Paper ID: 63817
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19th IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Strategies & Architectures as the Framework for Future Building Blocks in Space Exploration and Development (1)

Author: Mr. Kolemann Lutz
Mars University, United States

Mr. Paolo Pino
Polytechnic of Turin, Italy

SILICA AEROGEL: ISRU, ARCHITECTURE AND APPLICATIONS FOR MARS AND SPACE SETTLEMENTS

Abstract

Originally developed by Harvard Researchers to geoengineer a warmer more habitable Martian surface, a three cm thick silica (SiO2) aerogel layer could shield buildings and block almost all of the high-cancerous-levels of UVA, UVB, and UVC radiation. As one of the most well performing insulating materials, SiO2 materials, shields, and biosphere domes on the surface of a celestial body would simultaneously transmit visible light for photosynthesis, block ultraviolet radiation, and raise temperatures, and reduce energy costs with implications for inducing solid-state greenhouse effects on Mars.

Designing and building top-surface infrastructure with multipurpose aerogels as a building block to shield life from ionising radiation would better prepare future civilizations to thrive on Earth, Mars, Moon, and other celestial bodies with high radiation environments. A lack of awareness and inclusion into spacecraft, systems, modern houses, and habitat designs as well as integration into settlement architectures impose more costly, heavier, and less insulated radiation shielding techniques.

This research evaluates the methods, strategies, and implications for engineering radiation resilient architecture with aerogels on Earth, Mars, the Moon, and in Space. Researchers at Mars University investigate the integration of aerogels into buildings on Earth to overcome the next geomagnetic-pole reversal, conduct a payload analysis for integration into starship and habitats on Moon and Mars, and a SiO2-based budget analysis. Researchers explore optimal SiO2 installation methods and technologies as well as implications for society, additive manufacturing, production, supply chains, and planetary engineering.

This study would culminate in a research paper investigating the past, present, and future engineering applications, challenges, and advancements of SiO2 aerogel for lightweight, affordable radiation protection to enable industrial scale production and usage throughout the Solar system.