

Patterned photoalignment of liquid crystal and resulting disclination lines

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Replacing homogeneous liquid crystal alignment through rubbing by patterned photoalignment offers opportunities to create complex 3D structures in a layer with homogeneous thickness. The illumination of a photosensitive layer with linearly polarized blue or UV light is a non-contact method, and the patterns can have high resolution with many degrees of freedom. The generation of illumination patterns can be realized by interfering laser beams or by projection of light that is reflected from a spatial light modulator. This approach has been used to effectively align different phases: nematic, chiral nematic, blue phase and ferro-nematic liquid crystal [1-5].

If the photoalignment pattern contains defect points, where the alignment direction is not continuous, a disclination line is generated in the overlaying liquid crystal layer, which typically ends in another defect point. Disclination lines may also form in the liquid crystal layer without reaching the alignment layers. In blue phase liquid crystal disclination lines are spontaneously formed, while in other phases, the disclination lines represent excess free energy which creates a tension that tries to reduce the length of the disclination line. Defects at the surface with charge +1 or -1 can generate two disclination lines, but it is also possible to avoid disclinations by having the director escape in the third dimension, perpendicular to the substrate.

In the presentation, we will give an overview of photoalignment methods, procedures for photoalignment with multiple steps, examples of liquid crystal configurations near a substrate with an patterned alignment, and the resulting optical properties.

References

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