

A new rotating dilution refrigerator to study free surface of superfluid He

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Recently, the mobility of surface electrons (SE) on rotating liquid ^4He was studied by Mukuda *et al.* in the angular velocity (Ω) up to 1.0 rad/s^1 . One of their results was that the surface hollow of the liquid He, created by the quantized vortex, acted as a scatter of the SE. Therefore, SE are the excellent probe to study a unique properties of the surface with quantized vortices. For the experiment using SE, a mechanically stable cryostat is necessity. Hence, we made a new rotating dilution refrigerator as follows. There were three important points in this work. First of all, the refrigerator was placed on an anti-vibration massive plate supported by air springs, which is also used to adjust the free surface parallelism. Secondly, we used two mechanical bearing units, an initial torque of which was $< 3 \text{ Nm}$, and a servomotor to stabilize the rotation. In consequence, the stability was on the order of 0.1% at whole Ω range. Finally, a turbo-drag pump was mounted on the rotation axis of the cryostat directly to get enough cooling power. As a result, the base temperature of around 5 mK was achieved and no temperature increase was observed in Ω up to $\sim 3.5 \text{ rad/s}$. In addition no cooling power difference was observed in the whole temperature range between static and rotating state.

The resultant performances was satisfying so that the cryostat is good enough to study the free surface of liquid He with quantized vortex using SE at wide Ω range.

¹H. Mukuda, S. Nishiyama, and K. Kono *Physica E* **18**, 175 (2003) and references in there

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