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New antiferroelectric liquid crystal exhibiting a direct TGB-SmC_A* transition

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(*S*)-1-Methylheptyl2-[4-(4-dodecyloxybenzoyloxy)phenyl]pyrimidine-5-carboxylate and its racemic modification were synthesized. Basing on results of miscibility studies, differential scanning calorimetry, and electrical field studies, we conclude that this material exhibits an antiferroelectric twist grain boundary $TGBC_A$* analogue of the Abrikosov flux phase found in superconductors. This novel phase was found to exist between the isotropic liquid and the antiferroelectric smectic C* phase.

Синтезированы (*S*)-1-метилгептил2-[4-(4-додецилоксибензоилокси)фенил]пиримидин-5-карбоксилат и его рацемическая модификация. На основании результатов исследования смешиваемости, дифференциальной сканирующей калориметрии и исследований в электрическом поле сделан вывод, что вещество образует "закрученную зернограничную" (TGB) фазу $TGBC_A$*, аналогичную абрикосовской фазе в сверхпроводниках. Эта новая фаза существует в интервале между изотропной жидкостью и антисегнетоэлектрической смектикой C*.

1. Introduction

Since their discovery 10 years ago, antiferroelectric liquid crystals have been a subject of great scientific and commercial attention because they offer some close advantages in display technology. Tristable switching in the SmC_A* and especially V-shaped hysteresis-free responses found recently [1], provide an opportunity to achieve grey scale devices with wide viewing angles. Generally, the antiferroelectric phase in liquid crystals is accompanied by a number of sub-phases and frustrated structures. Among the latter, the family of TGB phases is of a special interest, because it manifests itself in a wide range of natural phenomena [3].

The prediction [2, 3] and discovery of the twist grain boundary (TGB) smectic A* phase in the (*S* or *R*)-1-methylheptyl4'-(4-alkoxyphenylpropioloyloxy)biphenyl-4-carboxylates, I [4, 5] led to the unification of phase transitions in liquid crystals with those found for superconductors. Apart from the unification of these two dissimilar physical phenomena, TGB phases have been found to be ubiquitous in the field of self-organising systems with such frustrated phases mediating phase transitions from either the isotropic liquid or the chiral nematic phase to the smectic state [6–8].

Over the past ten years, a number of TGB phases have been identified and characterised. Generally, the structures of TGB phases have been found to be based on those of smectic ones that they either replace or which they form upon cooling. Frustrated equivalents of the smectic A* and C* phases have been found, with both having variants that are dependent on the commensurability or incommensurability of the number of sheets in screw dislocations with respect to the pitch of the phase [9, 10], i.e. rational or irrational number per 360° twist of the helix. For the TGBC modification, a number of sub-phases have been discovered which are dependent on: (i) the presence (TGBC*)