AEROGEL INSULATED SOLAR COLLECTOR FOR PROCESS HEAT

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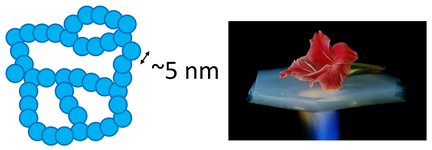
AeroShield Materials and Solar Designs

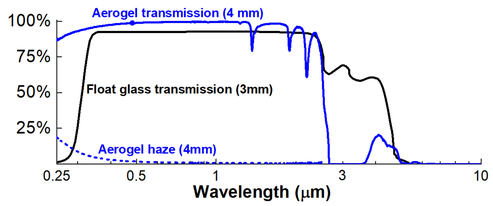
Silica Aerogel: Super-insulation



Silica aerogels are extremely porous (>95% air volume fraction) and the pores are very small (10s of nanometers). We are developing silica aerogels which are optically transparent and thermally insulating.

Optically transparent:

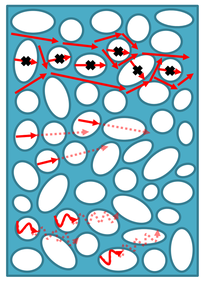
Naturally translucent. Tuning the fabrication process can minimize scattering and absorption of light.



Thermally insulating:

Low thermal conductivity due to their porous structure and low volume fraction of solid.

- Little solid material to conduct heat
- Pores smaller than air mean free path and too small to support convection
- Silica absorbs (blocks) infrared radiation



AeroShield: The Ultra-clear Aerogel

AeroShield's aerogel, based on foundational work at the Massachusetts Institute of Technology, is uniquely ultra-clear and super-insulating. This makes our patent-pending material ideal for solar thermal applications.

Collector Concept: Aerogels for Cost-effective Process Heat

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Harnessing Heat Beyond 200 °C from Unconcentrated Sunlight with Nonevacuated Transparent Aerogels

Lin Zhao, Bikram Bhatia, Sungwoo Yang, Elise Strobach, Lee A. Weinstein, Thomas A. Cooper, Gang Chen*, and Evelyn N. Wang*

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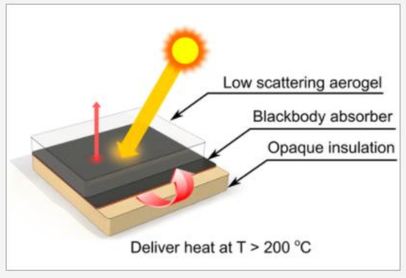
Abstract

Heat at intermediate temperatures (120−220 °C) is in significant demand in both industrial and domestic sectors for applications such as water and space heating, steam generation, sterilization, and other industrial processes. Harnessing heat from solar energy at these temperatures, however, requires costly optical and mechanical components to concentrate the dilute solar flux and suppress heat losses. Thus, achieving high temperatures under unconcentrated sunlight remains a technological challenge as well as an opportunity for utilizing solar thermal energy. In this work, we demonstrate a solar receiver capable of reaching over 265 °C under ambient conditions without optical concentration. The high temperatures are achieved by leveraging an artificial greenhouse effect within an optimized monolithic silica aerogel to reduce heat losses while maintaining high solar transparency. This study demonstrates a viable path to promote cost-effective solar thermal energy at intermediate temperatures.



Using our ultra-clear, super-insulating aerogel to insulate a flat plate solar thermal collector, it has been shown that unconcentrated sunlight can be used to efficiently provide heat at temperatures >200 °C. This creates opportunities for higher operating temperatures and new markets.

With AeroShield's expertise in aerogel optimization and manufacturing and with Solar Designs' experience in designing, building, and testing solar thermal collectors, we are excited to develop this concept and create a commercial prototype throughout the American Made Solar Prize.