Leibler Lines, Unbinding Lines, and Lifshitz Points:
Phase Transitions in Systems with Lamellar Order

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Lamellar order is ubiquitous in self-assembling systems and the transitions from this phase to others are very interesting. In a binary system, the lamellar phase consists of bilayers separated by solvent. On increasing the temperature, the wavelength of the phase can remain relatively fixed, while the amplitude of the density variation weakens and disappears almost continuously. This line of transitions to the disordered phase is called, in polymer systems, the Leibler line. On the other hand, on increasing the concentration of solvent, the amplitude of the density variation can remain relatively fixed while the wavelength increases indefinitely, resulting in a line of unbinding transitions to the disordered phase. These two lines of transitions meet at a Lifshitz point. In addition, there is also macrophase separation between a disordered solute-poor phase and a solute-rich one which may, or may not be, ordered. In a ternary system, analogous behaviors are possible. In this talk, I will review the theory of these transitions, some of their applications, and experiments on binary amphiphilic and ternary polymeric systems in which these behaviors are studied.