Mass flow through bulk solid helium and solid helium confined in Aerogel

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We have made mass flow measurements through 2.5 mm thick solid ^{4}He samples sandwiched between Vycor rods infused with superfluid. Bulk samples, samples where the flow path are partially blocked by a thin disk and samples confined in silica aerogel of 96% porosity were studied. The mass flow of the bulk samples showed superfluid-like properties similar to that found in 4 cm[1] and 8 μm [2] samples. While the flow rate varies from sample to sample, it decreases with increasing temperature up to 1 K and similar to that found in the 8 μm samples decays exponentially with pressure from melting up to 30 bar. In samples intersected by the thin disks, the flow rate shows a correspondingly dramatic decrease. We found no evidence of mass flow in samples grown in silica aerogel. Since the mean separation of the silica strands in aerogel is on the order 100 nm, these strands prevent the formation of dislocations network in solid ^{4}He. These results indicate dislocation network in the solid is essential for the observed mass flow. We will also report on the ongoing studies of solid helium samples nucleated on the surface of highly oriented pyrolytic graphite (HOPG). Single crystal helium samples with the c-axis grown perpendicular and parallel to the direction of the mass flow were studied.

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