ADSORPTION AND CONVERSION OF H_2S OVER MODIFIED PAN-BASED ACF IN PRESENCE OF H_2O AND O_2

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Introduction

Hydrogen sulfide is one of main resource for odorous pollution, and its treatment attracts many views[1,2]. In present study, PAN-ACF of high surface area is heat-treated, then the modified ACF shows much higher adsorption capacity of H_2S.

Experimental

PAN-ACF of higher surface area (abbreviated as K1ACF) (2781m^2/g) is heat-treated at 700℃ or 950 ℃ for 1.5hrs, cooled to room temperature in inert atmosphere, and contacted air at room temperature for 0.5hr. The final sample is named K1700 and K1HT, respectively.

The dynamic adsorption of H_2S was conducted in fixed bed. The model inlet gas mixtures were N_2+H_2S(300mg/m^3)+H_2O(5v%)+O_2(6.5v%). The weight of samples packed, inlet H_2S concentration, inlet total flow rate were 200mg, 300mg/m^3 and 270ml/min, respectively. The inlet and outlet H_2S were analyzed by GC-FPD.

XPS tests were conducted by PHI5300 ESCA, and TG analysis was conducted by Sinku-Riko TGD-5000.

Results

K1ACF is of much less adsorption capacity of H_2S than common PAN-ACF of smaller specific area surface (ACF) (e.g. 600~800m^2/g). While, after heat-treatment, the two kind of ACFs show different modification trend as for adsorption capacity of H_2S. The dynamic adsorption capacity of the compound over K1HT is enhanced to a relative large extent in presence of H_2O and O_2, compared with K1ACF (see fig.1). And the same modification doesn't occur for common PAN-ACF(fig.2).

Fig.1 also showed that heat-treating temperature effects the adsorption capacity of H_2S over final heating samples(K1HT and K1700)

Based XPS tests, after adsorption, some sulfur-containing complexes(BE 170ev) are formed on the surface of K1HT(fig.3).

Discussion

The adsorption of hydrogen sulfide over PAN-ACF contains catalysis process. Moreover, catalysis process is more important than the pure adsorption. At least, some H_2S is oxidized into SO_4^{2-}.

Based on table 1, after heat-treatment, the element content makes great changes. Especially, different heating temperature leads to different change of element content, especially for oxygen. For K1700, the oxygen content decreases to some extent, compared with original K1ACF due to removal of a portion of oxygen-containing complexes. While, for K1HT, oxygen content doesn't decrease, but increase, indicating some change occurs on the surface of micropore. From fig.3, the surface oxygen exists in different chemical states before and after heat-treatment at 950 ℃ (different thermal removal behaviors of surface complexes), and it is concluded that the cleaned surface by heat-treatment at 950℃ makes functions with oxygen and water when contacting air.

Since pore structure is destroyed by heat-treatment, changes of pore structure make little contribution to the modification of adsorption and conversion behaviors. It is changes of surface structure that lead to increases of adsorption capacity.

However, different surface structure leads to different adsorption and conversion mechanism.

As for K1700, the surface radicals formed by removal of oxygen-containing complexes can make great effect on the conversion of H_2S, as removal of SO_2. As for the K1HT, the water adsorbed and inlet water make important roles in the conversion of H_2S to SO_4^{2-}. These mechanisms will be discussed in detail in other paper.

Conclusion

After heat-treatment, K1HT and k1700 is of higher adsorption capacity than K1ACF in presence of H_2O and O_2. Different heat-treating temperature brings about different changes in micro-structure, which leads to different adsorption and conversion behaviors and different conversion mechanism.

References

1. Hiroshi K, Kuniyoshi I, Hirai M, Shoda M. Studies of the oxidation mechanism of sulphur-containing gases on wet activated carbon fiber. Applied catalysisB: Environmental 1995; 6:255-262
2. Ikeda H, Asaba H and Takeuchi. Removal of H_2S, CH_3SH and $(CH_3)_3N$ from air by use of chemically treated activated carbon. J Chem.Eng.Jpn 1988;21(1):91-97

Table 1 Bulk element content of samples before and after adsorption of H_2S

	C	H	N	O	K	S
K1ACF	87.75	0.59	2.15	6.46	2.69	
K1ACF(A)	83.31	0.83	3.30	8.89	2.79	0.20
K1HT	57.75	1.46	0.53	30.00	11.26	
K1HT(A)	49.28	1.08	0.70	38.59	10.35	4.66
K1700	92.55	0.45	1.61	5.29	1.79	
K1700(A)	92.01	0.47	1.37	2.63	2.00	1.52

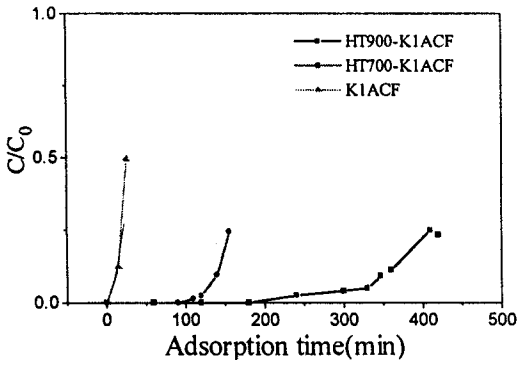

Fig.1 Breakthrough curve of H_2S over HSACF before and after heat-treatment

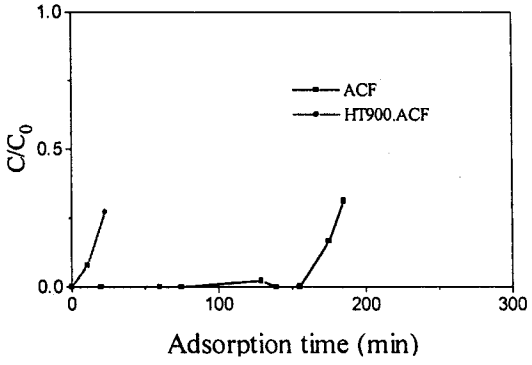

Fig.2 Breakthrough curve of H_2S over ACF before and after heat-treatment

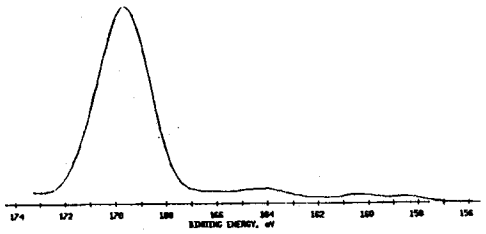

Fig.3 XP spectra of S2P of K1HT after adsorption of H_2S

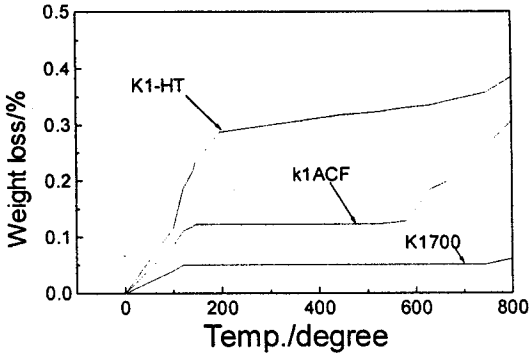

Fig.4 TG plot of HSACF before and after heat-treatment