Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

A Numerical Study of Pore Scale Partially Wet Interfacial Displacements SOHEIL ESMAEILZADEH, ZHIPENG QIN, Stanford University, AMIR RIAZ, University of Maryland, HAMDI A. TCHELEPI, Stanford University — Here, we study the pore-scale interfacial dynamics of immiscible two-phase flow in a partially wet regime using direct numerical simulation. We consider the displacement of a wetting fluid by a nonwetting one in a drainage scenario and a nonwetting fluid by a wetting one in an imbibition scenario. In a capillary tube we validate the previous experimental observations of pinch-off dynamics for a drainage scenario given a more viscous fluid being displaced by a less viscous one and extend such observations through a systematic study to an imbibition regime. We find that beyond a wettability dependent critical capillary number, a stable displacement by a less viscous fluid can transition into a growing finger that eventually leads to a series of pinch-off events in both wetting and non-wetting contact angles. For the phase separation in the form of pinch-off for drainage and imbibition, this work provides a quantitative study of the emerging length and time scales and their dependence on the wettability conditions, capillary effects, and viscous forces.

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Date submitted: 02 Aug 2020 Electronic form version 1.4