Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Dynamic Wetting in a Non-Equilibrium Gas: The Effect of Gas Pressure on Air Entrainment JAMES SPRITTLES, University of Warwick — Experimentally, it is now well established that lowering the pressure of an ambient gas can suppress wetting failures, or "air entrainment," at a liquid-solid-gas moving contact-line in both coating processes and drop impact dynamics. In this work, we consider the possibility that non-equilibrium effects in the gas are responsible for such phenomena. These can be included into a continuum framework by allowing for slip at both the solid-gas and liquid-gas interfaces, caused by Knudsen layers attached to these boundaries, which is related to the mean free path in the gas, and hence the ambient pressure. This model has been incorporated into a computational framework developed for dynamic wetting phenomena, which resolves all scales in the problem, so that these new effects can be investigated. It is shown that reductions in gas pressure, and hence increases in slip, can dramatically modify the flow field in the gas-film in front of a moving contact-line so that air entrainment is prevented. Specifically, in a dip-coating setup it is shown that the new model (a) describes experimental results for the critical wetting speed at a given gas pressure and (b) allows us to identify new parameters associated with the non-equilibrium gas dynamics which govern the contact-line's motion.

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Date submitted: 22 Jul 2014

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