Ferroelectric Nematic Phase over broad range of temperatures including room temperature in rod-type mesogens

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Abstract

The discovery of the ferroelectric nematic (N_F) phase has attracted significant attention from the soft matter community, both for exploring the scientific basis of its origin and for advancing its potential applications in devices such as optical modulators and high-energy-density storage supercapacitors. Unlike rigid solid-state ferroelectrics, the fluidic nature of N_F materials offers ease and flexibility in device fabrication. In the N_F phase, these materials exhibit remarkably large saturated spontaneous polarization ($\gtrsim$ 6 Micro C/cm^2), which is comparable to that of the solid-state pervoskites ferroelectrics. Due to extremely large spontaneous polarization, these materials will exhibit exceptionally strong non-linear electro-optic effects. In this talk, we report synthesis of the three new N_F phase compounds with an extended temperature range of up to 103 °C, including stability at room temperature, and compounds having low ionic conductivity. Two of these compounds show a direct Iso-to-N_F phase transition, and in two out of three, the N_F phase was stable below 20 °C. The synthesis is described, and compounds are characterized by analysis of the textures by Polarizing Optical Microscopy in different surface alignment configurations. Chiral domains in (N_F) phases formed by achiral molecules were observed under two different surface boundary conditions. X-ray measurements show that the effective length of the molecule is lower in the N_F phase than in the N/Iso phase. Dielectric measurements confirm the presence of a large ferroelectric mode in the N_F phase. Temperature-dependent birefringence data show a large increase in the order parameter at the Iso - N_F or N to N_F transition temperature. The fundamental properties determined for these materials will advance their future applications.