

Simulation of flow and temperature development in a thermoacoustic resonator

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Abstrak

The fluid flow pattern in a thermoacoustic resonator is an important characteristic that affects the performance of the thermoacoustic refrigerator. The main factor that affects the flow and subsequently the heat transfer processes between the oscillating fluid and the stack walls is the geometry of the stack unit, especially related to the stack thickness and stack separation. In this paper, a two-dimensional numerical simulation of the inviscid fluid flow around the stack unit in a quarter wavelength resonator is carried out by using the continuity, Navier-Stokes, energy and ideal gas equations. These equations are solved using the perturbation method and the finite difference method. Three cases of different stack plate thickness are investigated: negligible, 0.4 mm and 0.8 mm thicknesses, respectively. The stack separation has also been varied for the 0.4 mm thickness, within and beyond that recommended by previous studies. Results show that vortices and streaming are always present, more significantly with the thicker plates. Concentrated vortices in the thick plate case stay longer than those with the thinner plate. They contribute to the high heat transfer rate as shown by the temperature profiles.