Single bubble cavitation in quiescent and sheared liquids

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Abstract

The bubble cavitation problem in quiescent and sheared liquids is investigated using a third-order isothermal lattice Boltzmann (LB) model that describes a two-dimensional ($2D$) fluid obeying the van der Waals equation of state. The LB model has 16 off-lattice velocities and is based on the Gauss-Hermite quadrature method. The evolution equations for the distribution functions in this model are solved using the corner transport upwind numerical scheme on large square lattices (up to 4096×4096 nodes). In a quiescent liquid, the computer simulation results are in good agreement to the $2D$ Rayleigh-Plesset equation. In a sheared liquid, we investigated the evolution of the total bubble area, the bubble deformation and the bubble tilt angle, for various values of the shear rate. A linear relation between the dimensionless deformation coefficient D and the capillary number Ca is found at small Ca but with a different factor than in equilibrium liquids. A non-linear regime is observed for $Ca \gtrsim 0.3$.

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