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Title: 3D ALE-FEM Simulation of Microscale Two-Phase Flows with Phase Change

Numerical simulation is employed to simulate diabatic two-phase flow phenomena using the continuum method for surface tension modeling. The set of equations are based on the 'one-fluid' Arbitrary Lagrangian-Eulerian (ALE) description of the Navier-Stokes, which includes the mass, momentum and energy conservation equations. These equations are discretized by the Finite Element method on a tetrahedral unstructured grid in which the phase boundary is represented by a triangular surfaces that are part of the volumetric computational mesh, thus a sharp and precise representation is successfully achieved. This geometrical procedure also ensures undesirable modes and spurious oscillations are damped out, thus leading to the convergence of the results. A Laplacian smoothing operator is applied to the volumetric and surface meshes to keep the elements homogeneously distributed, thereby avoiding large concentrations of nodes in one specific region due to the moving interface. Moreover, by varying a single parameter, the formulation can be set to a fixed or a complete moving mesh technique. The new methodology proposed here to simulate diabatic two-phase flows in the ALE context is the fist time this has been done for phase change. It is shown to provide an accurate description of the interfacial forces, bubble dynamics, the heat and mass transfer between phases. The employed formulation, the interface representation, the phase change model, and results will be presented. Furthermore, 3D microscale simulations of diabatic slug flow will be presented.

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