Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Simulations of Droplet Coalescence in Simple Shear Flow OREST SHARDT, JOS DERKSEN, SUSHANTA MITRA, University of Alberta —

We present highly-resolved simulations of droplet coalescence in a shear flow. In general, droplet coalescence is difficult to simulate due to the wide range of relevant length scales: the diameter of a droplet may be 10^4 times larger than the minimum thickness of the film between a pair of droplets. In a shear flow, droplets coalesce unless a critical capillary number is exceeded. We found that this critical capillary number is about 20 times higher in simulations than in experiments when the domain size is at the scale of previous work. We use the binary-liquid free-energy lattice Boltzmann method. In this diffuse-interface model, the interface is characterized by a tension, thickness, and diffusivity. Using the parallel computational power of graphics processing units, we simulate sufficiently large domains to determine the dependence of the critical capillary number (Ca) on the diameter (D) of the droplets (relative to the interface thickness). The exponent in this scaling law depends strongly on the interface diffusivity. A new region in the Ca vs D map for the outcome of a simulated droplet collision was identified. We also study geometric effects. Due to the high resolutions that we simulate, we obtain critical capillary numbers that approach experimental values.

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Date submitted: 03 Aug 2012 Electronic form version 1.4