Multiple nematic phases observed for chiral mesogenic dimers

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The nematic liquid crystalline phase (NLC) for a long time was considered as a ‘simple’ phase. In recent years the reports about possible complex structures of nematic phase appeared in literature. Two modulated nematic phases: twist-bend and splay-bend were predicted. In the twist-bend structure the nematic director bends and rotates on the cone. In the splay-bend structure the nematic director exhibits an in-plane modulation, which is coupled to the splay deformation. In achiral nematics only one of the modulated structures, twist-bend, was found. The chiral materials made of bent dimers show by far more complex phase behavior. Here we presented multiple N-N phase transitions observed in chiral asymmetric dimers, [1] built of cholesterol and N-benzyldene-p-toluidine units (Series 1) and cholesterol and 4-methylazobenzene units (Series 2) connected by flexible alkyl spacer with odd-number of carbon atoms (Figure 1).

Fig. 1 Molecular structures of studied dimmers

All observed nematic phases are optically uniaxial. The highest temperature phase is a conventional chiral nematic (cholesteric) on heating or blue phases on cooling. The lowest temperature nematic phase expels the chiral twist and exhibits spontaneous bent-splay modulation (Figure 2). There are also up to 5 intermediate nematic phases with narrow temperature ranges that compromise both spontaneous twist and bend.

Fig. 2 Textures observed for bent-splay type nematic phase (left) and cholesteric phase (right). Schematic drawing of molecular arrangement is also given.

References

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