Abstract of Presentation

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Presentation Title(Should be no more than 20 words):

Pyrolytic conversion of structured alkaline lignins to porous carbonized materials

Abstract :

Considering CO_2 reduction in the atmosphere, effective utilizations of wooden biomass that is photosynthesized from CO_2 and H_2O by sunlight are urgent and crucial concern. In this sense, efficient pyrolytic conversions of the organic materials to carbon or semiconducting carbon-rich materials under anaerobic conditions must be an ultimate goal. To functionalize these carbon-rich materials, how to control their structures in nano to micron scale is a key problem. Activated carbon has been know as a microporous material and been widely used as adsorbent, catalyst support, and energy storages. However, the activation process is fundamentally C elimination reaction on the surface and is difficult to control the pore structure. Therefore, we attempt to synthesize porous carbon from wooden biomass by pyrolytic method without activation processes. Alkaline lignin (a kind of Kraft lignin) is chosen as the starting material, because it is a waste of paper industry, aromatic rich substance, and being commercially available.

Pyrolysis of alkaline lignin at heating rate of 1°C/min under an argon flow gave the carbonized material (CL) in 46% with BET surface area (S_{BET}) of 660 m^2/g. In order to increase effective surface area, it is attempted to structure alkaline lignin as below. Micelle of the lignin was prepared, freeze-dried and carbonized under the same pyrolysis conditions. The carbonized micellar lignin (CML) had higher S_{BET} (1340 m^2/g) than CL but carbonization yield remarkably decreased to 17%. For the purpose of increasing the carbon fixation ability of materials, lignin gel was prepared by the reaction of formaldehyde with phenolic portions in lignin, which was similarly pyrolyzed to give carbonized lignin gel (CLG) in 42% with S_{BET} of 915 m^2/g. Furthermore, lignin gel was prepared under the micellar conditions, freeze-dried, and carbonized to give carbonized micellar lignin gel (CMLG). The S_{BET} of CMLG showed the highest value (1420 m^2/g) and the carbonization yield (29%) was higher than that of CML. These microporous carbonized samples showed good electrical double layer capacitances comparable to those of activated carbon in H_2SO_4.