

Interfacial Tension and Correlation Length in "Water-Hydrotrope-Oil" Ternary Systems

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Hydrotropes are amphiphilic substances formed by molecules too small for micelle formation but still solubilizing various hydrophobic substances ("oils") in water. We have studied "water-hydrotrope-oil" ternary systems with *tert*-butanol as hydrotrope and cyclohexane, decane and toluene as "oils". Interfacial tension was measured by Wilhelmy plate and spinning drop methods, and correlation length was measured by dynamic light scattering. We found that interfacial tension isotherms can be described by the crossover formula in a form of Pade approximant, thus uniting surfactant-like behavior at low hydrotrope concentration with vanishing of interfacial tension near the critical point. Reconstruction of adsorption isotherm from interfacial tension data allows comparing the crossover, Langmuir, and Frumkin isotherms. Square root of interfacial tension and reciprocal correlation length can be linearly related, as expected from the scaling theory of smooth interfaces. We have studied the effect of temperature on the interfacial tension and correlation length near the critical point, and found that at both low and high temperatures the phase separation domain enlarges, forming a hyperboloid-like separation boundary surface in three-dimensional phase diagram. Studies of interfacial tensions in "water-hydrotrope-oil" ternary systems will promote the development of environmentally-safe oil spill removal reagents. This work is supported by Russian Foundation for Basic Research (grant No. 16-03-00895).