Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Experimental confirmation of multiple base states in two surface thermocapillary driven flows[1] RANGA NARAYANAN, BRAD MESSMER, University of Florida, ICHIRO UENO, Tokyo Univ. Science, THOMAS LEMEE, University of Florida — When a temperature gradient is applied along a fluid surface, there will necessarily be a resulting flow along the interface of that fluid. This interfacial flow can result in a bulk movement of the fluid and, at high enough temperature gradients, can cause instabilities and pattern formation. In the present work, experiments are performed on a double free-surface film in a rectangular geometry under thermo-capillary forcing. The films show two basic flow structures at low imposed temperature gradients. In cellular flow, the fluid leaves the hot source toward the cold wall and, upon reaching the cold wall, returns along the sides in a cellular-like structure. For the case of sheet flow, the fluid leaves the hot boundary, moves as a sheet toward the cool wall and then dips into the fluid returning to the hot source along the interior of the film. Simple scaling arguments show that differences arise on account of the lower velocity gradient in the direction of the imposed temperature gradient. This difference in velocity gradients results from inevitable surface deformations. For thin films the effect of surface deformations are magnified because of a larger interfacial-surface-area to volume ratio, whereas thicker films will show less sensitivity to deformations.

[1]Support from NSF 0968313 is gratefully acknowledged.

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Date submitted: 01 Aug 2014 Electronic form version 1.4