Experimental Investigation on Thermophysical Properties of Highly Nonideal Fluid Mixtures

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Thermophysical properties of fluid mixtures depend in a complicated way on the properties of the substance that form them. Of practical and theoretical interest are data on thermophysical properties of fluid mixtures with an essential deviation of properties from the ideal law. It is important to elucidate the interrelations of thermophysical properties with other macroscopic properties of a mixture, in particular, with the excess volume. In the course of an experimental study of heat transfer in binary mixtures with different types of intermolecular interactions, the existence of additional thermal resistance (i.e. extra mechanism of carrier power dispersion absent in pure liquids) has been revealed. This phenomenon is proved by the negative deviation of the concentration (volume) dependence of thermal conductivity coefficient for the mixtures from the additive law [1-3]. L.P. Phylippov proposed the hypothesis that the appearance of the additional thermal resistance is caused by the scattering of hyperacoustic waves on concentration fluctuations, and the main factor is the ratio of the difference of the densities of pure components $\Delta\rho = \rho_2 - \rho_1$ to the additive value of density $\Delta\rho / \rho_{add}$ [1]. The aim of our investigation is to check the commonness degree of the hypothesis with respect to the expansion of temperature and $\Delta\rho / \rho_{add}$ values range. To solve the problem we are developing the method of controlled pulse heating of a thin wire probe. The characteristic pulse length is 1 ms by the order of magnitude. The most significant particular cases are the constant power mode and the temperature plateau mode. The first mode makes it possible to determine the thermal conductivity in a region of stable states of a substance. The second mode serves for measuring the substance thermal resistance in a region of superheated and supercritical states in the temperature range 350-600 K [4]. The pressure in the measuring cell is from 0.1 to 30 MPa. The objects of study were as follows: saturated hydrocarbon + fluorinated hydrocarbon (systems with an UCST), saturated hydrocarbon + alcohol, poly(propylene glycol) + water (system with a LCST). Values of the excess volume of solutions with equal volume fractions of the components were from 0.6 cm^3/mol (tetradecane + 2-propanol) to 4.8 cm^3/mol (hexane + perfluorooctane). An obvious correlation between the values of the additional thermal resistance for a mixture and its excess volume has been revealed.

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