Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Spreading and mixing of drops on a miscible liquid of different surface tension S. AFKHAMI, I. SERIC, L. KONDIC, Department of Mathematical Sciences, New Jersey Institute of Technology, H. KIM, O. SHARDT, H. A. STONE, Department of Mechanical and Aerospace Engineering, Princeton University — We carry out Volume-of-Fluid based numerical simulations of a Marangoni-driven spreading of isopropyl alcohol (IPA) drops placed on water–air interface. The two fully miscible liquids create a spatially varying surface tension, leading to the spreading of the IPA drop on the water surface. We study the spreading of drops as IPA concentration is varied. In particular, we compute the spreading velocity and show that the scaling of the front position, L, with time, t, is given by $L \sim t^{0.7}$. We observe that while the surface tension difference between the two liquids controls the spreading velocity, it only slightly alters the power-law behavior for the range of considered IPA concentrations. We also provide detailed insight of the mixing of the IPA and water, and show the time evolution of liquid–air surface tension distribution. We show that the mixing results in a volume flux in a thin region on the surface, generating a vortical flow underneath the spreading front; we investigate the details of these flow patterns and show the time evolution of the circulation within the water. The numerical results are supported by new experimental observations reported separately.

S. Afkhami
Department of Mathematical Sciences, New Jersey Institute of Technology

Date submitted: 27 Jul 2016 Electronic form version 1.4