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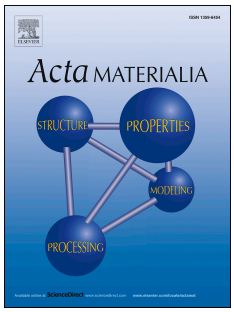

Cast-in-place, ambiently-dried, silica-based, high-temperature insulation

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Graphical Abstract

A cast-in-place, ambiently-dried, silica-based thermal insulation was synthesized using methyltrimethoxysilane (MTMS) as the precursor. To allow for casting into and around small, orthogonal features, zirconia fibers were added to increase stiffness and minimize contraction that could otherwise cause cracking during drying. Nano-sized titania powder was incorporated as an opacifier to reduce radiative heat transport. The insulation showed a pearl necklace-like microstructure that was mechanically robust with a Young's modulus ~3.7 MPa. Macroporous pores ranging from 3 to 30 μm penetrated the silica gel network. The gel retained its superhydrophobicity, high electrical resistance (> 1 G ohm) and low thermal conductivity (~0.08 W/(m.K)) after heating at 600 °C in Ar for 4 h. We believe this technology can act as an effective cast-in-place thermal insulation (CTI) for thermoelectric generator applications.