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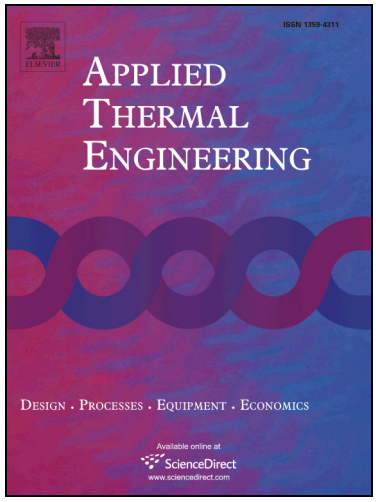

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Impact of coiled type inertance tube on performance of pulse tube refrigerator

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Abstract

An inertance tube is widely used to provide a phase shift between mass flow and pressure wave in pulse tube refrigerator (PTR). The inertance tube is usually coiled around the outer surface of a liner compressor or in a reservoir to reduce installation space. The performance of PTR is strongly influenced by different coiled types of inertance tube. Based on 1-D model (DeltaEC) and 3-D model (CFD), a coupling model is proposed to simulate the cooling performance of a PTR. The characteristics of phase shift and energy flow in the PTR are also analyzed in detail. The simulation results show that the phase shift ability of inertance tube would decrease while increasing the number of coiling turns, which would cause the increase of average mass flow rate within the regenerator. Therefore, more PV power would be consumed for the same cooling capacity. In order to improve the cooling performance of the PTR, it is necessary to adjust the length of the inertance tube when it is coiled. At last, the simulation results are verified by the test results.

Keywords: Pulse tube refrigerator; Inertance tube; Cooling performance; Simulation; Phase shift

1. Introduction

Pulse tube refrigerator (PTR) with no moving parts in cold region has the advantages over the Stirling refrigerator, resulting in high reliability, long life, and low vibration at the cold end [1-3]. The performance of the PTR is strongly dependent on the phase shift components, which control the phase between pressure wave and mass flow [4]. The impedance in the warm end of pulse tube plays an important role in the PTR [5]. The adoption of double-inlet [6] and multi bypass [7]

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