고분자 전구체로부터 합성된 활성탄소를 이용한 암모니아 흡착

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Ammonia Adsorption of Activated Carbons Synthesized from Polymeric Precursor

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1. Introduction

Activated carbons (ACs) are widely used in adsorption for the removal of gaseous and aqueous pollutants[1]. Although a wide range of carbonaceous materials can be converted into ACs, the coal and lingocellulosic materials are the most commonly used starting materials for the production of commercial ACs. Recently, there are a quite large number of studies regarding the preparation of ACs from various polymeric materials because of high carbon yield and low ash content In this work, ACs are prepared from polystyrene (PS) by chemical activation with potassium hydroxide and the effect of the KOH-to-PS ratio on adsorption of ammonia is investigated.

2. Experimental

2.1. Materials and Sample Preparation

Polystyrene (PS) and potassium hydroxide (KOH) were used as the starting material and chemical agent, respectively. The detailed preparation procedure was reported elsewhere[2].

2.2. Characterization

Nitrogen adsorption isotherms were measured using an ASAP 2010 (Micromeritics) at 77K. The amount of nitrogen adsorbed on ACs was used to calculate the specific surface area according to the BET's classification. Micropore volume was calculated using the Dubinin-Radushkevich equation. XPS characterization of surface composition and chemistry was carried out on a VG ESCALAB MK1 spectrometer (VG Scientific Ltd.) using Al Kα radiation (energy 1486.6 eV) in a vacuum of 10^{-7} torr.

2.3. Ammonia Adsorption

Ammonia adsorption capacities were determined by using ammonia detector (NH_3 detection tube; range: 1~1000 ppm, Gastec Korea). The gas flow rate was controlled by a mass flow controller (MFC; GMC1000, MKS) and NH_3 of 1000 ppm (balanced by He) was introduced into the quartz adsorption column (ID: 10 mm and length: 30 cm) at the rate of 20 mL/min. Prior to each analysis, the samples were dry at 373K for 1 h to remove moisture and other impurities on ACs.

3. Results and Discussion

The adsorption capacity of ACs is dependent on their structural parameters and the presence of surface functional groups[3]. Table 1 summarizes the structural parameters and surface properties of the ACs studied. It can be seen that BET's surface areas, micropore volumes, and mesopore volumes increase with the increase in the KOH-to-PS ratio. Also, it can be found that the surface of all the samples contains appreciable amount of oxygen, and the O/C ratios increase as the KOH-to-PS ration increases.

Figure 1 shows the ammonia adsorption capacities of the ACs studied. It is shown that the initial adsorption capacities increase as BET surface areas increase, and the time to reach the equilibrium is proportional to the O/C ratios. However, it can be seen that although the O/C ratio of as-received is similar to that of KPS-1, the equilibrium behaviors are significantly different.

4. References

1. P. M. Cheremisinoff and C. Ellerbusch, "Carbon Adsorption Handbook" , Ann Arbor Science, MI, 1978.
2. S. J. Park and W. Y. Jung, "Preparation of Activated Carbons Derived from KOH-Impregnated Resin" , *Carbon*, **40**, pp.2021-2022(2002).
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Table 1. Structural parameters and elemental surface composition of the ACs studied

Nomenclature	Structural paratmeters			Elemental surface composition		
	S_{BET} (m^2/g)	V_{micro} (cm^3/g)	V_{meso} (cm^3/g)	Total carbon (at %)	Total oxygen (at %))	O/C ratio
As-received	357	0.14	0.05	79.3	15.3	0.19
KPS-1	935	0.38	0.01	80.9	15.2	0.19
KPS-2	1337	0.50	0.08	71.4	21.6	0.30
KPS-4	1947	0.84	0.44	71.6	23.3	0.33

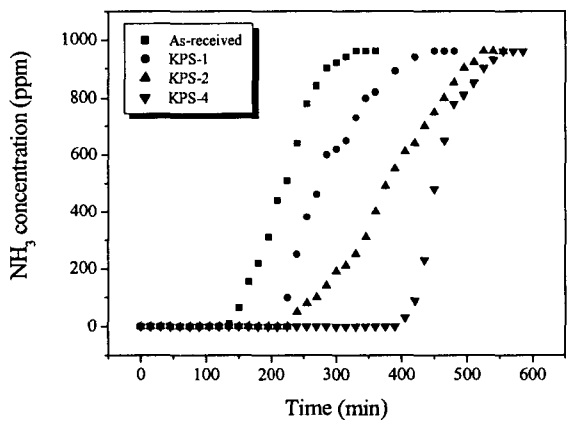

Figure 1. Ammonia adsorption capacities of the ACs studied.