

Suppression of temperature oscillation of GM cryocooler

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GM cryocooler has the advantage of easily attaining low temperature down to ~ 4 K. On the other hand, it has the disadvantage of large temperature oscillation. The typical peak-to-peak amplitude is ~ 0.3 K at around 4 K. This large oscillation prevents precise measurements. The purpose of this study is to suppress the temperature oscillation without losing the cooling power by a simple adapter.

The cooling power and the oscillation amplitude are proportional to κ and κ/C , respectively (κ : thermal conductivity, C : heat capacity) from thermodynamic analysis, so that the adapter should satisfy the condition that both κ and C are large. In order to achieve this, we constructed “He pot”, which is a Cu container filled with high pressure He at room temperature. We examined the thickness of the Cu container and the temperature dependence of the oscillation amplitude at several pressures. We have found that the ratio of outer diameter to inner diameter is 1.4 enough for 100 atm of He. We have also found that the temperature oscillation is strongly reduced in the case of liquefying He. The amplitude is less than 10 mK below 4.5 K and 3.7 K for 90 atm and 60 atm of He, respectively. When He does not liquefy, the oscillation is about 1/4. Just attaching this He pot to a GM cooling head, the temperature oscillation is strongly suppressed below certain temperature according to the filled He pressure. The application to THz detector and low temperature precise measurements etc. are expected.