Plastic Properties of Solid ^{4}He Probed by a Moving Wire: Viscoelastic and Stochastic Behavior Under High Stress

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We present the first measurements of a thin wire moving through solid ^{4}He. Measurements were made over a wide temperature range at pressures close to the melting curve. We describe the new experimental technique and present preliminary measurements at relatively high driving forces (stresses) and velocities (strain rates). The wire moves by plastic deformation of the surrounding solid facilitated by quantum tunneling of vacancies and the motion of defects. In the bcc phase we observe very pronounced viscoelastic effects with relaxation times spanning several orders of magnitude. In the hcp phase we observe stochastic step-like motion of the wire. During the step, the wire can move at extremely high velocities. On cooling, the wire ceases to move at a temperature of around 1 K. We are unable to detect any motion at lower temperatures, down to below 10 mK.

Section: QS - Quantum solids

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