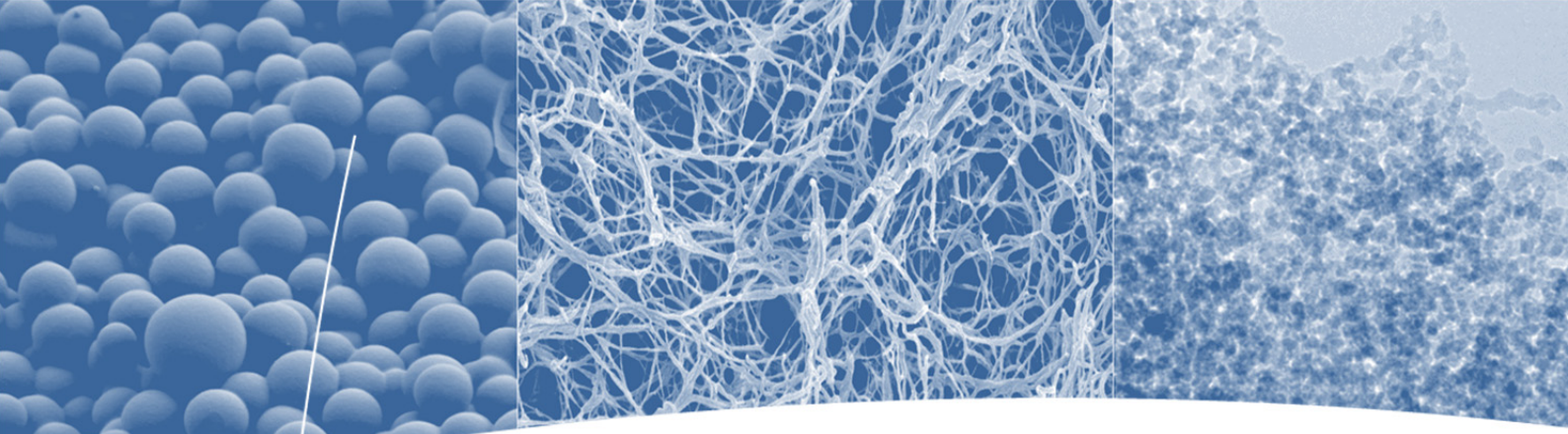
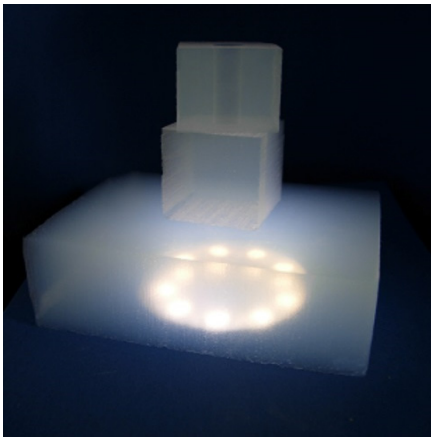
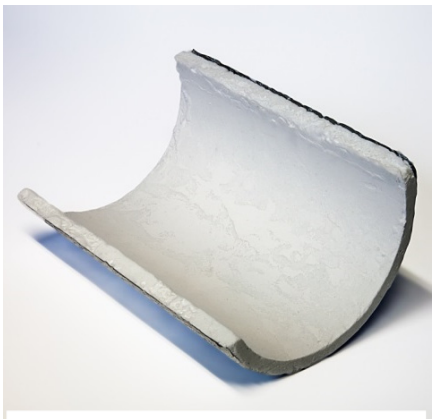


Aerogels and Aerogel Composites



Light suffused silica aerogel



Fiber-reinforced silica aerogel for thermal insulation and shielding

Aerogels are nanostructured, open-porous solids which are synthesized by a sol-gel process. All kinds of aerogels are low density materials, have a low thermal conductivity, possess a large inner surface, are good sound absorbers and can additionally be functionalized.

The department of aerogels is working on the synthesis of organic and inorganic aerogels and aerogel composites. The aim is to develop routines for manufacturing processes up to pilot plant-scale. Based on the extraordinary combination of properties aerogels are able to push new solutions into the field of materials.

Silica Aerogels
Depending on the specific requirements of applications aerogels are synthesized using suitable precursors. Pure inorganic silica aerogels (picture left top) are high-temperature resistant and can be used for insulation of exhaust systems (picture left bottom). For acoustic damping (cabin comfort) and cryogenic insulation (liquid H_2 / O_2 fuel tanks) mechanically flexible silica-based hybrid aerogels are well-fitting. Applicable recipes are being developed and generic parts are being produced.

Thermoset Aerogels
Organic aerogels based on Resorcinol-Formaldehyde are excellent insulating materials. They are not inflammable and non-toxic. The goal of development is to reduce their thermal conductivity.
The equilibrium of metal hydrides and hydrogen as a pore gas due to temperature and pressure changes is used to realize a tunable thermal conductivity of these aerogels.

Biopolymer Aerogels
Based on biopolymers such as cellulose, chitin, or carrageenan completely new kinds of aerogels with nano-sized felt-like structures are being produced. These surfaces are easy to be functionalized and are promising candidates for the selective adsorption of toxic gases, humidity, or materials with high susceptibility to oxidation. Such polysaccharide aerogels are produced up to pilot plant scale.

Carbon Aerogels
By carbonization of organic aerogels carbon aerogels with defined nanostructures are generated. These carbon materials are interesting for various applications. One of them is to advance future e-mobility with improved electrochemical efficiency in novel battery concepts using carbon aerogels. In addition, carbon aerogels are used as additives in sand cores for casting processes leading to reduced casting defects.

Aerogel Composites
To improve the properties of aerogels composite materials are developed. Granular aerogel composites, such as aerogel concrete, aerogel polymers, spray applicable aerogels or aerogel-aerogel composites are being developed for terrestrial and space applications. Aerogel-honeycomb and aerogel-fiber reinforced composites lead to remarkable improved mechanical strength and provide new possibilities for applications.
Furthermore, a brand new development of light-weight construction composites competing with CRFP or GFRP are being developed using polymer infiltrated 3D-nanostructured biopolymer aerogels.

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