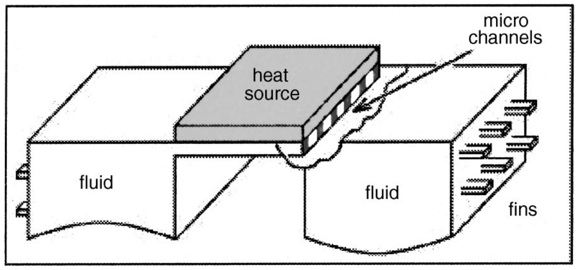

Fig. 1 A schematic view of the MHS

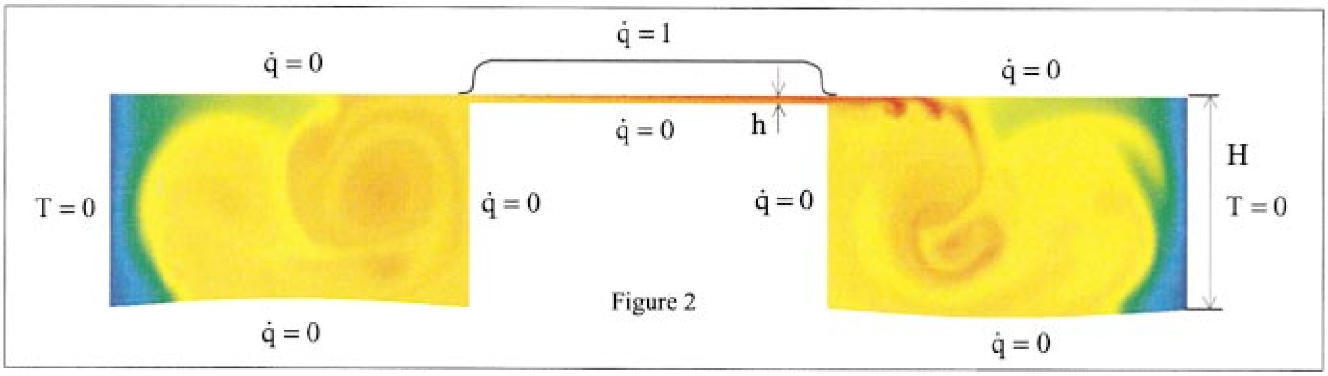

Fig. 2 Boundary conditions used in numerical modeling of MHS devices (insulated $q=0$, constant heat flux $\dot{q}=1$ and constant temperature $T=0$)

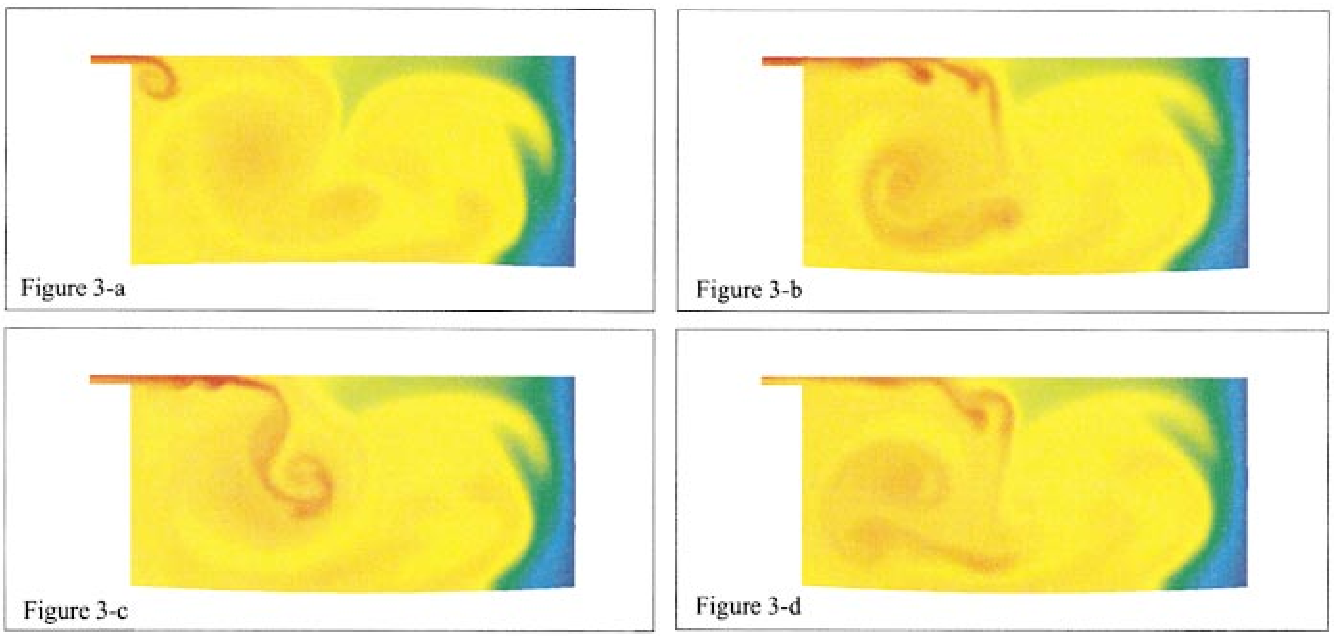

Fig. 3 Snapshots of temperature contours during ejection to the right reservoir. Red and blue show high and low temperatures, respectively.

SHEAR LAYER INSTABILITY AND MIXING IN MICRO HEAT SPREADERS

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The micro heat spreader (MHS) is a micro-fluidic device designed for thermal management of microelectronic components. It connects two reservoirs by a set of micro-channels (Fig. 1). The bottom surfaces of the reservoirs are membranes that are driven with a phase difference of π, either by electrostatic or piezoelectric actuation. The idea is to minimize the chip surface temperature by *oscillatory flow forced convection and mixing*. Numerical simulations are performed for an MHS device with channel to reservoir expansion ratio $H/h=25$. The boundary conditions and the MHS geometry are shown in Fig. 2. Both the flow and temperature fields are time-periodic, and Womersley and Prandtl numbers are $\alpha=5.6$. and $\mathrm{Pr}=1$, respectively. Since $\mathrm{Pr}=1$, the temperature field closely follows the flow. Figs. 3(*a–d*) show snapshots of temperature contours during ejection to the right reservior, where shear layer instability at the channel expansion is observed. The vortex rolls due to the shear layer instability are visible in the temperature contours of Figs. 3 (*b*, *c*). The flow rapidly turns towards the oscillating membrane due to the influence of the end wall and the membrane motion. The temperature contours show two primary counter-rotating zones with various smaller rotating structures, which promote further mixing in the MHS system.