Physico-chemical nanomaterials science

The pressure and temperature dependence of the dynamic shear-viscosity and self-diffusion coefficients in monatomic liquids

S.S. Lugovskiy[1], V.A. Tatarenko[1], I.M. Melnyk[1], V.S. Kharchenko[1]

[1] *Department of Solid State Theory, G.V. Kurdyumov Institute for Metal Physics, Natl. Acad. of Sci. of Ukraine. 36 Academician Vernadsky Boulevard, UA-03680, Kyiv-142, Ukraine.*
E-mail: sergeykpi@mail.ru

A phenomenological theory developed by A.A. Smirnov for the shear viscosity and self-diffusion in monatomic liquids is considered from a standpoint of thermodynamical fluctuation theory without any geometrical-model premises. It is assumed only that a transport results from the movement of atoms to small and variable distances as a result of local thermodynamic potential density fluctuation.

The following new expressions for the dynamic viscosity coefficient $\eta(p, T)$, and self-diffusion one, $D(p, T)$, were obtained:

$$\eta \approx B\left(e + vp - sT\right)^5 / T^4 \qquad (1)$$

$$D \approx AT^5 / \left(e + vp - sT\right)^5 \qquad (2)$$

where A = const > 0 and B = const > 0, and within a limited $p-T$ range, the smooth thermodynamical variables (as functions of pressure p and temperature T) s, e, v are supposed to be constant.

Expressions (1) and (2) are in good agreement with experimental data [1-3]. The intermediate numerical values of constants A, B, s, e, v were obtained for Ar, Ta, Mo, Al, Bi, Cs, Hg, K, Li, Na, Pb, Rb according to [1-3].

1. *Younglove B.A., Hanley H.J.M.* The viscosity and thermal conductivity coefficients of gaseous and liquid argon // J. Phys. Chem. Ref. Data.-1986.-**15**(4).-P.1323-1337.
2. *Kirillov P.L., Deniskina N.B.* Thermophysical properties of the liquid metal heat transfer agents // CNIIatominform.-Moscow.-2000.
3. *Grigoriev I.S., Meylihova E.Z.* Phydical values // Energoatomizdat.-Moscow.-1991.