THERMAL CONDUCTIVITY OF MODEL CELLULAR VITREOUS CARBON FOAMS

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The purpose of our global project was to investigate and separate the impacts of the porosity on the one hand, and of the cell size on the other hand, on the physical properties (mechanical, acoustical, electromagnetic and thermal) of cellular vitreous carbon foams with a controlled porous structure. Such foams were indeed successfully prepared with identical chemical compositions and carbon nano-textures, but with as much different architectures as possible.

This study presents the results of the thermal part. Thus, the thermal conductivity of cellular vitreous carbon foams was mesured at room temperature and pressure with a contact method (Hot Disk analyzer). According to the state of the art, the most important structural characteristics for the thermal properties should be the density (thus the total porosity), the average size of the cells, and their connectivity through the average size of the windows. From numerous samples covering a wide range of densities and cell sizes, thermal conductivities were analyzed, and trends were identified and confronted with the bibliography.

In addition the results of a 3D numerical model, made with COMSOL Multiphysics and incorporating thermal radiation, were compared with our experimental data. The porous structure was modeled by Kelvin cells and the equivalent thermal conductivity was evaluated by calculating the heat flux submitted to a temperature gradient of 1°C.

The two approaches that were used allowed validating the observed trends and separating the contributions of the solid from the gas phase, as well as quantifying the contributions of density on the one hand and of average cell size on the other hand.

Preferred participation: Poster presentation