Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Dynamics of Capillary Flow in Curvy V-Grooves[1] NICHOLAS WHITE, SANDRA TROIAN, California Institute of Technology, 1200 E. California Blvd., MC 128-95, Pasadena, CA 91125 — Capillary flows, also known as wicking flows, in straight open V-groove channels are widely used as a passive and reliable method of fluid delivery and flow control in applications such as point-of-care biomedical devices, heat micropipes for electronics cooling and spacecraft propellant management systems, to name a few. Advances in lithographic techniques and 3D printing now allow simple fabrication of curvy microscale V-groove channels which can be used to facilitate fluid transport in 3D using compact microgeometries. Romero and Yost (1996) and Weislogel (1996) first elucidated how the streamwise gradient in capillary pressure due to the change in curvature of the air/liquid interface from local variations in film thickness induces ultra rapid wicking of slender films into straight V-grooves of constant cross-section. Here we present an analytic model which extends their original formulation to systems with arbitrary channel curvature. Despite the complex flow trajectories which can ensue, a first order perturbation analysis yields an extended thin film equation which reveals the dynamics arising from the interaction between fluid interface and channel curvature. The resulting equation will be useful to the design of next generation 3D microfluidic systems.

[1]NCW gratefully acknowledges support from a 2017 NASA Space Technology Research Fellowship.

Sandra Troian
California Institute of Technology

Date submitted: 01 Aug 2019

Electronic form version 1.4