

## Control of Morphology and Nanostructure of Porous Materials by Ice-Templating

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Porous materials are widely used as adsorbents and catalyst supports in various fields. The fabrication of porous materials is extremely important for their applications. Especially, microhoneycombs or microfibers have recently attracted great attention from low pressure drop and short diffusion length. A novel template synthesis (ice-templating) has been proposed to synthesize porous microhoneycombs or microfibers. Ice-templating consists of sol-gel polymerization, unidirectional freezing of hydrosols or hydrogels, and pore-protecting drying method, such as freeze drying. When hydrosols or hydrogels are dipped into coolant at a constant rate, a pseudo steady state freezing occurs. Ice grows as a pillar and the sol or the gel is concentrated between ice crystals. After thawing and drying, microfibers and microhoneycombs are obtained. In the preparation, ice crystal plays a role of template. Therefore, the porous microfibers and microhoneycombs of silica, titania, silica-alumina, titania-silica, carbon and zeolite have been synthesized by ice-templating. The morphology and porous structure can be controlled by the freezing conditions and synthesis conditions of hydrogels.