PREPARATION AND PROPERTIES OF PITCH BASED HIGH SPECIFIC SURFACE AREA ACTIVATED CARBON

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INTRODUCTION

Activated carbon is used extensively in many fields . However, general activated carbon of low surface area and poor adsorptive capacity can not meet requirements of developing industry ,enviormental protection , medical and military fields,etc. Thus, high performance adsorbents are taken in account. The process of producing high specific surface area activated carbon (BET surface area >2500m²/g) was developed in U.S.A (1) in the mid-70's. Since it showed an excellent adsorption properties , applications such as methane storage and municipal water treatment have been foreseen. Recently, the carbon (so-called Maxsorb) has been produced commercially in Japan (2) .

Because of pitch having little amount of ash content and abundant source(low price), we chose it as raw materals to be activated by using excess potassium hydroxide (KOH)as activating agent to prepare pitch based high specific surface area activated carbon (PHAC,BET surface area: 2600~3600m²/g) .

In this paper, surface areas and pore structural parameters of PHAC were investigated by nitrogen adsorption(at 77K). Fuctional groups on the surface of PHAC were depicted by X-ray photoelectron spectroscopy(XPS) and adsorptive properties of PHAC were studied .

EXERIMENTAL

Preparation of PHAC

PHAC was prepared through the following processings: started by pulverizing pitch (softening point: 250 ℃ ;ash content: 0.04 wt%) (derived from petroleum heavy oil) into required size ; subsequently by oxidizing to stabilized pitch under heat air flow from room to 320℃at the heating rate of 2℃/min ; and finally followed by KOH activating to PHAC at 900 ℃ for 60min under nitrogen atmosphere at the heating rate of 10℃/min after mixing of a part pitch and four parts KOH(wt/wt).

Characterization of PHAC

Surface areas and pore structures of PHAC were quantified by BET equation and α_s methods(3),based on nitrogen adsorption (at 77K) measured by ASAP2000 adsorption apparatus . XPS spectrum and surface oxygen fuctional groups were examined by PHI-5300 ESCA SYSTEM Spectrometer (made by Perkin-Elmer Comp.).

RESULTS AND DISCUSSION

Some of properties of PHAC and commercial activated carbon were listed in Table 1. Pore distribution and pore structural parameters of PHAC1 were depicted in Fig.1.

Because smaller particals of raw materils to be activated have larger external surfaces and more active sites of reaction to produce more microporous structures when they are activated by KOH, better results (higher specific surface area) were obtained (seen in Table 1) .

As shown in Table 1 ,and Fig.1, PHAC has high specific surface area and excellent adsorptive properties , uniform pore structures (called cage-like structures) comprising of micropores ,and norrow pore distribution (radius mainly between 8~16 Å) .

Fitted C1s XPS spectrum and the results of XPS measurements of PHAC1 were shown in Fig. 2 and Table 2 . Since surface oxides on activated carbon can impart a polar character to the carbon surface , they have some inflences on the adsorptive properties . As given in Fig.2 and Table 2 , the surface of PHAC has abundant oxygen fuctional groups such as phenal hydroxyl (C-OH) , ether (C-O-C) , carbonyl (-C=O) , lactone,carboxylic anhydride (O-C=O),etc.

CONCLUSIONS

PHAC has excellent adsorptive properties , and are rich of micropores . There are abundant oxygen fuctional groups on the surface area of PHAC .

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Table 1, Some of properties of PHAC and Commercial activated carbon

Sample	PHAC1	PHAC2	PHAC3	Commercial activated carbon
Size of materials for activation,mm	100~74	74~65	65~40	
BETsurface area,m^2/g	2666	3021	3646	1100
Yield , wt%	28.8	24.7	20.5	
Adsorptive capacity to				
Iodine , mg/g	2633	2905	3114	1205
Benzene , mg/g	992	1154	1308	400

Table 2 . The results of XPS measurements of PHAC1

Band No.	1	2	3	4	5
Peak	C-H	C-O	C=O	O=C-O	C-X
Position,ev	284.71	286.69	287.62	289.32	291.44
Delta,ev	0.00	1.58	290	4.61	6.73
Area,ev/s	37402	9529	6382	4742	702
%Total Area	63.66	16.22	10.86	8.07	1.19

C-H--C1s for graphitoid C;C-O--C1s for C-OH and C-O-C,etc;C=O--C1s for H-C=O and R-C=O ,etc;O=C-O--C1s for COOH and COOR, etc;C-X--C1s for Shake-up C

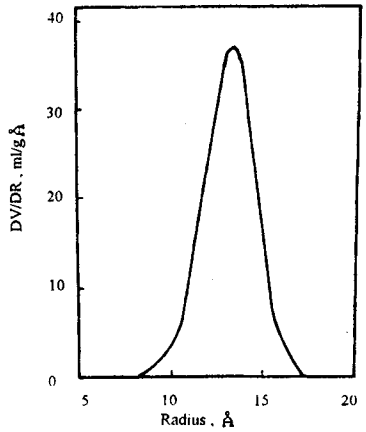

Fig.1, Pore distribution (radius) of PHAC1 (S_{BET}=2666m^2/g ,Smicro=2313m^2/g , Vtotal=1.54ml/g ,Vmicro=1.38ml/g)

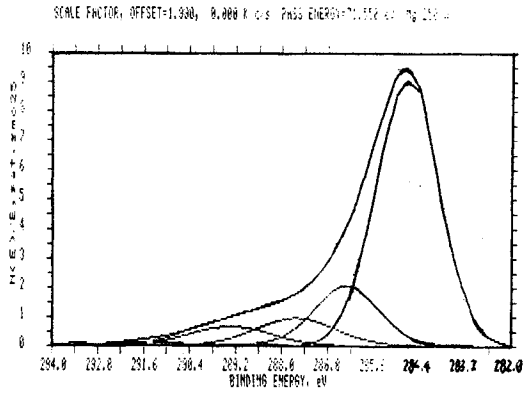

Fig. 2 , Fitted C1s XPS spectrum of PHAC1