Colloids and Surfaces A: Physicochem. Eng. Aspects 414 (2012) 327–332

Contents lists available at SciVerse ScienceDirect

Colloids and Surfaces A: Physicochemical and Engineering Aspects

journal homepage: www.elsevier.com/locate/colsurfa

Solvothermal synthesis of highly porous polymers and their controllable transition from macro/mesoporosity to meso/microporosity

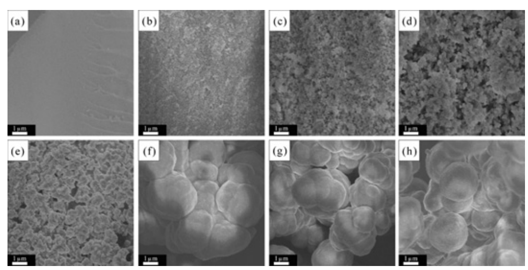
Shu Wei [b,d], Dong-Xiao Lu [c], Jing Sun [d], Yan He [c], Longfeng Zhu [d], Yong-Lai Zhang [b,*], Feng-Shou Xiao [a,**]

[a] Department of Chemistry, Zhejiang University, Hangzhou 310028, China
[b] State Key Laboratory on Integrated Optoelectronics, College of Electronic Science and Engineering, Changchun 130012, China
[c] College of Physics, Jilin University, Changchun, China
[d] State Key Laboratory of Inorganic Synthesis and Preparative Chemistry, Jilin University, Changchun 130012, China

HIGHLIGHTS

- ► Solvothermal synthesis of highly porous polydivinylbenzene.
- ► The nanoporous nature of the resultant polymers could be modulated simply.
- ► The key factor for this transition in porous structures is micro-phase separation.
- ► The nanoporous polymers have large BET surface areas and superhydrophobicity.
- ► The nanoporous polymers show high adsorptive capacity and selectivity to VOCs.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 22 May 2012
Received in revised form 17 July 2012
Accepted 5 August 2012
Available online 14 August 2012

Keywords:
Nanoporous polymer
Solvothermal synthesis
Controllable porosity
VOCs adsorption
Adsorptive capacity and selectivity

ABSTRACT

Reported in this paper is a solvothermal synthesis of highly porous polydivinylbenzene. The nanoporous structures of the resultant polymers could be modulated from macro/mesoporosity to meso/microporosity by simply changing the amount of acetone solvent in the synthesis. A micro-phase separation during the solvothermal process was found to be the key factor for this transition in porous structures. The hierarchically porous polymers prepared here were characterized by N_2 physi-sorption, scanning electron microscopy (SEM), transmission electron microscopy (TEM), and contact angle testing. Experimental results show that these nanoporous polymers have large BET surface areas (up to 420 m^2/g), large pore volumes (up to 1.73 cm^3/g), and superhydrophobicity due to their highly porous structures, which make these nanoporous materials an excellent candidate for selective removal of toxic volatile organic compounds (VOCs). In the adsorption tests, the nanoporous polymers show outstanding adsorptive capacity and very high selectivity to organic compounds, giving a great potential for indoor VOCs removal.

1. Introduction

Nanoporous materials, including microporous and mesoporous structures, are being intensively pursued as an important class of materials in various fields, such as adsorption, separation, gas storage, biocatalysis, and sensors [1–3]. As a promising member of the porous materials family, organic nanoporous materials, such as covalent organic frameworks (COFs) [4,5], mesoporous phenolic resins [6,7], and commercially available Amberlite resins [8], have

* Corresponding author. Tel.: +86 431 85168590; fax: +86 431 85168624.
** Corresponding author.
E-mail addresses: yonglaizhang@jlu.edu.cn (Y.-L. Zhang), fsxiao@zju.edu.cn (F.-S. Xiao).

0927-7757/$ – see front matter. Crown Copyright © 2012 Published by Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.colsurfa.2012.08.012