Non-contact optical control of multiple defects and structures in liquid crystals using holographic and time-shared optical trapping

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Laser tweezing in liquid crystals (LCs) exhibits richness of new phenomena and provides fascinating experimental capabilities. In this work, manipulation of multiple defects and structures is performed in the framework of such approaches as holographic optical trapping and time-shared laser trapping in LCs of both thermotropic and lyotropic origin. Moreover, employing laser beams with intensity exceeding the threshold for the optical Freedericksz transition, a variety of director structures are first optically generated and then spatially translated, rotated, sorted, and organized into superstructures such as periodic arrays. One of the major challenges complicating the quantitative measurements is the anisotropic nature of LCs, which makes the tight laser beam focusing difficult and considerably weakens trapping forces [1,2]. Using LCs with low birefringence allows us to mitigate these artifacts. Optical trapping forces and the trap stiffness are first calibrated for different laser powers using viscous drag forces. This is then used to probe interaction forces between defects and structures in the nematic bulk as well as to characterize tension of LC line defects. The measured data are in a good agreement with the theoretical predictions.

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