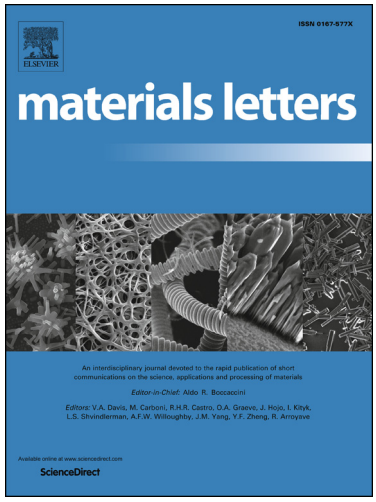

Rapid synthesis of ambient pressure dried monolithic silica aerogels using water as the only solvent

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Rapid synthesis of ambient pressure dried monolithic silica aerogels using water as the only solvent

Xudong Cheng, Congcong Li, Xiaojing Shi, Zhi Li, Lunlun Gong*, Heping Zhang*

State Key Laboratory of Fire Science, University of Science and Technology of China, Hefei, Anhui 230027, PR China

Abstract

To avoid lengthy solvent exchange and surface modification processes and reduce the production cost, monolithic silica aerogels were prepared rapidly (reduced from regular three days to 5 hours) under ambient pressure using methyltrimethoxysilane (MTMS, precursor) and water (solvent). For preparing aerogels in aqueous phase, the phase separation caused by the immiscibility between hydrophobic oligomers and water should be avoided. This problem has been solved by using an efficient surfactant, cetyltrimethylammonium bromide (CTAB). The porous morphology and different properties of the aerogels were observed changing along the content of CTAB. It was found that the macroporous morphology evolves from coarsened structure to continuous structure, and finally to elongated column, showing decreased structural size. Based on bulk density measurement, SEM and TG-DSC, it is known that the aerogels with 0.02 g CTAB (molar ratio CTAB/MTMS=1.5×10^{-2}) show the lowest density (0.079 g/cm^3), highest porosity (96.1%), and thermostability up to approximately 490 °C.

Keywords:

Silica aerogel; Sol-gel preparation; Ambient pressure drying; Porous materials; CTAB

1. Introduction

Silica aerogels are highly porous materials possessing extraordinary properties, including ultra-low densities, high porosity, and low thermal conductivity [1, 2]. These characteristics enable promising applications in various fields [3-5]. However, the commercial production of the aerogels and their wide exploitation in various potential applications has been hindered greatly by the expensive, dangerous and complex supercritical drying technique [6, 7].

Recently, ambient pressure drying (APD) method has emerged as a satisfactory and more practical

* Corresponding author. E-mail address: gongll@mail.ustc.edu.cn.

* Corresponding author. E-mail address: zhanghp@ustc.edu.cn.