Nonflammable, Hydrophobic Aerogel Composites for Insulation

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Aerogel composites that are both nonflammable and hydrophobic have been developed for use as lightweight thermal-insulation materials for cryogenic systems. Aerogels are well known in the industry for their effectiveness as thermal insulators under cryogenic conditions, but the treatments used heretofore to render them hydrophobic also make them flammable. Nonflammability would make it safer to use aerogel insulation, especially in oxygen-rich environments and on cryogenic systems that contain liquid oxygen.

A composite of this type is a silica aerogel reinforced with fibers. In comparison with unreinforced aerogels, the aerogel composite is about ten times as stiff and strong, better able to withstand handling, and more amenable to machining to required shapes. The composite can be made hydrophobic and nonflammable by appropriate design of a sol-gel process used to synthesize the aerogel component.

In addition to very low thermal conductivity needed for insulation, aerogel composites of this type have been found to exhibit high resistance to moisture and nonflammability in oxygen-rich atmospheres: Samples floating on water for months gained no weight and showed no signs of deterioration. Samples were found to be nonflammable, even in pure oxygen at atmospheric pressure [14.7 psia (0.10 MPa)].

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