Thermoacoustic devices

T. Biwa

Department of Mechanical Systems and Design, Tohoku University, Japan

Simplifying heat engine's hardware design while maintaining the highest possible efficiency has been a longstanding desire since the 19th century. One way to achieve this is to eliminate solid pistons from heat engines.

Thermoacoustic devices use acoustic gas oscillations in place of pistons and execute mutual energy conversion between work flow and heat flow through the heat exchange between the gas and the channel walls. Work flow is equivalent to the acoustic intensity used in acoustics. Heat flow, which is absent in adiabatic waves in free space, is the energy flow associated with the entropy oscillation of the gas. Understanding of the acoustic field is necessary to control the resulting energy flows in thermoacoustic devices.

We will present from experimental point of view the physical mechanism of a pulse tube refrigerator that is one of the traveling wave thermoacoustic heat engines. Measurements of pressure and velocity oscillations show that pulse tube refrigerator controls the phase difference between them to enhance heat flow through the regenerator. Experiments also show the pulse tube design that can recover the work flow emitted from the regenerator for a better efficiency.