification of surface of activated carbons by air oxidation reveals the increase of resistance.

References

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