New compounds with the TGBA-TGBC-SmC* phase sequence

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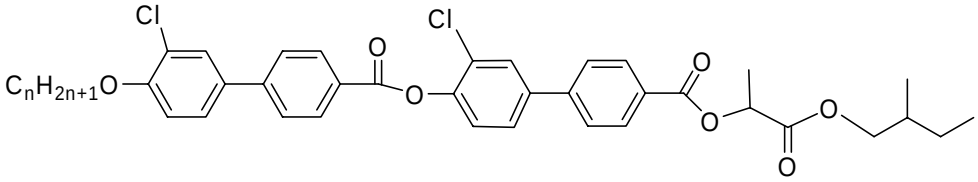
Twist grain boundary (TGB) phases result from competition between chiral forces and the tendency of molecules to effectively pack into layers. The model of TGBA (TGBC) phase[1] takes into account analogy between smectic liquid crystals and superconductors and presumes small blocks with a layered SmA (SmC*) structure separated from each other by the grain boundaries of screw dislocations.[2,3]

We present synthesis and physical properties of new materials with four-phenyl-ring molecular core laterally substituted by chlorine atoms and lactic acid unit in the chiral molecular chain. General chemical formula is shown in the following figure, where n varies from 5 to 12. For all compound we have found the TGBA and TGBC phases in wide temperature range followed by the SmC* phase on cooling. The phase transitions have been checked by differential scanning calorimetry and phases have been identified on the basis of the planar sample as well as the free-standing films observation under polarizing microscope.



The ferroelectric switching has been detected in the TGBC and SmC* phase and temperature dependences of spontaneous polarization and spontaneous tilt angle have been measured. Dielectric spectroscopy has been performed in the frequency range of 1 Hz-10 MHz and specific dielectric modes have been found. Temperature dependences of fitted relaxation frequency and dielectric strength are presented and discussed. X-ray structural studies in small angle region provided information about layer spacing values.

References:

1. P. Oswald, P. Pieranski: Smectic and Columnar Liquid Crystals, CRC Press Taylor and Francis Group (2006).
2. S. R. Renn, T. C. Lubensky, *Phys. Rev. A*, **38**, 132 (1988).
3. H.-S. Kitzerow, Ch. Bahn: Chirality in Liquid Crystals, Springer-Verlag (2001).