Simultaneous Measurements of Torsional Oscillator and Shear Modulus of Solid Helium-4 with 1ppb 3He impurity

J. Shin[a], J. Choi[a], S. Jang[a], E. Kim[a], and K. Shirahama[b]

[a]Center for Supersolid & Quantum Matter Research and Department of Physics, KAIST, Daejeon 305-701, Republic of Korea
[b]Department of Physics, Keio University, Yokohama 223-8522, Japan

To understand the connection between the torsional oscillator (TO) response and shear modulus change of solid helium, we measured the resonant period of TO and the shear modulus simultaneously. A pair of concentric piezo transducers is inserted into the annulus of the TO cell. The pzt transducers allow us to measure the shear modulus of solid helium in the annulus during the measurements of TO period. We found that the TO response was influenced by the change of shear stress applied by a drive pzt. However, the magnitude of suppression and relaxation time between two measurements show discrepancies. In addition, we investigated the hysteric behavior of shear modulus anomaly with various applied drive and frequency to compare with the change of TO period.

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Section: QS - Quantum solids

Keywords: Supersolid, Solid helium-4