Buoyancy-driven mixing of multi-component fluids in two-dimensional tilted channels

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ABSTRACT

Buoyancy-driven mixing of multi-component incompressible immiscible fluids in two-dimensional tilted channels is studied numerically using a phase-field model. The mixing dynamics are governed by the modified Navier–Stokes equations and the multi-component convective Cahn–Hilliard equations. A finite difference method is used to discretize the governing system. To solve the equations efficiently and accurately, we employ Chorin's projection method for the modified Navier–Stokes equations, and the recently developed practically unconditionally stable method for the multi-component Cahn–Hilliard equations. We numerically investigate the effects of various density ratios, tilt angles, Reynolds numbers, and Weber numbers on the interface structures and front velocities.