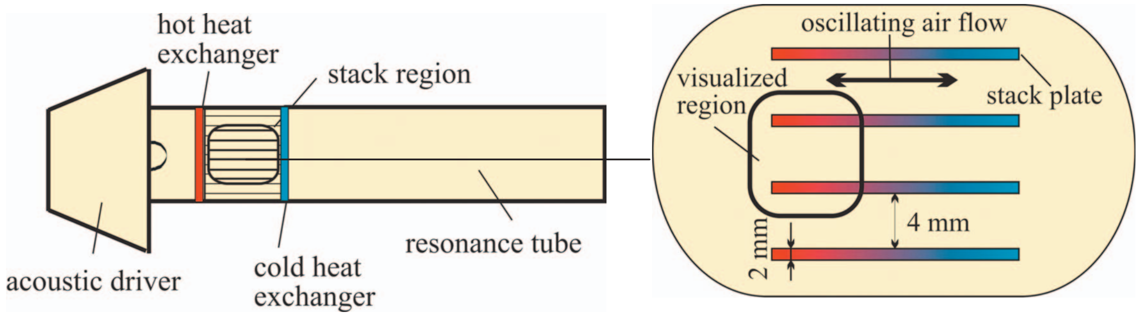
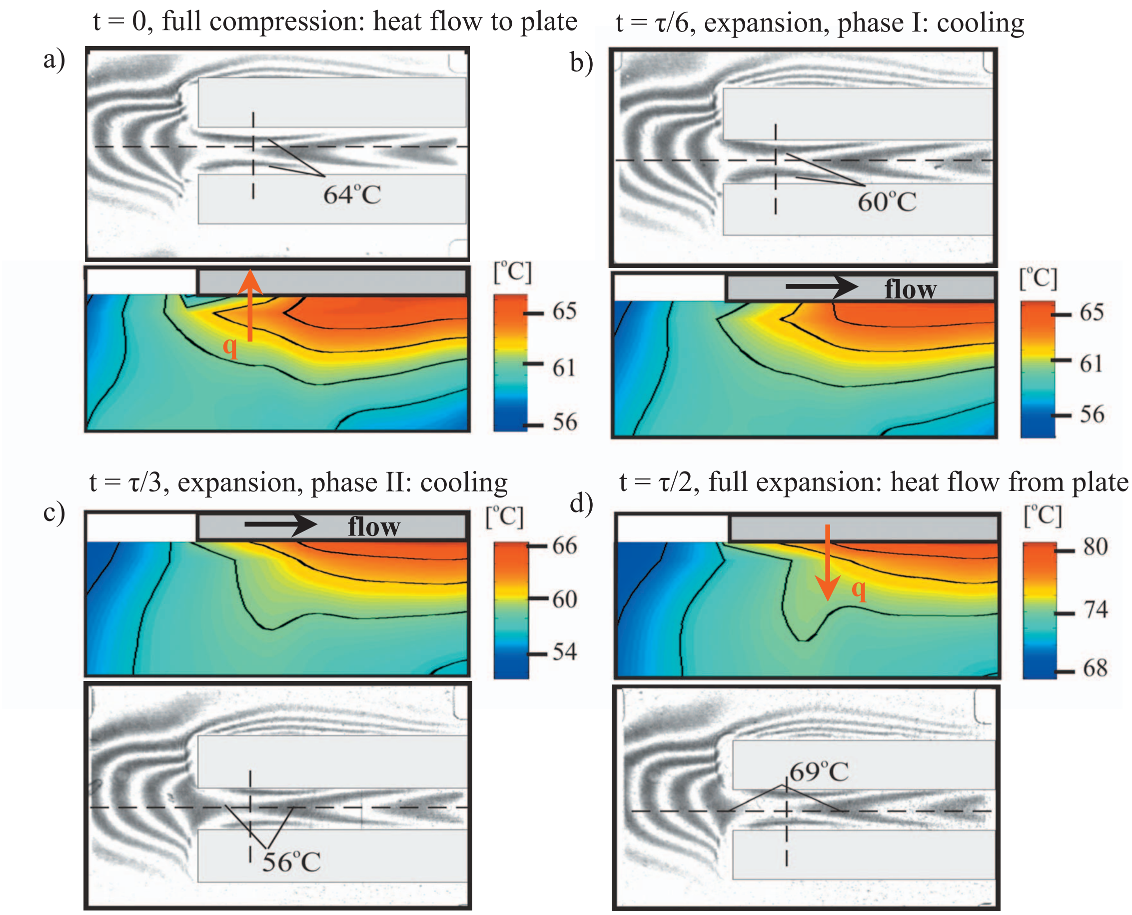
Thermoacoustic refrigerator



Experimentally visualized temperature fields by holographic interferometry and temperature distributions reconstructed from interferometry images (color plots)



Experimental visualization of the thermoacoustic effect

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A thermoacoustic refrigerator uses sound energy to transport heat. Using a sound source such as a loudspeaker, a standing wave is formed in a tube filled with noble gas. As the wave travels back and forth (oscillates) in the resonator, the gas compresses and expands. To exploit this effect for heat pumping, a “thermoacoustic core”, consisting of a densely packed stack of plates, is placed in the tube. In the compression phase of the cycle, the gas heats up, transferring heat to the plates (a). Then, as the gas gradually expands and cools down (b,c), it absorbs heat from the plates (d). This sets up an overall temperature gradient along the plates, effectively pumping heat from the cold side to the hot side of the core. When heat exchangers are attached to the thermoacoustic core, this device becomes a useful refrigerator. Four image pairs, showing one half of the acoustic cycle (t = 0, τ/6, τ/3 and τ/2), are the first experimental visualization of the thermoacoustic effect on two stack plates. Fringe patterns are generated by holographic interferometry and color images are reconstructed temperature distributions based on experimental data.

