Microbullet Assembly in Confined Nematic Liquid Crystal

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While the physics of spherical colloids confined in a nematic slab has been thoroughly investigated (see, e.g. [1-3]), interactions between anisotropic particles are less well studied [4-6]. Here we report the behavior of rod-like 'bullet'-shaped microparticles rounded at one end and flat at the other confined in a nematic cell. We carefully controlled the anchoring conditions of the NLC at the particle surfaces and the confining boundaries. Microbullets with homeotropic anchoring dispersed in a uniform nematic director field created defects in order to satisfy global topological constraints and behaved as elastic dipoles with a particular orientation associated with the particle shape. This allowed the study of particle assembly as a function of dipole orientation in liquid crystal cells with either planar or homeotropic surface anchoring. Depending on the type of the anchoring, bullets spontaneously form 1D structures, chains parallel to the director, and 2D ordered structures, crystals with hexagonal symmetry. These latter structures are not observed for isotropic particles. By application of an external field, the anchoring conditions on the bounding walls can be dynamically controlled, and transitions between the different structures can be generated [7]. Recent progress in understanding the particle self-assembly process is presented.

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