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M1Or2C-04: [Invited] Thermal Conductivity and Mechanical Properties of Polymeric Aerogels for Cryogenic Insulation Applications

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Non-vacuum insulation systems are frequently applied in the thermal management of low temperature systems as well as for the use and storage of cryogens. Aerogels are known for their low density, high mesoporosity, high surface areas, low thermal conductivity and high acoustic impedance. This study focuses on polymeric aerogels that can be mass produced as large monoliths while maintaining the low thermal conductivity over a wide temperature range. The manufacturing flexibility of polymeric aerogels allows fabrication of monolithic blocks and sheets that can be applied in various configurations to insulate cryogenic and superconducting devices. To measure the thermal conductivity, an immersion calorimeter was developed and has been operated at different cold boundary temperatures. The calorimeter heats a hollow cylinder of insulating material on the inside surface and the surrounding bath maintains a cold boundary. This calorimeter was used to measure the thermal conductivity of commercially available FoamGlass and a hollow cylinder of a polymeric aerogel machined from a cast cylinder. The thermal conductivity of the FoamGlass and the polymeric aerogel are compared at room temperature (290 K), ice bath (273 K), and liquid nitrogen (80 K) cold boundary temperatures. Room temperature measurements of the modulus of elasticity and yield strength using an optical technique are also reported for flat specimens of the aerogel made from the same stock as the cylindrical specimens tested for thermal conductivity.

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