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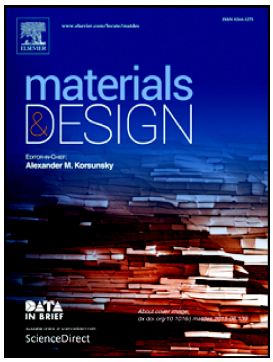


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ACCEPTED MANUSCRIPT

# Merging flexibility with superinsulation: machinable, nanofibrous pullulan-silica aerogel composites

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**Abstract:** Freeze-dried nanofibrous scaffolds are flexible, but typically have high thermal conductivities. Conversely, silica aerogel has an ultra-low thermal conductivity, but is brittle. Here, the impregnation of pullulan/PVA nanofiber scaffolds with hydrophobic silica aerogel decreased the thermal conductivity from 31.4 to 17.7 mW/(m·K). The compatibility between the silylated nanofibers and the silica aerogel promotes the overgrowth of silica particles onto the fiber surfaces and the fiber incorporation. The composites display improved compressive and tensile properties compared to the neat pullulan scaffold and silica aerogel. The composite's E-modulus is 234 kPa compared to 4 kPa for the pullulan scaffold and 102 kPa for the silica aerogel. The composite's tensile strength is five times higher than that of the silica aerogel. Because of its reduced brittleness, the pullulan-silica aerogel composites can be shaped using a sharp blade. The composites can sustain uniaxial compression up to 80% strain, but the

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