

Silica-based Aerogels and its applications in the field of thermal and acoustic insulation

Aerogels are nano-structured open porous super insulating solids. They are synthesized by means of the sol-gel process. The variation of the synthesis parameters such as the composition of precursors and catalysts, the pH value, the reaction temperature, the reaction times, and the drying conditions leads to a wide range of different, correspondingly adjustable properties of the aerogels. Systematic studies on the development of aerogels for high temperatures as well as cryogenic conditions are executed, materials characterized, and tested under real conditions. By means of applying ceramic materials and embedding oxide particles, long term stability of the aerogels in the range of 800°C and above can be obtained. Slight variations in the used precursors and surface functionalization are required to obtain suitable aerogels for low temperature applications. It turns out that mechanical flexibility can be preserved under the harsh conditions. In addition, many applications require acoustic damping too. Investigations to optimize the acoustic properties look promising. For aeronautics, mobility, and space applications, scaling up is the next step to realize proof of concept full scale test facilities.

Based on the experimental results, a database is under development. This scientific data are used for the generation of numerical and physical models in order to simulate/predict the properties of aerogels. Furthermore, artificial intelligence-based models in the form of neural networks will be used to strategically develop aerogel-based materials, for reverse engineering the aerogel synthesis process for the preparation of aerogels tailored to specific desired applications.

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