Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

Wave Phenomena during Lattice Boltzmann Simulation of Interdiffusion for Species having Unequal Masses ROBERT SEKERKA, ALEX FORE, Carnegie Mellon University, VICTOR SOFONEA, Romanian Academy Sciences, Timisoara, MICHAEL WIDOM, Carnegie Mellon University — We discuss wave propagation phenomena in a Lattice Boltzmann (LB) model of a binary diffusion couple for species having unequal masses. LB simulations reveal oscillations in the position of the global center of mass of the couple as it moves toward the center of the couple from its initial position located toward the more massive species. These oscillations are related to waves in the total number density and barycentric velocity. Waves are generated at the initial discontinuity in composition and propagate toward the ends of the couple, from which they reflect. For a small difference in the masses of the diffusing species, we use a perturbation expansion to obtain driven wave equations for the total number density and the barycentric velocity. For sufficiently long samples these waves have a negligible effect on the composition versus distance profiles during interdiffusion; however, for microfluidic devices whose length is comparable to the diffusivity divided by the wave speed, the tails of the composition profiles get cut off. Periodic boundary conditions (PBC) were used in the direction perpendicular to the axis of the diffusion couple. If these PBC are replaced by no-slip walls, the waves are heavily damped.

Robert Sekerka
Carnegie Mellon University

Date submitted: 17 Nov 2006 Electronic form version 1.4