Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Pressure-driven displacement of a viscoplastic material by a Newtonian fluid[1] PINAKINARAYAN SWAIN, PHD Student, GEORGE KARAPETSAS, Department of Mechanical Engineering, University of Thessaly, Greece, OMAR MATAR, Department of Chemical Engineering, Imperial College London, South Kensington Campus, SW7 2AZ, KIRTI SAHU, Department of Chemical Engineering, Indian Institute of Technology Hyderabad, Yeddumailaram 502 205, Andhra Pradesh, India — The pressure-driven displacement of a non-Newtonian fluid by a Newtonian fluid in a two-dimensional channel is investigated via a multiphase lattice Boltzmann method using a non-ideal gas equation of state well-suited for two incompressible fluids. We validate the code by comparing the results obtained using different regularized models, proposed in the literature, to model the viscoplasticity of the displaced material. Then, the effects of the Bingham number, which characterises the behaviour of the yield-stress of the fluid and the flow index, which reflects the shear-thinning/thickening tendency of the fluid, are studied. We find that increasing the Bingham number and increasing the flow index increases the size of the unyielded region of the fluid in the downstream portion of the channel and increases the thickness of the residual layer. This in turn decreases the interfacial instabilities and the speed of the propagating finger.

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Date submitted: 26 Jul 2013 Electronic form version 1.4