Thematic Section: Theoretical Research. **Full Paper**
Subsection: Thermodynamics. *Registration Code of Publication:* 14-40-11-15
The article is published on the materials of report presented at the "International Scientific Forum Butlerov Heritage – 2015". http://foundation.butlerov.com/bh-2015/ *(English Preprint)*
Contributed: December 24, 2014.

Exact solutions of Gibbs-Tolman-Koenig-Buff equation for spherical dividing surface and exactly solvable models of interfacial layer

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Keywords: surface tension, curvature radius, liquid drop, bubble, tension surface, break surface, Gibbs surface, dividing surface, equimolar surface, Tolman's length, Tolman's parameter, Tolman's formula, boundary of interface, coexisting phases, ideal thermodynamic system of comparison.

Abstract

Exact solutions of the Gibbs-Tolman-Koenig-Buff equation for the dependence of the surface tension on the radius of the spherical liquid droplet in the vapor and spherical vapor bubble in a liquid are found. Five well-known formulae for this dependence are theoretically justified. New approximate formulae for this dependence are obtained using method of sequential approximations. The approximate formulae are compared with the exact formula. A simple approximated theoretically based formula for the dependence of the surface tension on the radius is suggested. The method to restore the radius and temperature dependences of the Tolman's length using the radius and temperature dependences of the surface tension is suggested. The radius dependence of the Tolman's length, when Tolman's formula and this simple formula become accurate, and the asymptotic behavior of this dependence in the limits of small and large radii of curvature are obtained.