Structure of activated carbon prepared by chemical activation

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1. INTRODUCTION

Recently, the effective energy storage and new sources of electricity like lithium ion second batteries and fuel cells are most expected to solve the future energy problem. Among them, fuel cell systems, which have relatively higher efficiency and discharge only water without any toxic polluent, are considered best for future energy system. The promising candidates for hydrogen source of such fuel cells are hydrogen itself, methane, methanol and a clean gasoline of new type.

However, hydrogen and methane have storage problems as a source gas for fuel cell. Some effective gas storage of carbonaceous materials are expected to have function to reduce the pressure and increase the energy density and safety when they are filled under high pressure in the storage tank.

The aim of this work is to attempt to produce novel carbonaceous material on new concept. The sun face of carbon fiber prepared by the melt spinning of mesophase pitch is usually known to be covered with basal planes of graphene sheets. Recently, several reports confirmed that hexagonal graphene edges can be effectively exposed with solvent extraction on the surface as-spun fibers. We tried the method of the solvent extraction to create hexagonal carbon edges on the surface for the effective hydrogen or methane storage.

The alkaline activation of carbon fibers was also tried to increase the surface area as mind as possible.

2. Experimental

As-spun mesophase pitch fibers were extracted to remove the soluble portions using pyridine as a solvent for 48-62 hours. Such insoluble fibers this obtained were stabilized at 270　for 60min at heating rate of 0.5　/min under the air atmosphere. Then
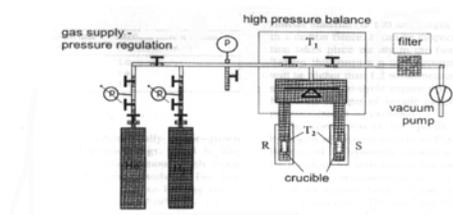

Fig.1 CAHN balance of the gravimetric methane adsorption analysis

they were carbonized and activated by alkalis (KOH, NaOH).

The gas adsorption properties of various novel activated carbon fibers and commercial activated carbons were examined using high pressure isothermal gravimetric and capacity analysis. A schematic drawing of the apparatus is shown in Figure 1.

The balance chamber can be pressurized up to 3.5MPa, and mass resolution is within the range of 100 mg. The buoyancy of sample was calibrated with numerical method. Before starting the high-pressure adsorption experiment, the sample chamber was filled showed with N_2. The chamber was evacuated for 1 hour. After evacuation, the chamber was heated to 200　for 1h under nitrogen atmosphere. The samples were measured in one adsorption - desorption cycle at the maximum pressure of 3.5 MPa.

Additionally, to determine the volumetric adsorption capacity, we mixed the teflon for binder (about 10wt%), and pressed from 5 to 40 MPa.

Table1. Parameters of samples

MP: Mesophase Pitch **PN:** Polyacrylonitrile **FC**: Fruid Coke **K**: Kevlar fiber

Sample	Extraction	Carbonisation (　)	A/C	Activation (　)	Surface Area (m^2/g)	CH4 storage (wt%/g)
MP-1	Pyridine	450	4	700	1560	9.1
MP-2	Pyridine	450	4	900	3500	17
PN-1	Nothing	800	4	800	3700	17.9
FC-1		Nothing	4	800	3400	13.9
K-1		600	4	700	3470	14.4
K-2		600	2	800	3000	17.5

3. Result and discussion

Table1 shows condition of samples. We got many samples over 3000m^2/g. Above all, PN-1 showed maximum adsorption amount of methane is 17.9wt%/g. But when we use ANG way, value of wt%/ml is important. So we discuss the change of press and density of mould about Maxsorb(Table2). The adverse change carried out between wt%/g and wt%/ml. This shows Maxsorb have small density so did. Consequentially, we must aim to synthesize the sample have in part large surface area and high density.

Table2. Parallel between wt%/g and wt%/ml on Maxsorb

Pressing (kg/cm^2)	0	50	100	400
density (g/ml)	0.289	0.466	0.487	0.617
Methane storage (wt%/g)	13.2	12	12.4	11.4
Methane storage (wt%/ml)	3.8	5	5.5	6.4

4. Reference

[1] Strobel R, Jorissen L. J Power Sources 1999; 84: 221-224.

[2] Lozano-Castello D, Alcaniz-Monge J. Fuel 2002; 81: 1777-1803.