Photonic structures in liquid crystals obtained via depth-resolved sub-micron optical control of self-assembled monolayers at confining LC-glass interfaces

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Light-controlled alignment of liquid crystal (LC) materials is of great fundamental interest and of importance for applications ranging from displays to all-optical and data storage devices, and to novel optical metamaterials. In this work, we use photosensitive self-assembled monolayers (azo-SAMs) to provide optically-controlled LC alignment at the two opposite surfaces of the LC cell. We demonstrate that the depth-resolved tight focusing of a scanned laser beam allows for independent control of the two aligning surface monolayers at confining glass plates and thus for obtaining manifold of director structures that minimize LC elastic energy in the bulk at given boundary conditions. Using the scanned laser beams and holographically-generated light intensity distributions, arbitrary surface boundary conditions at the LC-monolayer interfaces can be obtained by light-controlled spatial patterning of the easy axis for the LC director at surfaces with submicron resolution. These findings are of great interest for alignment of LC materials with spatially-periodic ground states, such as cholesteric and blue phases, as well as for a variety of all-optical applications.