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Design and optimization studies of a two stage 20 K Stirling type Pulse tube cooler for a helium recondensation system

The design and development of the two stage pulse tube cryocooler, for a helium recondensation system, with a design goal of 2 W at 20 K is discussed in this paper. The cold end of the first stage regenerator is thermally anchored at 80 K using liquid nitrogen supply. The second stage regenerator operating with the warm and cold ends at 80K and 20 K respectively employs SS mesh and Erbium-Proscenium pellets as the regenerator material, thus ensuring high regenerator effectiveness at operating temperatures. The entire two stage cooler along with the inertance tube configuration is designed and optimized using Sage and a phasor analysis is carried out for the design. The two stage cooler is fabricated and tested. Initially a no load temperature of 40 K could only be achieved. The reasons for the low performance of the cooler like streaming in the pulse tube are analyzed using CFD package, Fluent. It has been shown that flow streaming in the pulse tube significantly affects the performance of the cooler, and can be suppressed by optimally sizing the cooler configuration. A new cooler has been built based on the optimized design and the results are presented.

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