Influence of alumina/silica ratio on the properties of alumina-silica-based aerogels reinforced with aramid fibres

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Silica aerogels are solid amorphous materials consisting of interconnected particles, which form an open 3-D network structure. This structure endows silica aerogels with exceptional properties, such as high porosity (80-99.8 %), high surface area (500-1200 $m^2 g^{-1}$), as well as low bulk density (0.03-0.5 g cm^{-3}) and very low thermal conductivity (< 0.015-0.025 W $m^{-1} K^{-1}$) [1,2]. Additional properties, like non-flammable character, low refractive index and low thermal expansion coefficient, make them excellent candidates for a wide range of applications, particularly in thermal insulation [2,3]. Despite these unique properties, silica aerogels also exhibit some disadvantages, such as limited mechanical strength and poor dimensional stability under high temperature (> 600 ºC).

Aramid pulp-reinforced silica aerogels synthesized from a TEOS-VTMS precursor system were previously optimised [4]. In this work, in order to overcome the densification behaviour of the silica matrix of these aerogels at higher temperature, a ceramic thermally resistant phase, alumina, was introduced in the nanocomposites in small amounts, since this was proven in the literature as a good solution for that problem [5]. Thus, alumina-silica-based aerogels reinforced with aramid fibres were synthesized using different alumina to silica ratios, and their physical, structural, thermal and mechanical properties were assessed and analysed as function of the gradual increase of aluminium content in the aerogel matrix.

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