1. High Birefringence and High Dielectric Anisotropy Nematic Liquid Crystals

Almost all LC-related devices, such as liquid crystal display (LCD) panels, LCD TVs, spatial light modulators, and optical phased arrays (OPA) for laser communications and variable optical attenuator applications, require faster response time. In order to achieve a fast response time, low viscosity LC mixtures are preferred. The alternative approach is to use a thin cell gap filled with a high birefringence (Δn) and low viscosity LC mixture. High birefringence also enhances the display brightness and contrast ratio of polymer-dispersed liquid crystals (PDLCs), holographic PDLCs, and bistable reflective cholesteric LCDs.

The most effective way to increase birefringence is to elongate the π-electron conjugation length of the LC compounds\textsuperscript{1,2}. Conjugation length can be extended by multiple bonds or unsaturated rings in the rigid core. We have developed some high birefringence compounds and eutectic mixtures with birefringence in the 0.4-0.7 range and dielectric anisotropy of +21-25 based on the isothiocyanato-tolane systems. Due to the longer π-electron conjugation, the fluorinated NCS-based LC compounds exhibit a larger birefringence and maintain a high resistivity.

Ultraviolet (UV) stability is a concern for all the high birefringence LC materials which arises from the UV light absorption induced molecular structure change. For these high birefringence LCs, the absorption tail extends to the long UV (320-380 nm) region. Thus, to avoid UV instability, these high birefringence compounds are more suitable for infrared applications.


*Research was supported in part by ARMY BOSS and AFOSR IR-LC Programs.