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Photoactive liquid crystalline materials – structures and properties

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Organic photoactive materials that exhibit self-assembly have attracted considerable interest due to their potential to drive, tune, and control the optical properties of soft matter systems in a contactless manner [1, 2]. Integrating chirality and photosensitivity into self-organizing materials further enhances their functional versatility [1, 3, 4]. These features can be engineered directly into liquid crystalline (LC) molecules by introducing suitable chiral groups and photosensitive moieties [5, 6].

Photoactive LC materials composed of rod-like molecules represent a distinct class of systems that display unique optical and electrical responses under light irradiation. By combining the intrinsic anisotropy of liquid crystals with light-induced, reversible structural or phase changes, these materials hold significant promise for applications in sensing, imaging, and advanced optical technologies [6, 7]. Among various photosensitive units—including spiropyran, stilbene, hydrazone, coumarin, diarylethene, and cinnamoyl—the azobenzene group is particularly widespread for designing both low-molar-mass and macromolecular LC systems with photoresponsive behaviour [8, 9].

The molecular structure specificities of calamitic photosensitive chiral materials play a crucial role in mesophase formation and in the resulting structural and photo-optical behaviour. To advance the understanding of how molecular architecture influences mesomorphism and photosensitivity, several recently developed photoactive materials will be discussed. Lateral substitution on the molecular core of calamitic liquid crystals proves to be an effective strategy for tuning both mesomorphic and photoresponsive behaviour [10], particularly when the chiral unit is derived from lactic acid [11, 12, 13]. The influence of various substituents including halogen atoms placed near the azobenzene moiety on mesomorphic properties and photoactive performance will also be examined.

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