Low T Study of PdH_x System by Torsional Oscillator Measurements using a New Refrigerator

K. Watanabe[b], K. Saito[b], M. Yagi[a], T. Miya[a], T. Igarashi[a], S. Donuma[b], S. Harada[b], and M. Kubota[a]

[a]Istitute for Solid State Physics, University of Tokyo, Chiba, Japan
[b]Graduate School of Sci. & Tech., Niigata University, Niigata, Japan

Hydrogen atoms dissolve in Pd at densities up to one H atom per Pd, which provides higher atomic H density than in solid H_2. They are known to have large diffusion cofficient due to quantum tunnering even at low temperatures. Torsional Oscillator (TO) technique is employed to investigate the phases of H in Pd, which is known to show phase boudaries at the lowest T among metal-hydrogen systems. This TO measurement is a powerful method to investigate superfluidity of He films. We have been performing TO experiments, in order to study the effect of atomic H intrusion and the dynamics in the $PdH(D)_x$ system. The TO experiments have shown the resonance frequency shift and the Q value change for PdH_x , $0.16 \leq x \leq 0.75$, specimens around over 40K[1]. However, TO data behaved noisy in the temperature region over 60K. So we have planed the stability of the TO system and of the T of the specimen over longer period of time by using a pulse tube refrigerator with great heat capacity. We will show the detail of experimental machine's improvements and improved experimental result.

[1] S.Harada, T. Donuma, H. Araki, T. Kakuta, R. Nakatsuji, R. M. Mueller, and M. Kubota, J. Low Temp. Phys. **162** 724-732 (2011).