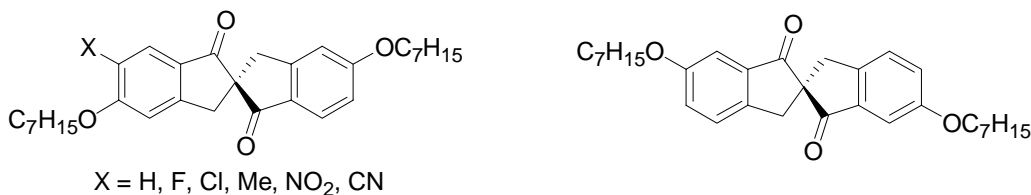


Understanding the Origin of Polar Order in Ferroelectric Liquid Crystals via Substituted 2,2'-Spirobiindan-1,1'-dione Dopants

Qian Cui

Ferroelectric liquid crystals (FLC) have been investigated as an alternative to nematic liquid crystals in display applications due to their low power requirement and fast switching time. Commercial FLC mixtures are composed of a small amount of a chiral additive (dopant) and a large amount of achiral liquid crystal host. The chiral dopant induces a spontaneous electric polarization (P_S) in the smectic C (SmC) phase that can be coupled to an applied electric field to produce an ON-OFF light shutter. The switching time of such devices is inversely proportional to P_S . Therefore, the design of chiral dopants that can induce high ferroelectric polarizations is a key aspect of FLC research and requires an understanding of the relationship between molecular structure and polar order in the chiral SmC* phase.

Our work is aimed at understanding the many factors that contribute to polar order in the SmC* phase via a class of axially chiral compounds with a conformationally restricted 2,2'-spirobiindan-1,1'-dione core. Previous work in the Lemieux lab has led to a conformational distribution model for 2,2'-spirobiindan-1,1'-dione dopants in a SmC host, and revealed the possibility of chirality transfer exerted by these dopants.^[1] As a follow up, we detected the chiral perturbation of these dopants by ^2H NMR and chiral probe experiments.^[2] Furthermore, in order to test the proposed conformational distribution model, we introduced polar functional groups on the 2,2'-spirobiindan-1,1'-dione core in order to correlate transverse molecular dipole with observed polarization. Finally, we made the 2,2'-spirobiindan-1,1'-dione compounds into liquid crystalline material by adding a benzoate group linking the core to the alkyl side-chains, and revealed the possibility of biaxial ordering contributions to polar order.



References

- [1] Boulton, C. J.; Finden, J. G.; Yuh, E.; Sutherland, J. J.; Wand, M. D.; Wu, G.; Lemieux, R. P. *J. Am. Chem. Soc.* **2005**, *127*, 13656.
- [2] Cui, Q.; Huntley, C. M.; Lemieux, R. P. *J. Mater. Chem.* **2009**, *19*, 5188.