Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Mechanisms of dynamic wetting failure in the presence of soluble surfactants SATISH KUMAR, CHEN-YU LIU, University of Minnesota, MARCIO S. CARVALHO, PUC-Rio — A hydrodynamic model and flow visualization experiments are used to understand the mechanisms through which soluble surfactants can influence the onset of dynamic wetting failure. In the model, a Newtonian liquid displaces air in a rectangular channel in the absence of inertia. A Navier-slip boundary condition and constant contact angle are used to describe the dynamic contact line, and surfactants are allowed to adsorb to the interface and moving channel wall (substrate). The Galerkin finite element method is used to calculate steady states and identify the critical capillary number Ca^{crit} at which wetting failure occurs. It is found that surfactant solubility weakens the influence of Marangoni stresses, which tend to promote the onset of wetting failure. The experiments indicate that Ca^{crit} increases with surfactant concentration. For the more viscous solutions used, this behaviour can largely be explained by accounting for changes to the mean surface tension and static contact angle produced by surfactants. For the lowest-viscosity solution used, comparison between the model predictions and experimental observations suggests that other surfactant-induced phenomena such as Marangoni stresses may play a more important role.

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Date submitted: 16 Jul 2017 Electronic form version 1.4