

Enhancing Low-Frequency Stirling Cryocooler Efficiency with Metal Bellows Compressors

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Cryocoolers based on Gifford-McMahon (GM) technology encounter efficiency losses attributed to the rotary valve, amounting to approximately 50% compared to Stirling-type operation. In this work, we address this challenge by employing metal bellows compressors, eliminating the need for a rotary valve and enabling low-frequency operation of GM-type cryocoolers.

A single cold head was operated with 650W of electrical input power, yielding 140mW of cooling power at 4.2K. This achievement corresponds to a Coefficient of Performance (COP) of 215mW per 1000W at 4.2K. To further enhance efficiency, we explored the operation of two cold heads on a single compressor with a 180-degree phase difference. This configuration resulted in a substantial increase in COP.

The experimental setup and detailed results are discussed, shedding light on the potential of metal bellows compressors to significantly improve the efficiency of GM-type cryocoolers.