588g Preparation of Nanoporous Carbon through an Aerosol-Assisted Template Approach

Qingyuan Hu, Jiebin Pang, J. Eric Hampsey, Zhiwang Wu, and Yunfeng Lu

Porous carbon materials with high surface areas and large pore volumes have received much attention recently due to their potential applications as adsorbents, catalysts, electrodes, and hydrogen storage systems. One of the most common techniques used to synthesizing these carbon materials is the two-step templating approach. Although this technique allows for precise control of pore sizes and pore structures, it has several limitations such as incomplete infiltration of the carbon precursor, formation of nanoporous carbon on the exterior of the template, and requiring many tedious and time consuming infiltration steps. As an alternative approach, many researchers have focused on direct one-step methods that can eliminate the preformed template and tedious infiltration steps. However, direct synthesis of mesoporous carbon particles still remains challenging. In this report, spherical carbon particles with unimodal and bimodal microporous and mesoporous channels are synthesized from solutions of sucrose, silica sols, and/or colloidal silica particles using a direct one-step aerosol process. When colloidal silica particles were used as only template, the resulting porous carbon particles show high porosity with narrow pore size distributions, surface areas as high as 2000 m2/g, and pore volumes as large as 4 cm3/g. When silica sols were used as template, the resulted silica particles were nanoporous with high surface area. If both silica sols and colloidal silica were used as templates, micro/meso bimodal carbon materials were obtained. The porous carbon particles are characterized using transmission electron microscopy (TEM), scanning electron microscopy (SEM), and nitrogen sorption techniques. These spherical porous carbon particles may have future applications such as column packing adsorbents, nanocomposite fillers, hydrogen storage, and supercapacitors.