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C2Or3A-06: Advances in Pulse Tube Cooler with Dual-opposed Ambient Displacers

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The pulse tube cooler has the advantages of low vibration, high reliability, and no moving parts at the cold end. However, the poor phase modulation capability and acoustic power dissipation in the phase shifter limit the improvement of its efficiency. Lihan Cryogenics has reported the development of a Stirling pulse tube cooler using ambient displacers. The cooler consists of a moving magnet compressor with dual-opposed pistons and a co-axial cold finger. Ambient displacers are employed to recover the expansion work, increase cooling efficiency, and achieve a relative Carnot efficiency of 26%. This article presents recent advances in this type of cooler. To further reduce manufacturing difficulty, the displacers adopt rod structure, thus lessening the requirement of the supporting spring stiffness and achieving higher reliability. The room temperature displacers are of dual-opposed configuration, and their axis is crossed with the compressor piston axis, which leads to low vibration, less flow resistance, and reduces the difficulty of assembly and production. Typical experimental tests show that compared with the cooler using inertance tube phase modulation, the cooler's power consumption using the new ambient displacer structure is reduced by 24% when the cooling capacity is 60W at 77K.

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