

Theoretical and Experimental Investigation of a 4 K Single-Stage Stirling Type Pulse Tube Cryocooler with Precooling

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Abstract - The efficiency of 4 K Stirling type pulse tube cryocoolers (SPTC) is rather low compared with that of 80 K SPTCs. Real gas effects and low specific heat capacity ratio of regenerator matrix to helium near 4 K are the main reasons that lead to the low efficiency of 4 K Stirling type PT. A single-stage Stirling type PTC precooled by a two-stage G-M type PTC is developed to study the performance of 4 K Stirling type PTC with a focus on the performance of the regenerator working at 4 K-10 K. In order to reduce loss associated with real gas effects, relatively low average pressure was used. In order to reduce the regenerator loss caused by ineffective heat transfer between regenerator matrix and helium, Gd_2O_2S (GOS) was used as regenerator matrix to replace $HoCu_2$ around 4 K. A systematic comparison between the two types of regenerator matrix was made theoretically and experimentally including effect of frequency, average pressure and precooling temperature. Performance of the linear compressor is also presented in this paper.

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