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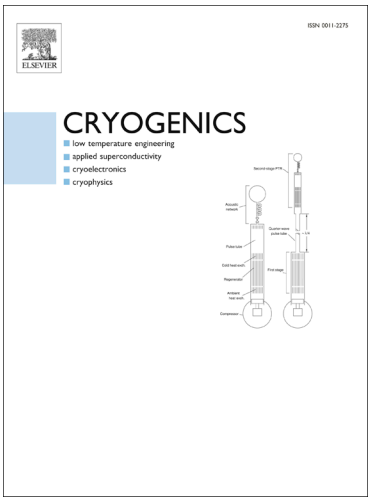

Research paper

An approach for estimating acoustic power in a pulse tube cryocooler

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An approach for estimating acoustic power in a pulse tube cryocooler

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Abstract

Acoustic power at the cold end of regenerator is the measure of gross cooling capacity for a pulse tube cryocooler (PTC), which cannot be measured directly. Conventionally, the acoustic power can only be derived from the measurement of velocity, pressure and their phase angle, which is still a challenge for an oscillating flow at cryogenic temperatures. A new method is proposed for estimating the acoustic power, which takes use of the easily measurable parameters, such as the pressure and temperature, instead of the velocity and phase angle between the pressure and velocity at cryogenic temperatures. The ratio of acoustic powers at the both ends of isothermal components, like regenerator, heat exchangers, can be conveniently evaluated by using the ratio of pressure amplitudes and the local temperatures. The ratio of acoustic powers at the both ends of adiabatic components, like transfer line and pulse tube, is obtained by using the ratio of pressure amplitudes. Accuracy of the approach for evaluating the acoustic power for regenerator is analyzed by comparing the results with those from REGEN 3.3 and references. For the temperature range of 40-80 K, the deviation is less than 5% if the phase angle at the cold end of regenerator is around -30°. The simple method benefits for estimating the acoustic power and optimizing the PTC performance without interfering the cryogenic flow field.

Keywords

Acoustic power measurement, Pulse tube, REGEN, Regenerator

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