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PHASE TRANSITION IN LANGMUIR LIQUID CRYSTAL FILMS

Several papers devoted to the study of Langmuir–Blodgett films that are fabricated based on liquid crystals have been published recently. The authors point out to changes in the properties of liquid crystal films with a decrease in their thickness. Thus, variations in the properties of such substances are to be expected when turning from "bulk" layers of liquid crystals to Langmuir films. Such changes may be related, first of all, to a decrease in the mobility of liquid crystal molecules in a Langmuir film. Moreover, there is no certainty that a hyperfine film has a mesomorphic phase and phase transition.

A para-tetradecyloxybenzyliden-amino-2-methylbutyl-cyanocinnamate (TDOBAMBCC) liquid crystal, whose "bulk" properties have been studied in detail, was chosen as an object of investigation. The present study is aimed at phase transitions revealing in Langmuir films of liquid TDOBAMBCC crystals. The properties changes are not sharp in hyperfine films with structural defects. It was necessary to study in detail different properties of material in a wide temperature range (including the point of the expected phase transition) in order to reveal the transition and to realize the mechanism of the phase transition. The whole complex of independent methods was applied to study the phase transition in Langmuir films. The methods applied include: measurements of the isotherms of molecule adsorption from a gaseous phase at different temperatures, optical measurements (light reflection and polarization) and electrophysical measurements that were used for explaining the phase transition nature. Probe microscopy was used to study the surface morphology of the samples.

The test objects were films obtained using the Langmuir–Blodgett method based on the Schiff compound of TDOBAMBCC. This compound in the bulk is a ferroelectric liquid crystal (C* smectic) in the temperature range of 54–70°C. Spontaneous polarization is $P_s \approx 10^{-9}$ C cm^{-2}. The chemical formula of TDOBAMBCC is $C_{14}H_{29}O–C_6H_{14}–CH=N–C_6H_4–CH=C(CN)–COO–CH_2C^*-H(CH)_3C_2H_5$. The asterisk marks the carbon

atom that provides the chiral structure of the substance. A dipole momentum inclined with respect to the director is created by the CN group. The films were produced using a TDOBAMBCC solution in chloroform with a concentration of 1–3 10^{-2} wt %. The 30 monolayer TDOBAMBCC films were obtained using the Langmuir–Scheffer method (horizontal lift).

The structural phase transition was revealed at the temperatures about 70 °C in TDOBAMBCC LB-films by the adsorption measurements. The anomaly of the reflected light intensity and polarization at the same temperatures (about 70 °C) evidences not only the structure changes but also the changes in dipole momenta distribution in the film. The capacity measurements in the same temperature range provided more data on the transition nature. The analysis of all data obtained allows asserting that we have observed ferroelectric-paraelectric phase transition. The temperature of the transition is higher than that of the bulk material. This can be due to the high stabilizing effect of the substrate surface onto the thin film. The great length of the phase transition on a temperature scale (ten degrees) points to the sufficiently high system heterogeneity.