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The Inversion of Helical Twist Sense in Liquid Crystal by Spectroscopy Methods

Authors : Anna Drzewicz, Marzena Tykarska

Abstract : The chiral liquid crystal phases form the helicoidal structure, which is characterized by the helical pitch and the helical twist sense. In anticlinic smectic phase with antiferroelectric properties three types of helix temperature dependence have been obtained: increased helical pitch with temperature and right-handed helix, decreased helical pitch with temperature and left-handed helix and the inversion of both. The change of helical twist sense may be observed during the transition from one liquid crystal phase to another or within one phase for the same substance. According to Gray and McDonnell theory, the helical handedness depends on the absolute configuration of the assymetric carbon atom and its position related to the rigid core of the molecule. However, this theory does not explain the inversion of helical twist sense phenomenon. It is supposed, that it may be caused by the presence of different conformers with opposite handendess, which concentration may change with temperature. In this work, the inversion of helical twist sense in the chiral liquid crystals differing in the length of alkyl chain, in the substitution the benzene ring by fluorine atoms and in the type of helix handedness was tested by vibrational spectroscopy (infrared and raman spectroscopy) and by nuclear magnetic resonance spectroscopy. The results obtained from the vibrational spectroscopy confirm the presence of different conformers. Moreover, the analysis of nuclear magnetic resonance spectra is very useful to check, on which structural fragments the change of conformations are important for the change of helical twist sense.

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