Lattice Boltzmann Model for Free Surface Flow Including Gas Diffusion

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Problems involving liquid-gas interfaces are common in the production of materials. The presence of interfaces is intimately correlated with the specific production method, e. g. casting, and may influence the resulting product quality in an essential way. One particular material class - foams - is dominated by the dynamics of growing and strongly changing interfaces by a gas releasing blowing agent. The Lattice Boltzmann method seems to be especially suitable to simulate such complicated systems in an efficient way.

A Lattice Boltzmann model for the treatment of free surface flows including gas diffusion is presented. We use a front-capturing method to describe the movement of the gas-liquid interface. The kinetic interpretation of the Lattice Boltzmann approach is explicitly explored in order to treat interface advection as well as to fulfill the macroscopic boundary conditions for the hydrodynamic and diffusion problem. Mass, momentum and gas fluxes are extracted directly from the particle distribution functions. In this sense, the hydrodynamic boundary conditions are fulfilled by controlling the fluxes without relying on any gradient information.

This contribution is thought to describe the theoretical basis of our approach to handle free surfaces within the LB formalism. An explicit application of our method is presented in *Lattice Boltzmann modeling of foaming processes* and *LBM Simulation and Visualization of Free Surface Flows in 3D.*