
"SESSION 10: Stirling and Pulse Tube Coolers"

Paper 10.2 Wednesday POSTER Session 1:15 to 2:45 PM

Development of 15K 2-Stage Stirling Type Pulse Tube Cryocooler: Performance Test Results of Prototype 2-Stage Expander

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Sumitomo Heavy Industries, Ltd. (SHI) has been supplying 1-stage and 2-stage Stirling cryocoolers (STC) and 4K and 1K J-T cryocoolers as cooling systems for earth observation satellites and scientific satellites for sensor cooling and shield cooling applications. The performance of the 2-stage STC used as a pre-cooler for the J-T cryocooler has a cooling capacity of 0.2 W at 20 K/1 W at 100 K at a maximum electrical input power of 90 W. In the future, it is planned to increase the size of the sensor to improve the observation capability, which will require an increase in the cooling capacity of the cryocoolers. Furthermore, there is also a demand for sensors to reduce the vibration level of cryocoolers. In the case of the STC, the expander is also equipped with a drive mechanism controlled by an external control circuit to actively control vibration and achieve low vibration. Currently, SHI is using 1-stage STC as a pre-cooler for a 2-stage STC to increase cooling capacity and improve system efficiency by operating each cryocooler at a specialized frequency for 80 K and 15 K, the pre-cooling temperature of the J-T cryocooler. Furthermore, there is a need to extend the life of cryocoolers from the current 5 years to 10 years, and the 1-stage STC and J-T cryocoolers are on track to have a 10-year life based on the knowledge obtained from past tests. However, for the 2-stage STC, it is difficult to maintain the clearance seal of the 2-stage displacer and achieving a 10-year life is a tough challenge. This paper describes the results of performance tests using a previously developed 1-stage pulse tube cryocooler(=PTC) with a cooling capacity of 5 W at 77 K as a pre-cooler and 15K 2-stage PTC expander designed and fabricated using a compressor for a 2-stage STC.