PREPARATION OF MESOPOROUS ACTIVATED CARBON FIBERS AND THEIR ADSORPTION

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Introduction

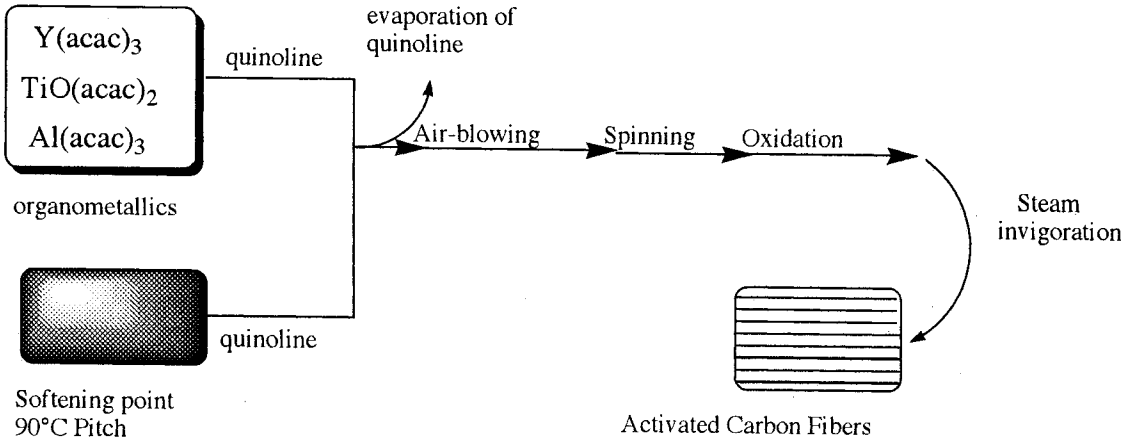
Activated carbon fibers are practically very interesting and important adsorbents due to the high adsorption capacity. The pores of activated carbon are classified into sub-micropore (pore size<0.8nm), micropore (0.8-2nm), mesopore (2-50nm), and macropore (>50nm). Adsorption capabilities of activated carbon fibers mainly depend on pore sie and specific surface area. Microporous activated carbon fibers give high adsorption affinity for relatively small molecules. On the other hand, mesoporous activated carbon fibers are supposed to be useful for the adsorption of large molecules. However, there are few reports on the preparation of mesoporous activated carbon[1]. In this work, we attempted the preparation of mesoporous activated carbon fibers using organometallics/pitch composites, according to the procedure as shown in Scheme 1. In addition, the adsorption of various large - size molecules on activated carbon fibers obtained was investigated.

Experimental

Organometallics/pitch composites were prepared by mixing of quinoline solutions of low softening point pitch with quinoline solutions of organometallics and the removal of quinoline by flash distillation. Obtained organometallics/pitch composites were converted to high softening point pitch by air-blowing reaction and then pitch fiber were produced by spinning of organometallics/pitch composites. The fibers were invigorated by N_2 gas saturated with water vapor

Results and Discussion

Table 1 shows the pore characteristics, BET surface areas, mesopore surface areas and mean pore sizes of activated carbon fibers obtained from various organometallics/pitch composites. The activated carbon fiber which was highly mesoporous and had high BET surface area was obtained from $Y(acac)_3$/pitch composite. On the other hand, the activated carbon fibers from



Scheme 1 Preparation of Activated Carbon Fibers from Organometallics/Pitch composites

Table 1 Pore Characteristics of Activated Carbon Fibers

sample	metal compound	activation (C-min)	yield (wt %)	BET surface area (m^2/g)	mesopore surface area (m^2/g)	mesopore ratio (%)	pore size (A)
Y-ACF-2	$Y(acac)_3$	800-80	32.9	1210	430	35.8	29.8
Y-ACF-3	$Y(acac)_3$	875-50	13.3	1370	999	73.0	42.8
Ti-ACF	$TiO(acac)_2$	875-40	32.7	1280	140	10.9	23.3
Al-ACF	$Al(acac)_3$	875-40	33.8	1339	24.0	1.8	20.8
A-20	——	875-70	17.5	1990	91.5	4.6	21.4

metal content: 0.3%

$TiO(acac)_2$ or $Al(acac)_3$/pitch composites were microporous. Rare earth metal complexes such as $Y(acac)_3$ were effective for mesopore formation.

The adsorbed amounts of vitamin, humic acid, cyclodextrin, and various dyes on the mesoporous activated carbon fiber(Y-ACF-3) were measured. Fig.1 shows the adsorption of vitamin B_{12}, which is relatively large in molecular size, on the activated carbon fibers. The adsorbed amount of vitaminB_{12} on mesoporous activated carbon fiber was about three times higher than that on microporous activated carbon fiber. The high amount of γ-cyclodextrin was adsorbed on mesoporous activated carbon fiber. The higher adsporption affinity of γ-cycrodextrin on mesoporous activated carbon fiber than that on microporous one, in spite of lower BET specific surface area of mesoporous activated carbon fibers , is supposed to be due to high mesopore content. Fig.2 shows the adsorption isotherms of humic acid (*Mn*(PEO):12800), which is cited as the precursor to carcinogenic substances, trihalomethane formed during chlorination in water treatment plants. The adsorption affinity of humic acid on the mesoporous activated carbon fiber is much higher than that on the microporous activated carbon fibers. These results suggest that the mesoporous activated carbon fiber obtained from $Y(acac)_3$/pitch composite is useful as an adsorbent for large molecules.

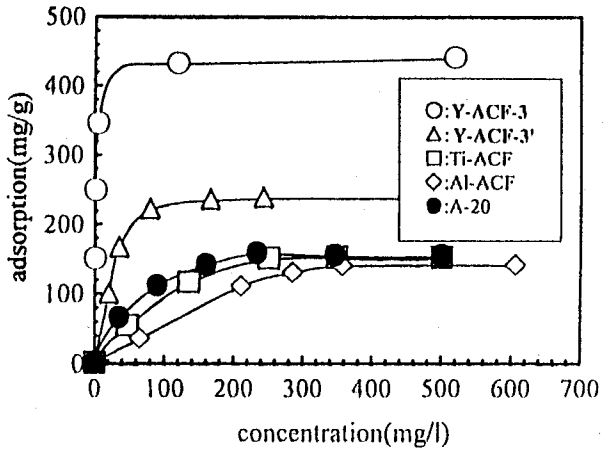


Figure 1 Adsorption of vitamin B_{12}

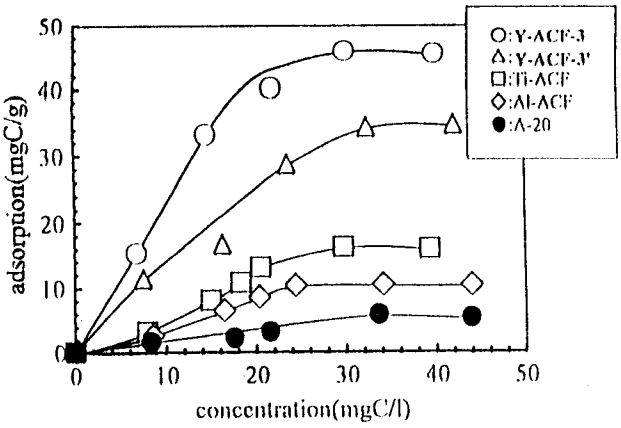


Figure 2 Adsorption of humic acid *Mn*(PEO):12800

References

1. Tamai, H., Kakii, T., Hirota, Y., Kumamoto, T., and Yasuda, H., Chem. Mater., 1996, **8**, 454.