Crystalline ordering of colloidal particles dispersed in liquid crystals

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We present a mean field theory to describe phase separations in mixtures of a liquid crystal and a colloidal particle. By taking into account a nematic and a smectic A ordering of liquid crystals and a crystalline ordering of colloidal particles, we calculate the phase diagrams on the temperature-concentration plane. We predict various phase separations, such as a smectic A-crystal phase separation and a smectic A-isotropic-crystal triple point, etc., depending on the interactions between a liquid crystal and a colloidal surface. Inside binodal curves, we find new unstable and metastable regions which are important in the phase ordering dynamics. We also find a crystalline ordering of colloidal particles dispersed in a smectic A phase and in a nematic phase. The cooperative phenomena between liquid crystalline ordering and crystalline ordering induce a variety of phase separations.