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Positron annihilation in highly ordered smectic E phase of 4-hexyl 4′ – isothiocyanatobiphenyl (6TCB)

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Positron annihilation lifetime spectroscopy (PALS) has been employed for characterization of the local structure in molecular substances such as polymers or liquid crystals. For many liquid crystal forming materials the sensitivity of the positron annihilation parameters to phase transformations has been demonstrated. In such materials not only local microstructure but also molecular dynamics can influence the Ps lifetime and its intensity as it was demonstrated in our studies of supercooled smectic E (SmE) phase of 4TCB [1,2]. The obtained value of *o*-Ps for 4TCB can be explained by formation of Ps bubbles due to a liquid-like state of the butyl chains molecules in the SmE phase and the lamellar structure with nano-segregation of alkyl chains and other parts of molecules proposed by Saito et al. [3].

The present studies were performed for the other member of the nTCB homologous series, i.e. 6TCB. The obtained temperature dependencies of the *o*-Ps lifetime and its intensity for the supercooled SmE phase indicate two processes taking place during heating of the sample. Softening of the glass phase and cold crystallization occurring simultaneously can pose a difficult problem for PALS data analysis and interpretation. The two processes cannot be resolved in PALS measurements as it was in the case of 4TCB thanks to difficult and lengthy crystallization of the latter. The proposed explanation of the obtained dependencies may shed light on the results of previous PALS studies of supercooled liquid crystals reported in the literature.

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