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C2Or2A-06: Study on the characteristics of the transfer tube in a high capacity Stirling type pulse tube cryocooler

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High capacity Stirling type pulse tube cryocoolers (SPTCs) have promising prospect in high temperature superconductivity and gas liquefaction applications due to their definite potential of high reliability and high efficiency. However, impedance mismatching between the linear compressor and cold head in the high capacity SPTC becomes one of the main problems causing its inefficiency and hindering its commercialization. A simple method for impedance match is inserting a hollow tube called transfer tube between the liner compressor and the cold head, but there is lack of guide on choosing a transfer tube for the high capacity SPTC system and the characteristics of the transfer tube need further study. In this study, the mechanisms of the transfer tube have been revealed from the acoustic perspective. The characteristics of transfer tubes with three different shapes have been investigated. Experiments based on a high capacity SPTC working at liquid nitrogen temperatures have been conducted to verify the theoretical analyses. Results show that a suitable transfer tube can increase the COP more than threefold. Comparing with the stubby transfer tube, the slender transfer tube can amplify the pressure amplitude by 80%, decrease 20%~40% of the input power. In addition, a tube paralleled by another volume called reservoir transfer tube can increase the cooling rate when the total volume keeps constant. This study provides a guide to the selection of transfer tubes which can be helpful to the optimization of the impedance match for high capacity SPTCs.

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