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M2Or1C-07: Thermal Properties of Isocyanate Derived Organic Aerogels for Cryogenic Insulation Applications

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The use and storage of cryogens such as liquefied nitrogen, helium, hydrogen among others requires reliable and efficient thermal insulation systems. Passive insulation from high performance materials that are well-known for their inherent low thermal conductivity would reduce the overall costs involved in design, manufacture and maintenance of such systems. One such class of materials is referred to as aerogels, and it is known for their low density, high mesoporosity, high surface areas, low thermal conductivity and high acoustic impedance. Aerogels were invented by S.S. Kistler in 1931 and the most common type are those made of silica. However, the inherent fragility of silica aerogels makes them hard to mass produce, and therefore applications have been limited. A major breakthrough was introduced by our team almost 20 years ago with the invention of polymer crosslinked silica aerogels. Those materials shifted attention to all-polymer aerogels that have overcome all fragility issues associated with their inorganic counterparts. This study focuses on such polymeric aerogels that can be mass produced as large monoliths while maintaining the low thermal conductivity of traditional silica aerogels over a wide temperature range. Manufacturing flexibility of polymeric aerogels allows fabrication of blocks and sheets that can be applied in various configurations to insulate cryogenic and superconducting devices. Thermal conductivity properties between room temperature and 80 K are reported as well as other properties (mechanical and electrical), that need to be considered when designing devices for cryogenic applications.

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