ACOUSTICS2008/122
Physical mechanism and theoretical model of thermoacoustic heat exchangers

Ercang Luo[a] and Bo Gao[b]

[a]Technical Institute of Physics and Chemistry, CAS, Beiyitiao Rd., Zhongguancun St., P.O.Box 2711, 100080 Beijing, China

[b]Graduate University of Chinese Academy of Sciences, Zhongguancun St., 100049 Beijing, China

Unlike a regenerator, there are both oscillating heat exchange flux (first order) and non-zero time-averaged heat exchange flux (second order) in the hot and cold end heat exchangers of thermoacoustic systems. The non-zero time-averaged heat flux just reflects the net heat exchange between the working substance and external heat sinks, which is more important and interesting for design. In this paper, the physical mechanism of oscillating flow heat exchanger is first analyzed. Based on understanding of the heat transfer mechanism, the theoretical model of heat transfer is then developed; in this part, the key of the problem is to obtain transversal distribution of the second order time-averaged temperature, T20(y). Eventually, an analytical expression of Nusselt number for the thermoacoustic heat exchangers is obtained under the assumption of laminar flow.