Hysteretic Response of Torsional Oscillators Containing Solid ^{4}He at Low Temperatures

H. Kojima[a], P. Gumann[b], M. C. Keiderling[a], and D. Ruffner[a]

[a]Serin Physics Laboratory, Rutgers University, Piscataway, NJ 08854 USA
[b]Present address: Institute for Quantum Computing, University of Waterloo, ON, Canada.

A characteristic but outstanding puzzling property of solid ^{4}He contained in a torsional oscillators at very low temperatures is the history dependent response to changes in the oscillator drive level. Extensive measurements on hysteretic response of torsional oscillator containing solid ^{4}He have been carried out by varying the oscillator drive level starting from high to low and then back up to the initial high value. Hysteresis in the oscillator response appeared only below an onset temperature (T_H) and disappeared above it. Studies by a compound oscillator showed that T_H did not depend on the oscillator frequency. Annealing of a sample surprisingly increased its hysteresis response but did not alter its T_H. Dependence of T_H was studied as ^{3}He impurity concentration in the solid ^{4}He samples was varied from 0.1×10^{-9} to 25×10^{-6}. T_H varied tantalizingly close to theoretical values for isotopic phase separation temperature of solid ^{4}He-^{3}He mixtures.