BIAXIAL NEMATICS OF HARD CUBOIDS IN AN EXTERNAL FIELD

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Colloids are biphasic systems consisting of particles dispersed in another medium. When these dispersions have anisotropic shapes, they can self-assemble into liquid crystalline (LC) phases. In this research, we are interested in the biaxial nematic phase (N_B), an elusive phase that is foreseen to be a promising candidate in the engineering of next generation liquid crystal displays (LCDs). In equilibrium, board-like colloids cannot form the N_B phase in monodisperse [1,2] and bidisperse systems [3]. However, theory [4] and experiment [5] have suggested that significant size dispersity may enhance its stability. Previously, the N_B phase has been observed experimentally in systems of board-like particles through magnetic field application [5]. This experimental finding unveiled an important phenomenon about the N_B phase: that we can stabilise it with an external field. Motivated by the experimental finding, we attempt a computational study on the phase behaviour of board-like particles in an external field.

By Monte Carlo simulation, we modelled the phase behaviour of colloidal board-like particles when subjected to an external field. By varying shape anisotropy and field strength, we constructed phase diagrams for fields applied to the isotropic (I) and uniaxial nematic (N_U) phases. We coupled the external field to the intermediate axis of our particles and were able to observe, from initially I and N_U phases, the formation of weak and strong N_B phases. At the self-dual shape, very weak fields are able to spark direct I-N_B and N_U-N_B phase transitions; other shapes required stronger fields. In line with theoretical predications [6], the self-dual shape is shown to promote phase biaxiality in our system. This finding paves the way to exploit low-energy N_B phase transitions through the self-dual shape. Currently, work is being done to study the reorientation dynamics of these phase transitions using dynamic Monte Carlo simulations [7].

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Back to Programme