Nature of Ultra-Low Interfacial Tension in Near-Critical Liquid Mixtures in the Presence of a Surfactant

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It is well known that at the critical consolute point of liquid-liquid equilibrium the interfacial tension vanishes (van der Waals-Widom mechanism). We show that the presence of a surfactant results in an additional contribution to the reduction of the interfacial tension related to vanishing of the gradient-term coefficient in the Landau-Ginzburg free energy (Lifshitz-point mechanism). Near the Lifshitz point the density profile in the interface displays specific oscillations which have been observed experimentally. It is shown that the same mechanism is crucial for understanding of the formation of either the locally inhomogeneous isotropic phase (microemulsion) or lyotropic liquid-crystalline phases, both cases characterized by extensive amounts of internal interface. The phase diagram of near-critical mixtures in the vicinity of the Lifshitz point is discussed.