

Detailed Analysis of a Coaxial Stirling Pulse Tube Cryocooler with an Active Displacer

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Coaxial pulse tube cryocoolers are the configuration of choice as they allow better access to the cold head. Hence, a previously built and tested in-line pulse tube cryocooler which uses an active displacer for phase control has been modified into a coaxial configuration. The active displacer allows the mass flow and the pressure pulse at the cold end of the pulse tube to be easily adjusted for optimum performance. The displacer also allows the expansion power at the warm end of the pulse tube to be recovered in order to operate more efficiently. A numerical Sage model is used to demonstrate this by examining the work flows throughout the cryocooler and it is shown that more than 6% of the power required to drive the cryocooler comes from the warm end of the pulse tube via the displacer. When using an inertance tube or orifice, this expansion power is dissipated as heat which is why using a displacer can lead to a more efficient cryocooler. Moreover, the effect of changing the displacer phase and stroke on cryocooler performance and pressure characteristics is examined both experimentally and numerically.