Pore tailoring concept to enhance the quality of adsorbents

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Activated carbon is widely used as an adsorbent material due to its excellent porous and thermophysical properties. However, the pore size distribution of commercial available activated carbons contains a significant percentage of ultra-micropores which are below 0.7 nm and a small quantity of mesopores of size between 2 and 4 nm. In adsorption cooling applications, commonly used refrigerant molecule clusters are unable to enter into such tiny ultra-micropores and no adsorption occurs there. Hence, these ultramicropores degrade the performance of an adsorption cooling system (ACS). Moreover, another essential property of a good adsorbent is high thermal conductivity and lower specific heat capacity. Trapped air molecules and foreign elements inside these pores cause a reduction of the thermal conductivity and increase the specific heat capacity. Additionally, the presence of mesopores might cause slower kinetics. The objective of this research work is to remove those unusable pores by chemical vapor deposition (CVD) and enhance the quality of commercial activated carbon namely Maxsorb III. Pyrolysis of methane gas and liquid benzene on Maxsorb III have been performed to block the unusable pores. Pyrolysis temperature range is from 800 °C to 1000°C for various time duration (5 min to 30 min) and flow rate (5 ml/min to 50 ml/min). Porosimetry change of the pyrolyzed samples have been compared with the parent Maxsorb III. Pyrolization of methane (T_{pyr} = 1000°C, $\dot{m}$ = 50 mL/min, t = 30 min) and benzene (T_{pyr} = 800°C, $\dot{m}$ = 25 mL/min, t = 10 min) removes the ultramicropores and most of the mesopores which might improve the quality of activated carbon.

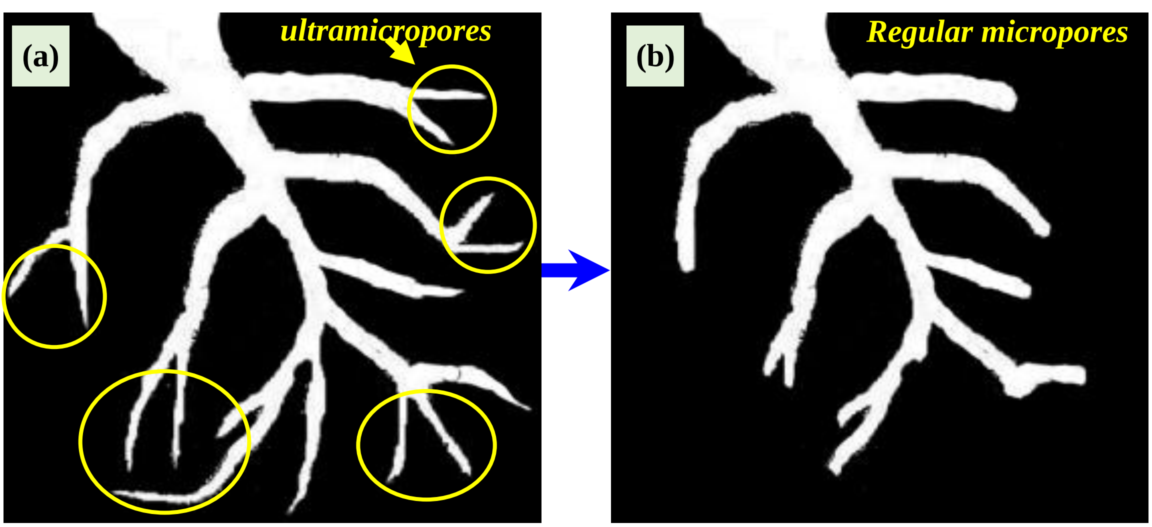

Fig. 1. (a) An overview of pores before pyrolysis; (b) modified pores after pyrolysis.

* This is a collaborative research between SAHA lab. (Prof. Bidyut Baran Saha, PI, Multiscale Science and Engineering for Energy and the Environment Thrust, I^{2}CNER, Kyushu University) and Yoon-Miyawaki lab (Laboratory of Carbon Materials Science, IMCE, Kyushu University).