

Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Thermocapillary Actuation of Binary Drops on Solid Surfaces

FANGJIE LIU, YUEJUN ZHAO, CHUAN-HUA CHEN, Duke University — Under thermocapillary actuation, aqueous drops typically remain stuck on hydrophobic solid surfaces subjected to a temperature gradient. We report the thermal actuation of water drops on a parylene-coated silicon substrate, where the actuation was enabled by encapsulating the water drop with a minute amount of long-chain alcohol. When placed near an initially stuck water drop, heptanol spread toward the water under thermocapillarity. The merged binary drop can take on a unique shape: the dome shaped water drop is capped by a thin layer of heptanol and the cap protrudes through a “foot” to a precursor film. For intermediate volumes of water drop with a fixed volume of heptanol, the speed of the binary drop was linearly proportional to its diameter and the imposed temperature gradient with an offset accounting for the hysteresis force. The thermocapillary actuation speed can be modeled by a lubrication theory adapted from the models of slender liquid ridges. The binary thermocapillary actuation also works for other combinations of secondary fluids and solid surfaces, making it an attractive scheme for transporting aqueous samples of biomedical and industrial relevance.

Chuan-Hua Chen
Duke University

Date submitted: 05 Aug 2011

Electronic form version 1.4