Aerogel particles: state of the art and recent advances

Pavel Gurikov*, Victor Baudron, Imke Preibisch and Irina Smirnova
Hamburg University of Technology, Institute of Thermal Separation Processes,
Eißendorfer Str. 38, Hamburg 21073, Germany
* Presenting author

Aerogels are low-density highly porous nanostructured solids. Aerogels possess a set of unique properties such as low thermal conductivities, high acoustic attenuation, large specific surface area and pore volume. Further, they can host functional guests with useful chemical, electrical, magnetic or optical properties making them attractive for a broad gamut of applications [1].

Aerogels are produced in a multistep process that involves gelation in a mold, solvent exchange and supercritical drying. This process results in monolithic aerogels. Many applications such as adsorption (gas and humidity filters), personal care (cosmetics) and food (functional foodstuffs) require however aerogels as particles of a specific size. Furthermore, the production of particulate aerogels has a tremendous advantage: duration of the solvent exchange and supercritical drying is much shorter than that of monoliths allowing for a remarkable reduction of the process costs.

In this contribution we discuss the state of the art of the production of aerogels in particulate form. A comprehensive comparison of the available methods in terms of particle size, throughput, energy input and integrability is presented. Special attention is given to emulsion gelation as the most studied method. We present our own results on the scale up of the emulsion gelation process. Recent advances in this field (drop-on-demand jetting, inkjet printing) as well as emerging applications of aerogel (micro)particles are outlined.

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[1] I. Smirnova, P. Gurikov, Aerogels in Chemical Engineering: Strategies Toward Tailor-Made Aerogels, Annual Review of Chemical and Biomolecular Engineering. 8 (2017) 307–334. doi:10.1146/annurev-chembioeng-060816-101458.