291f Direct Fabrication of Mesoporous Carbon with Tunable Pore Size by Template-Assisted Activation Process

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Porous carbons are useful materials for a wide range of applications like catalysis, purifications, electrodes, and gas storage. The most commonly used porous carbon materials are activated carbons, which are often produced through a physical or a chemical activation process that produces microporosity. The small-sized micropores may limit their applications where rapid mass transport or larger pore sizes are required. In order to overcome the limitations, there has been a great deal of interest in the synthesis of mesoporous carbon. The templating method is one of the most commonly used techniques, which involves the infiltration of carbon precursors into pre-formed porous templates (e.g., mesoporous silica and opal-like silica colloidal crystals), carbonization of the precursors, and removal of the templates to create a porous carbon network. Very recently, a simplified method, termed direct-synthesis method, was developed, in which an assembly of silicates and carbon precursors is directly carbonized to generate silica/carbon nanocomposites. Subsequent silica removal results in mesoporous carbons. Such a direct synthesis method provides a much efficient route to prepare mesoporous carbon materials. Due to the limited choice of carbon precursors, the synthesized materials, however, often contain pore diameters below 4 nm. In this study, mesoporous carbons with high surface areas, tunable pore size distributions and large pore volumes were synthesized by a simple one step template-assisted activation process. In this process the direct template technique and chemical activation process were integrated together by adding activation reagent and carbon precursor into a sol-gel process to form a carbon precursor/silica/activation reagent nanocomposite. After high temperature carbonization/activation and followed template removal, mesoporous carbons with uniform pore size and high surface area were synthesized successfully. The pore diameter of the obtained mesoporous carbon can be precisely controlled from about 2 nm to more than 10 nm by changing the carbonization/activation conditions. The effects of sol-gel conditions on the properties of final products were also discussed.