Blue Phase Liquid Crystal Colloids

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Liquid crystal blue phases possess a crystalline symmetry of molecular ordering although the material is liquid[1]. The chirality of molecules leads to director structures in the form of double-twist cylinders, which give rise to an array of disclination lines. Interesting phenomena in terms of applications are observed, such as lasing[2] and large electro-optic Kerr effect[3]. For most of the blue phases, a serious drawback for application is their typically narrow temperature range of few K. The exceptions are materials recently developed by Coles and co-workers[4].
Here, we propose a new type of materials – blue phase liquid crystal colloids. They combine the structural and optical complexity of blue phases with optical patterns of particles. Numerical modelling based on free energy minimization technique is used to approach these materials[5,6]. Defect lines are observed to act as trapping sites for colloidal particles. By its symmetry, the configuration of the defects determines the equilibrium particle structure. Stable 3D colloidal crystals are found in blue phase I and blue phase II. Using the symmetry of the host fluid and its defects opens a new direction for true self-assembly of 3D colloidal structures. In addition, doping the defects by colloidal particles substantially stabilizes the blue phases and increases their temperature range. The corresponding phase diagram is calculated.

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