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Phase-exchange thermoacoustic engine[1] AVSHALOM OFFNER, AVISHAI MEIR, GUY Z. RAMON, TECHNION, WET LAB TEAM — Phase-exchange thermoacoustic engines are reliable machines holding great promise in converting heat from low grade heat sources to mechanical or electrical power. In these engines the working fluid is a gas mixture containing one condensable component, decreasing the temperature difference required for ignition and steady state operation. Our experimental setup consists of a vertical acoustic resonator containing a mixture of air-water vapor. Water evaporates near the heat source, condenses at the heat sink and is drawn back down by gravity and capillary forces where it re-evaporates, sustaining a steady state closed thermodynamic cycle. We investigated the stability limit, namely the critical point at which temperature difference in the engine enables onset of self-excited oscillations, and the steady state of the engine. A simple theoretical model was derived, describing mechanisms of irreversible entropy generation and production of acoustic power in such engines. This model captures the essence in the differences between regular and phase-exchange thermoacoustic engines, and shows good agreement with experimental results of stability limit. Steady state results reveal not only a dramatic decrease in temperature difference, but also an increase in engine performances.

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