Kinetic theory of transport coefficients for dense gaseous mixtures with multistep interaction

Y.A. Humenyuk[a] and M.V. Tokarchuk[a,b]

[a] *Institute for Condensed Matter Physics of the National Academy of Sciences of Ukraine, 1 Svientsitskii Str., 79011 Lviv, Ukraine, E–mail: josyp@ph.icmp.lviv.ua*

[b] *National University "Lvivska Politekhnika", 12 Bandera Str., 79013 Lviv, Ukraine*

Model potentials of a square well or a multistep function enable to formulate a kinetic theory for real dense gases and fluids in the pair-collision approximation [1,2]. The collision integral describes explicitly pair processes at distances of interparticle attraction and allows to elucidate the role of attraction in transport processes [3] and relaxation [4]. The transport equation for the potential energy density complements the kinetic equation for the one-particle distribution function (d.f.) and is a necessary constituent of the theory.

We generalize this theory for the multistep potential to the case of mixture and search for the normal solution of the corresponding set of kinetic equations. Using the modified Chapman-Enskog method, integral equations for the first-order corrections to the one-particle d.f. are obtained. The correction to the inverse potential-energy quasi-temperature is deduced from the potential-energy density equation. It turns out to be linear in the divergence of the hydrodynamic velocity and is coupled to the bulk-viscosity terms of the corrections to the d.f.'s. The obtained contributions to the stress tensor, heat flux, and mass diffusion fluxes define the bulk and shear viscosity, thermal conductivity, and diffusion coefficients.

1. Karkheck J., van Beijeren H., de Schepper I., Stell G. // Phys. Rev. A, 1985, **32**, p. 2517.
2. Tokarchuk M.V., Omelyan I.P., Kobryn A.E. // Phys. Rev. E, 2000, **62**, p. 8021.
3. Van Beijeren H., Karkheck J., Sengers J.V. // Phys. Rev. A, 1988, **37**, p. 2247.
4. Leegwater J.A., van Beijeren H., Michels P.J. // J. Phys.: Condens. Matter, 1989, **1**, p. 237.