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Liquid Crystalline Behaviour of Dimeric Systems Exhibiting Two Nematic Phases

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The uniaxial, apolar, achiral nematic phase (N), is the simplest and most widely studied liquid crystalline phase. Within this phase the molecules possess orientational order along a unique macroscopic axis, called the directror and being an axis of full rotational symmetry, and no positional order. Recently, a fascinating new nematic phase was detected experimentally in certain types of symmetric liquid crystalline dimers with odd carbon-number alkyl spacers, upon cooling from the conventional nematic phase [1-4]. Under the microscope this low temperature phase displays features of a layered smectic-type structure, however X-ray investigations confirm its nematic character [1]. More interestingly, chiral domain formation associated with a very fast electro-optic response, has also been found in the new phase, although the constituent molecules are nonchiral [1,2]. Current investigations on the commonly termed Nx/tb phase are receiving close review in the field of liquid crystals, as the new mesophase is not yet fully characterized and its structure is a highly debated topic in the literature [5].
In the current contribution we investigate the mesomorphic behaviour of a new class of dimeric difluoroterphenyl systems that undergo the N-Nx/tb phase transition and exhibit a smectic phase at lower temperatures. Mixtures, of the difluoroterphenyl dimers with their corresponding monomer are also studied in order to gain insight on the stability of the phases upon adding a dopant that lacks the Nx/tb.The physical and structural characterization of the new materials are probed via complimentary characterization techniques, such as Polarizing Optical Microscopy (POM), Differential Scanning Calorimetry (DSC) and X-ray Diffraction (XRD). The results are discussed in connection to the rationalization of the structure-properties relationships that prevail the nature of the Nx/tb phase.

References

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