

Preliminary characterization of physical properties and colour rendering performance of monolithic hydrophobic silica aerogels

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Abstract

Silica aerogel is a promising building material able to improve thermal and acoustic performance. The monolithic form is more difficult to produce, but ensures better optical and thermal performance than granules. The goal of this work is to investigate the influence of hydrophobicity level on monolithic silica aerogel properties. Samples of 12.7-mm-thick, 28- and 100-mm diameter disks were prepared using a rapid supercritical extraction method. The precursor recipe for the 28-mm samples used 9.78 g of tetramethylorthosilicate (TMOS), mixed with 24.47 g of methanol, 4.04 g of deionized water and 302 μ L of 1.5-M ammonia. Hydrophobic samples were prepared by replacing 7.5 and 10 (% v/v) of TMOS with methyltrimethoxysilane (MTMS). Density and thermal conductivity were not significantly affected by the level of hydrophobicity however the surface area (measured using an ASAP 2020 gas adsorption system) showed an increase from 455 m²/g (0% MTMS) to 655 m²/g (10% MTMS). Spectral transmittance measurements, carried out using a conventional spectrophotometer with a small integrating sphere in the 300- to 2500-nm wavelength range, indicate that as hydrophobicity increases, visible transmittance is reduced to a maximum of 10% for samples with 10% MTMS. Acoustic properties measured at normal incidence in a traditional impedance tube show that the absorption coefficient increases with hydrophobicity: a noise reduction coefficient of 0.21 and 0.25 was measured for the 0% and 10% MTMS samples, respectively. A moderate reduction of sound insulation performance (about 2 – 3 dB) was obtained. The effect of the aerogel on colour rendering was investigated using a dome-shape illuminator, digital camera, chroma meter, and colour checker. The presence of aerogel tends to shift colours towards a blue hue and to make them brighter; the maximum variations occurring with red, green, and yellow colours. Future works will focus on effect of ageing of the samples on the same properties.

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