Contribution ID: **10** Type: **Poster**

Design and Optimization of Miniature Regenerators for Pulse Tube Cryocoolers using REGEN3.3

Wednesday 29 October 2025 14:00 (1 minute)

Regenerators are an integral part of regenerative-type cryocoolers, such as pulse tube, Gifford-McMahon cryocoolers, etc. The main function of a regenerator is to store and release heat during the cyclic operation of cryocoolers. The performance of the regenerator directly influences the performance of the cryocooler. Therefore, regenerators should be designed and optimised carefully. The objective of the present study is to design and optimise the parameters, such as inverse mass flux, phase angle, aspect ratio of regenerator, etc. For this purpose, a well-established one-dimensional code, REGEN3.3, is used. The coefficient of performance obtained for various operational and geometrical parameters from REGEN3.3 is used for finding the optimum values. The range of parameters is carefully chosen so as to keep the values of operational parameters within practical range. Frequencies from 60 Hz to 120 Hz are used in the simulations, since the commercial compressors provide this frequency range. The targeted cold-end temperature is 80K. #635 SS-304 woven screen matrix is selected as the regenerator material. The results show that different optimum values were attained at 60 Hz, 80 Hz, 100 Hz and 120 Hz for various phase angles, and inverse mass flux. The obtained results can be helpful to the designers of cryocoolers.

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Session Classification: Poster session

Track Classification: Cryocoolers