Hamburg University of Technology (TUHH)
Institute of Thermal Separation Processes -V8-
Eissendorfer Str. 38, DE-21073 Hamburg

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Title: Optically Transparent Silica Aerogels

Authors: G. Lazovski1, C. Libov1, R. Gvishi1, G. Reichenauer2, C. Scherdel2

Presenting author: G. Lazovski

Institution (Presenter): 1Soreq NRC, Yavne 81800, Israel 2Bavarian Center for Applied Energy Research (ZAE Bayern), Würzburg, Germany

ABSTRACT (Space limited to 2200 characters)

Silica aerogels are one of the first members of a large family of porous materials categorized for their density being below 200 kg/m³. Silica aerogels have been thoroughly investigated for several decades and have even been implemented in a wide variety of applications (from thermal insulators to star dust collectors). Yet while their extremely low refractive index promises great potential for implementation in optical applications, their practical utilization in this field have been quite scarce.

The main reason for the low acceptance of silica aerogels in optical applications is due to scattering stemming from their porous nature, depending on the pore size and pore size distribution [1, 2]. Pores less than 10 nm in diameter have negligible scattering in the visible spectrum and thus little effect on the aerogel's optical properties. Pores between 10 to 30 nm cause significant Rayleigh scattering and are responsible for the characteristic blue appearance of the gel as light is reflected from it and yellowish color as light is passed through it. Larger density fluctuations will have even greater scattering effect and will cause the aerogel to become translucent (light diffusive) or even completely opaque.

For this reason, it is advantageous to gain control over the density fluctuations through the synthesis of the aerogel. By carefully choosing the right synthesis parameters, in addition to modifying the solvent of the synthesis, it was possible to increase the uniformity of the aerogel, reduce the average pore size, narrow the pore size distribution and obtain aerogels with extremely high transmission in the visible range.

This synthesis procedure could be utilized for the production of aerogels with increased transmission over a wide range of densities from 10 to 200 kg/m³. Doing so would enable tailoring of the aerogels for the specific optical requirement, such as windows [3].

References:

[1] C. Marliere et al., J. Non-Cryst. Solids 285(1-3) (2001) 148-153.

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[3] B. Büttner et al., Evacuated Glazing with Silica Aerogel Spacers, ISES Conf. Proc. 2018