Size dependences of the surface tension and the kinetic boundary of metastable states in liquids

Jana Kalova [C, S]
University of South Bohemia, Faculty of Science, Department of Mathematics and Biomathematics, Ceske Budejovice, Czech Republic
jkalova@prf.jcu.cz

Radim Mares
University of West Bohemia, Faculty of Mechanical Engineering, Department of Power System Engineering, Pilsen, Czech Republic

Study of the curved interfaces is an urgent problem of the first-order phase transitions. The curvature dependence of the surface tension is important for the description of nucleation phenomena and fluids in microcapillaries or nanopores. The effect of a droplet size on surface tension is discussed in the paper. When the droplet radius becomes very small, its surface tension is different from that of a large droplet. It is difficult to determine a size dependency of the surface tension by an experiment, only theoretical models are available. Several models for the size dependency based on Gibbs−Tolman−Kening−Buff (GTKB) equation have been published in recent time. By use of the GTKB equation, the exact relationship between the microdroplet surface tension and the radius can be obtained. We have used results of the models to calculate the kinetic spinodal (Kiselev) of superheated and supercooled water. We have compared our calculations with the previous works and with experimental data. We have used different equations of state and of the surface tension to calculate a prediction of the kinetic spinodal in metastable liquids. We have compared our results with thermodynamic spinodal calculated from empirical equations for real liquids. The models of the curvature dependence of the surface tension are discussed in the paper.