Surface vs. Bulk Chiral Orientation Effects in Liquid Crystals

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Molecular chirality refers to the asymmetrical qualities in which a molecule is non-superimposable on its mirror image. In liquid crystals, chirality causes the director, or imaginary common axis, of the liquid crystal to rotate around an axis perpendicular to the molecular length, forming a helical pattern. In order to determine whether the director aligns parallel to the surface's "easy axis" as it does for nonchiral liquid crystals, or if the chirality causes it to rotate by some angle at the surface, two chiral dopants are added to a nonchiral liquid crystal. To create the chiral dopant mixture, 2% of the combined left-handed chiral dopant, ZLI811, and right-handed chiral dopant, CB15, are added to the nematic liquid crystal, MBBA.The combination of these three molecules displays some of the same properties as a naturally occurring chiral liquid crystal, except the absence of a bulk twist when the concentrations of the chiral dopants are adjusted properly. Compensation between the two liquid crystal materials is tested for using an electroclinic effect. After determining the appropriate concentration, to determine whether there is a rotation at the surface, the surface orientation of the directors of the chiral mixture and nonchiral liquid crystal are compared using a polarizing microscope. A "hybrid cell" split into two separate sides is rotated one degree at a time and the transmitted intensities of light for the two different materials are documented. After analysis, the directors' orientations differed by approximately 1°, suggesting that there is some rotation of the chiral dopant mixture's director at the surface even though the electroclinic effect in the bulk was zero. The project's successes advance the understanding of the nature of liquid crystals.