THE STRUCTURES OF ACTIVATED CARBON FIBERS AND THE ADSORPTION FOR XENON

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Introduction

Activated carbon fibers(ACFs), were prepared by the carbonization and activation of polyacrylonitrile, polyvinyl formal and pitch, are highly microporous with small external surface areas and very little mesoporosity. ACFs has a greater adsorption rate and adsorption capacity than the usual granulated activated carbons. ACFs have been extensively investigated from both fundamental and practical aspects[1]. Before this work we use various base ACFs to study the properties of adsorption of noble gas xenon under different condition[2]. we also systematically researched the static and dynamic adsorption characteristic of ACFs for xenon and inorganic gases, and the actual adsorption behavior for radioactive ^{133}Xe. It will be applied to the adsorption for the radioactive off-gas xenon in nuclear power station or nuclear reactor.

Experimental

The fibers were firstly pre-oxidized in air (heated up to 250 ? at 4? /min and held for 60 mins). After oxidization, the fibers were heated to 800? at 6? /min for carbonization in nitrogen gas(99.99%) for 30min. The carbonized fibers were activated under a vapor of water (water flow is 3ml/min) for 60min. The ACF of Sisal ,Viscou PVF,PVA ,PAN and pitch, respectively were designated as SACF, VACF, FACF, AACF, NACF, PACF. The outlet concentration of the column was continually measured by a PID detector of a gas chromatograph(HP-5890A) from figure 1.

Results and Discussion

The adsorption with different precursor activated carbon fibers (ACFs) for xenon were studied. The figure 2 show that adsorption amount of PACF for xenon have a optimal extent with surface area. The adsorption amount of ACFs for xenon was not linear proportion with their specific surface area, but greatly influenced by their distribution of pore diameter. The mostly suitable size of micropore was about 0.7nm, the adsorption amount for xenon depended on the amount of micropores in this range. The probable reason for the observed phenomenon is that during the activation process not only the surface are a increases but the pore size distribution of the activated carbon fibers also increases. The figure 3 were a curves of dynamic adsorption by different based of the ACF for xenon, it shows that their breakthrough times have a notable different for the ACFs of different based, however the breakthrough times of FACF has more long times, it's about fourteen minute. The results show that ACF of polyvinyl formal based had the greatest adsorption amount for xenon. The adsorption amount of ACFs for inorganic gases were small in air, but the adsorption behavior for dio xide carbon was the same as that for xenon. In mixed adsorbent system, dioxide carbon would obviously influenced the adsorption of ACFs for xenon, leading to decrease the amount of adsorption. The possible reason was that these two kinds of gases occupied the micropores with the same size of ACFs(table 1). In order to increase the ACFs amounts of adsorption for xenon, dioxide carbon must be removed in initial step. The table 2 show that the adsorption radioactive ^{133}Xe were with the ACF and activated carbon(AC) at dynamic system. Although the weights of ACF were small than that of AC, but the ACF amounts of adsorption for xenon were obviously higher than that of AC. It results that the ACF had much more amounts of adsorption for xenon than that of AC.

Conclusions

The ACFs have a optimal amounts of adsorption for xenon. Its size of micropore mostly effects the amounts of adsorption for xenon. The ACF had much more amounts of adsorption for xenon than that of AC.

References

1. Kaneko.K. Specific intermolecular structures of gases confined in carbon nanospace. Carbon 2000; 38:287-303
2. Deng JY, Zeng HM, Zhang HT and Zhang LX. Xenon adsorption of activated carbon fibers. Chinese J. of Mater.Res., 2000;14(2):179-182

Acknowledgments

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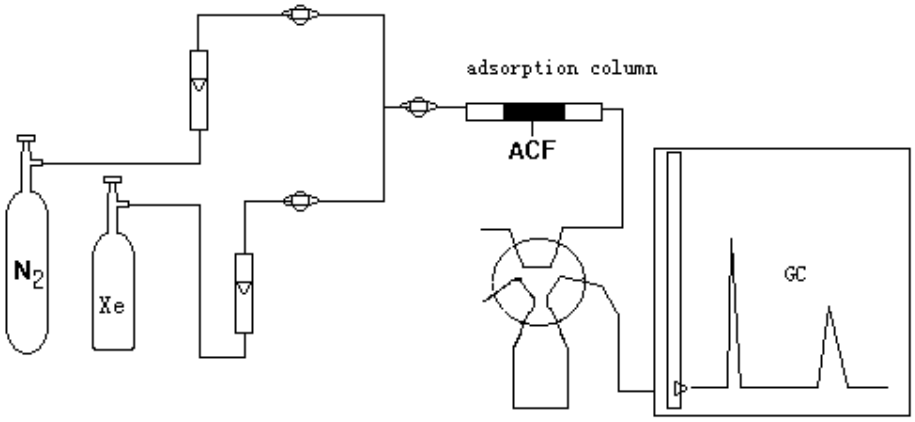

Fig.1. The schematic of dynamic adsorption

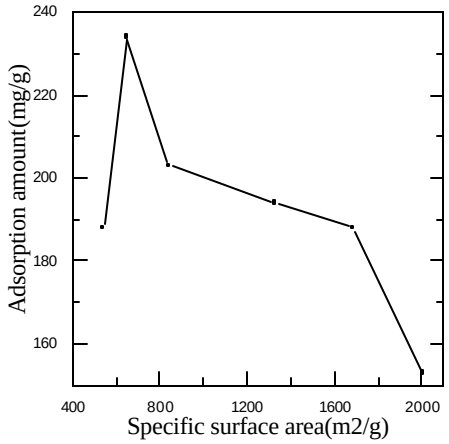

Fig.2. The relationship of the surface area of PACF with adsorption amount for xenon

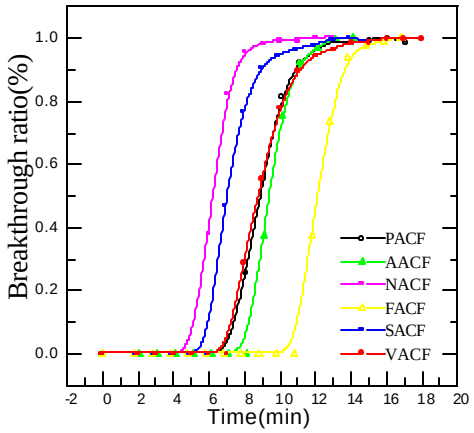

Fig.3. The comparison of adsorption breakthrough curves of different base ACFs for xenon

Table1 The dynamic adsorption amount of the ACF for Xe in different mixture system

Sample	ACF-1	ACF-2	ACF-3	ACF-4	ACF-5	ACF-6
N_2+Xe	81.52	64.27		79.22	69.92	60.33
Air+Xe	79.53	60.50	66.79	70.41	61.31	51.65
CO_2+Xe	48.65	55.48		46.12	46.61	45.62

Table 2 The dynamic adsorption of ACF and AC for ^{133}Xe at low-temperature

Sample	Gas rate (l/min)	Gas volume (m^3)	Adsorbent weight(g)	Adsorption amount(ml/g)
ACF1	10	0.25	25.93	3.46×10^{-4}
ACF2	7	0.175	25.99	1.03×10^{-4}
AC	7	0.175	102.01	8.16×10^{-5}