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NMR relaxometry study of liquid crystal dimers exhibiting a peculiar nematic phase

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The liquid crystalline (LC) nematic phase is characterized by the liquid-like short distance positional order of the molecules and long range orientational order, defined by a common average orientation of a specific molecular axis. This is the most widely studied LC phase and actually that of higher technological interest due to its industrial use, mainly in LCD displays. The dimer CB-C9-CB exhibits a weak first order nematic-nematic transition, confirmed by polarising optical microscopy, DSC and X-ray diffraction [1]. The structure of the low temperature nematic, N_x, phase is of significant interest due to the fundamental questions related to the formation of a second nematic phase and due to potential applications such as microsecond switching of such materials [2]. In this work, a proton NMR relaxometry study of the dimeric LC system CB-C9-CB is presented. Spin-lattice relaxation times, T_1, were obtained as a function of Larmor frequency, temperature and angle between the sample alignment reference axis and the static NMR field. These experiments were performed taking advantage of the recent technological improvements introduced in the low power FFC NMR setups [3] combined with standard high field NMR techniques. The relaxation results in the N_x phase, indicate a molecular dynamics behaviour, which is clearly different from that of the standard nematic phase N_u of this and other LC materials. As the molecular dynamics is considerably influenced by the molecular organization within the LC phase, the analysis of the relaxation results contribute to the understanding of the physical behaviour of this system both with respect to fundamental and application aspects.

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