



Contribution ID: 126

Type: **Poster presentation (105min)**

Development of High Capacity Split Stirling Cryocooler for HTS

Tuesday 8 July 2014 14:15 (1h 45m)

Abstract. Sumitomo Heavy Industries, Ltd. (SHI) developed a high power stirling type pulse tube cryocooler for the purpose of cooling high-temperature superconductor (HTS) devices, such as superconductor motor, SMES and current fault limiter. The experimental results of a prototype pulse tube cryocooler were reported in September 2014. For a U type expander, the cooling capacity was 151 W at 70 K with a compressor input power of 4 kW. Accordingly, COP was about 0.038. However, the efficiency of the cryocooler is required to be $COP > 0.1$ and it is found that, theoretically, it is difficult to further improve the efficiency of a pulse tube cryocooler because the work-flow generated from the hot-end of the pulse tube cannot be recovered. Therefore, it is decided to change the expander to a free-piston type from a pulse tube type. A prototype has been developed and preliminary experiments have been performed, as the results, the cooling capacity was 120 W at 70 K with a compressor input power of 2.15 kW, COP was about 0.056. The detailed results are reported in this paper.

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Session Classification: Tue-Af-Posters Session 1.2

Track Classification: C-02: Cryocoolers- Pulse tube, Stirling, Magnetic and other coolers