Transverse dynamics of binary fluids with mass asymmetry

I. Mryglod and O. Prytula

Institute for Condensed Matter Physics of the National Academy of Sciences of Ukraine, 1 Svientsitskii Str., 79011 Lviv, Ukraine, E–mail: prytula@icmp.lviv.ua

We consider the influence of the mass asymmetry on the dynamic behaviour of binary fluid. The investigations are performed by combining the molecular dynamic simulations (MD) and general modes approach (GMA). The MD simulations are performed in the microcanonical ensemble for the system consisting of $N = 1000$ particles at temperature $T = 1.0$ and particle density $\rho = 0.75$. A four-variable analytical model based on the transverse components of mass and mass-concentration flows as well as their first derivatives permits us to obtain the spectrum of collective excitations. It contains the branch corresponding to the transverse sound modes and another branch describing propagating the optic-like excitations in the system.

The dependence of collective mode spectra on the mass asymmetry at the wide region of wave vectors and the mass asymmetry ratio is investigated. We show that in the region of intermediate and small wave vector numbers heavy particles are responsible for the transverse sound modes whereas light particles oscillations determine mainly the spectrum of optic-like excitations. It is found that the range with well defined sound excitations in the total momentum spectral function is reduced with increasing of the mass asymmetry ratio.

The behaviour of the lowest relaxation mode which corresponds to the transverse viscosity in the long-wave limit is considered. It is found the agreement of the result for transverse viscosity calculated in GMA and data received via direct MD simulations.