ELECTRICALLY INDUCED DYNAMICS OF COLLOIDAL PARTICLES DISPERSED IN NEMATIC LIQUID CRYSTAL

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S u m m a r y

We study the behavior of colloidal particles dispersed in a nematic liquid crystal. Particles create defects of a dipolar type (hyperbolic hedgehogs) in the otherwise homogeneous director field due to the normal anchoring of the nematic director at the particle's surface. Being heavier than the surrounding nematic, the particles still do not fall at the bottom of the cell, and levitate in the nematic bulk thanks to the elastic repulsion from the bounding plates mediated by director distortions [1]. Contrary to an intuitive expectation, the larger the particles, the further away they are repelled from the bottom of the cell. By applying the electric field perpendicular to the overall director, one lifts the particles either to the top of the cell or to the bottom. The direction of this lift depends on the polarity of the director dipole; we discuss the elastic and dielectrophoretic forces among the possible mechanisms of the lift. By switching the electric field on and off, one creates a material flow (backflow effect) that carries particles in two antiparallel directions in the plane of the cell. The velocity of particles can be controlled by the amplitude and duty ratio of the modulated waveform. Numerical simulations of the backflow agree well with the experimental observations, suggesting that the bidirectional dynamics of colloidal particles is controlled mostly by the backflow.