Mesoscopic Structure of Pitch Based Activated Carbon Fiber through Extraction and KOH Activation

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1.Introduction

Development of novel materials for the gas storage is most promising to solve the future energy problem. Among them, some carbonaceous materials like carbon nanotube and carbon nanofibers have been reported to show more hydrogen storage capacity at room temperature than metal hydride, recently. The effective methane and hydrogen storage materials is expected as a key technology to commercialize PEM type fuel cell.

The present authors reported microdomains of carbon. 50 nm as a mesoscopic structural unit in the mesophase pitch based carbon fibers by solvent extraction and successive carbonization of the mesophase pitch fibers[1]. Such a structural unit maintained its size in the transverse cross-section and longitudinal surface of the fiber up to graphitization temperatures.

In the present study, the authors examined the detailed morphology of carbon fibers through the solvent extraction, and the successive heat treatment for the development of novel effective carbonaceous materials of methane hydrogen storage. The face of carbon fiber made from the melt spinning of mesophase pitch is usually known to be covered with horizontal hexagonal graphene sheets of 110 phase, but several reports confirmed us that hexagonal graphene sheet of 002 phase can be effectively exposed with solvent extraction of as-spun fibers. We tried the method of the solvent extraction to create hexagonal carbon edges to surface for the effective hydrogen charge in the step of storage.

2. Experimental

Mesophase pitch based activated carbon fiber was prepared through the mesophase pitch spinning, pyridine extraction, stabilization, and heat treatment under the inert atmosphere up to 1200 . Some properties were summarized at Table 1. The detailed preparation method of Py-CF (Carbon fiber from pyridine extraction) is as following. As-spun mesophase pitch fibers were fixed in the soxhlet equipment and extracted the soluble portions using pyridine as a solvent in 48-62 hours, and obtained insoluble fibers. Such insoluble fibers were stabilized at 270 for 60min with heating rate of 0.5 /min under the air atmosphere, and carbonized under argon atmosphere at 1200 .

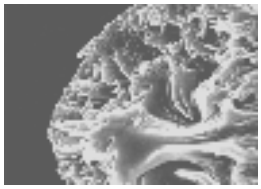
3.Results and discussion

Fig.1 shows HR-SEM photographs of the transverse cross-sections of fiber spun at 270 (Petoca-CF), extracted with pyridine, and heat-treated at 1200 . Petoca-CF showed a kind of dual texture that the microdomains in out-section near the fiber surface were arranged along to the fiber surface like the onion-type arrangement, whereas in the inside section were rectangular to the surface like the radial type. The arreangement of microdomains Py-CF is very difficult to obseve because the fraction section of fiber specimen so flat. The out-section nearest to the surface of PY-CF showed the onion type arrangement of microdomains, and the middle-section near to the surface did the radial type arrangement of microdomains.

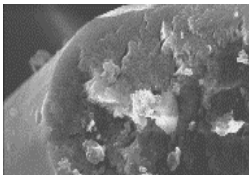
Table 1 showed Py-CF has higher carbon content compared to petoca-CF and petoca-ACF. Petoca-ACF showed relatively higher oxygen content compared to Py-CF and petoca-CF, which might be induced from the alkaline activation and cleaning prodcedures.

4.Reference

1. Seong-Hwa Hong, Yozo Korai and Isao Mochida, ***Carbon*, 38,** 805–815 (2000)



Fiber type x 5000



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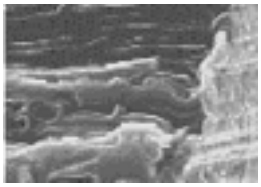
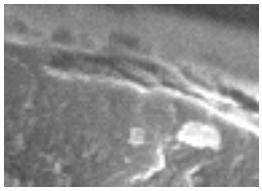
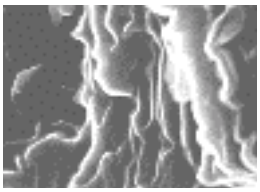


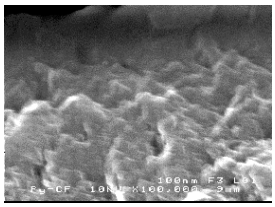
Fiber type x 50,000



Fiber type x 60,000



Fiber type x 75,000



Fiber type x 100,000

Petoca-CF

Py -CF

Figure1 SEM photograph of petoca-CF and Py-petoca-CF

ACF and CF	C	H	N	O
Petoca-CF	94.18	4.83	0.01	0.98
PetocaACF	93.36	0.37	0.17	6.10
Py-petoca-CF	99.11	0.32	0.02	0.55