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Authors: Irina Smirnova, Pavel Gurikov

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# *Aerogel production: Current status, research directions, and future opportunities*

Irina Smirnova\*, Pavel Gurikov

Institute of Thermal Separation Processes, Hamburg University of Technology,

Eißendorfer Straße 38, 21073 Hamburg, Germany

## Highlights

- Future perspectives of aerogel development
- Promising aerogel research fields
- Main aerogels producers
- Aerogels application: current state

## Abstract

Being the lightest solid materials known, and given the great variety of possible chemistries capable of yielding wet-gels, aerogels and composite aerogel materials have a tremendous potential in a wide range of applications, where high pore volume and high surface area play major roles. Today, the main commercialized application of aerogels is thermal insulation, although aerogels can be used for a huge variety of applications such as electrochemistry (super capacitors), carrier of catalysts and other active agents, filling materials, materials for tissue engineering etc. However, industrial production of aerogels is so far mostly limited to silica-based systems, limiting the possibility to prove the potential application by prototyping. In this paper first the state of the art of the aerogel manufacturing and applications are briefly discussed. Based on the current status, main knowledge gaps and challenges are identified and the future research directions from the point of view of the authors are derived. In the next future, we expect significant further development in the area of the organic and hybrid aerogel aerogels, optimization of their manufacturing processes and their transfer to the market.

## Introduction

Aerogels are low-density nanoporous solids with a fine, open-pore structure resulting in low densities (0.003–0.15 kg/m<sup>3</sup>), high porosity and large surface areas (500–1000 m<sup>2</sup>/g). This combination of properties makes them unique in many senses, opening a possibility to a huge number of applications, some of which have been commercialized already. The definition of aerogels has been discussed a lot in the last years [1]. According to Smirnova and Gurikov [2] an aerogel is an open colloidal or polymeric network consisting of loosely packed, bonded particles or fibers that is expanded throughout its volume by a gas and therefore exhibits very low density and high specific surface area.

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