

Available online at www.sciencedirect.com

ScienceDirect

www.elsevier.com/locate/jes

JES
JOURNAL OF
ENVIRONMENTAL
SCIENCES
www.jesc.ac.cn

Review Article

A brief review of preparation and applications of monolithic aerogels in atmospheric environmental purification

Linfeng Nie¹, Shuangde Li^{1,2,*}, Mengjie Cao^{1,2}, Ning Han^{1,2,3},
Yunfa Chen^{1,2,3,*}

¹ State Key Laboratory of Multiphase Complex Systems, Institute of Process Engineering, Chinese Academy of Sciences, Beijing 100190, China

² Center of Materials Science and Optoelectronics Engineering, University of Chinese Academy of Sciences, Beijing 100049, China

³ Key Laboratory of Science & Technology on Particle Materials, Institute of Process Engineering, Chinese Academy of Sciences, Beijing 100190, China

ARTICLE INFO

Article history:

Received 10 July 2023

Revised 29 January 2024

Accepted 29 January 2024

Available online 10 February 2024

Keywords:

Monolithic aerogel

Environmental purification

Catalysis

Adsorption

ABSTRACT

Monolithic aerogels are promising candidates for use in atmospheric environmental purification due to their structural advantages, such as fine building block size together with high specific surface area, abundant pore structure, etc. Additionally, monolithic aerogels possess a unique monolithic macrostructure that sets them apart from aerogel powders and nanoparticles in practical environmental clean-up applications. This review delves into the available synthesis strategies and atmospheric environmental applications of monolithic aerogels, covering types of monolithic aerogels including SiO₂, graphene, metal oxides and their combinations, along with their preparation methods. In particular, recent developments for VOC adsorption, CO₂ capture, catalytic oxidation of VOCs and catalytic reduction of CO₂ are highlighted. Finally, challenges and future opportunities for monolithic aerogels in the atmospheric environmental purification field are proposed. This review provides valuable insights for designing and utilizing monolithic aerogel-based functional materials.

© 2024 The Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences. Published by Elsevier B.V.

Introduction

With the growth of the economy and industrialization, the global atmospheric environmental pollution problem has increased severely, challenging people's primary expectations

and dreams for a healthy life. Solving the atmospheric environmental pollution problem has become a crucial task for environmental engineering researchers. As dominant gas-phase environmental pollutants, VOCs seriously damage human health and the environment, since most VOCs are precursors of ozone and chemical smog (González-Martín et al., 2021; Mozaffar and Zhang, 2020; Nie et al., 2022). Therefore, the principal mission of atmospheric environmental pollution control is to reduce the content of VOCs. Many technolo-

* Corresponding authors.

E-mails: sdli@ipe.ac.cn (S. Li), chenyf@ipe.ac.cn (Y. Chen).