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RECENT RESEARCH ACTIVITIES

Production of useful substances from tropical wood by fast pyrolysis

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A stable supply of fossil fuels is expected to be difficult in the future. The conversion from unused biomass to the production of useful products has the potential to create a society with sustainable production. The production of useful products from unused biomass, is expected to stimulate the local economy. Based on the above research background, the authors have been investigating the optimal conditions for producing useful products from various tropical fast-growing woods. Here, we focused on the solid residues produced by fast pyrolysis. We then attempted to analyze the nanopore structure of the solid residues, which has an effect on carbon dioxide and ammonia adsorption. The size of nanopores is an important factor in gas adsorption. The microporous structure of the pyrolysis residue was observed using transmission electron microscopy (TEM) and the image analysis of the TEM images was conducted.

A schematic of the fast pyrolysis system is shown in Fig.1. The fast pyrolysis system is an enclosed system consisting of an L-shaped reaction tube, a liquid recovery tube, and a gas recovery bag. The graphite dye in which the reaction tube is inserted between the two electrodes of the pulsed current-heating device, and a load and a current are applied. Sengon (*Paraserianthes falcataria*) and Abies sachalinensis (*Abies sachalinensis*) were powdered and inserted into the graphite dye in the L-shaped reaction tube shown on the left side of Figure 1. The materials of the reaction tube are quartz, Cu, and Ti. A thermocouple was inserted near the reaction tube in the graphite dye, and the temperature was controlled by monitoring the temperature with a PC. The temperature of pyrolysis was 300°C to 800°C, the pyrolysis time was 3 minutes, and the heating rate was 15°C to 20°C/s. The TEM was used to observe and process the fast pyrolysis residues. [2]: For the electron microscope observation, the images were processed in the image being observed on a PC monitor connected to the TEM, and then taken into the PC. The image analysis consists of two processes: spatial frequency analysis and measurement processing. In the spatial frequency analysis, a two-dimensional fast Fourier transform (2D-FFT) was performed.

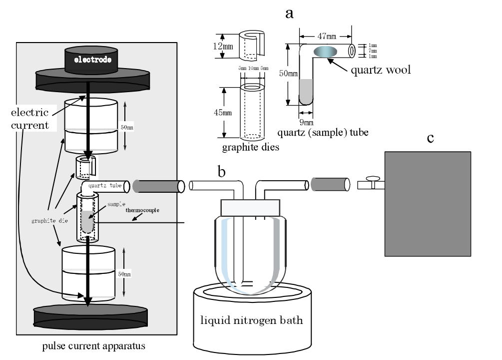

Fig. 1. Schematic of fast pyrolysis system[1]

Different spacing of the hexagonal carbon layers was obtained depending on the species, treatment temperature, and reaction tube material. Pyrolysis of Abies sachalinensis in a quartz reaction tube showed that the spacing of the hexagonal carbon layer was smaller at 500°C, with the spacing increasing in the order of quartz, Cu, and Ti. When compared under the same non-species conditions, the face spacing of the carbon in Sengon tended to be smaller than that in Abies sachalinensis. The surface spacing is very important for gas adsorption because it reflects the potential of gas molecules that can be stored or adsorbed in the nanopores.

References

[1] Honma, S.; Hata, T.; Ohashi, Y.; Sulistyo, J.; Watanabe, T.; Yoshimura, T., Simultaneous production of aromatic chemicals and ammonia adsorbent by pulse-current pyrolysis of woody biomass. Journal of Chemical Technology & Biotechnology, 92 (3), pp. 522-529 (2017).

[2] Oshida, K.; K. Takeuchi; T. Hayashi, M. Endo, Evaluation of Structure and Morphology of Carbon Materials by Image Analysis of Microscopic Image. Tanso, 2012 (255), pp.292-304 (2012).