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A VOF-based method for the simulation of thermocapillary flow
CHEN MA, DIETER BOTHE, Technical University Darmstadt — This contribution concerns 3D direct numerical simulation of surface tension-driven two-phase flow with free deformable interface. The two-phase Navier-Stokes equations together with the energy balance in temperature form for incompressible, immiscible fluids are solved. We employ an extended VOF (volume of fluid) method, where the interface is kept sharp using the PLIC-method (piecewise linear interface construction). The surface tension, modeled as a body force via the interface delta-function, is assumed to be linearly dependent on temperature. The surface temperature gradient calculation is based on carefully computed interface temperatures. Numerical results on thermocapillary migration of droplets are obtained for a wide range of Marangoni numbers. Both the terminal and initial stage of the migration are studied and very good agreement with theoretical and experimental results is achieved. In addition, simulation of the Bénard-Marangoni instability in square containers with small aspect ratio and high-Prandtl-number fluids is discussed concerning the development and numbers of convection cells in relation to the aspect ratio.

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