

Нанокompозити та наноматеріали

Preparation and electrical studies of nanocomposites based on liquid crystals with Cu₆PS₅I superionic nanoparticles

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Cu₆PS₅I superionic conductors are characterized by high electrical conductivity and can help to extend functional properties of liquid crystals (LC). Therefore, the aim of this work was to study the influence of Cu₆PS₅I nanoparticles on the electrical conductivity of 6CB and 6CHBT liquid crystals.

6CB and 6CHBT LC without/with Cu₆PS₅I nanoparticles was studied in a sandwich-type cell with transparent ITO electrodes. The electrodes were coated with an appropriately processed polymer layer to provide the planar orientation of the LC molecules. The concentration of nanoparticles of a near-spherical shape with the average size of 35 nm in the liquid crystal was 0.01, 0.05, and 0.1 mg/ml. The cell thickness was 10 μm. The LC cell was filled using the capillary method at a temperature by 5–10 K above the nematic-to-isotropic phase transition temperature. The dielectric properties of the prepared sandwich cells were studied in the frequency range 10-10⁶ Hz at 293 K using the oscilloscopic technique.

Frequency dependences of the electrical conductivity for planarly oriented pure 6CB LC as well as for 6CB LC with different concentrations of Cu₆PS₅I nanoparticles are studied in the frequency range 10-10⁶ Hz. A significant difference in the influence of Cu₆PS₅I nanoparticles on the conductivity of 6CB LC and 6CHBT LC is shown. First, contrary to 6CHBT LC, the conductivity of 6CB LC is a monotonous function of the concentration of the Cu₆PS₅I nanoparticles (for the whole range of concentrations the conductivity is observed to increase). Second, for the same values of the Cu₆PS₅I nanoparticle concentration the electrical conductivity changes for 6CB LC are much greater than for 6CHBT LC. An especially significant difference in the electrical conductivity is observed for the intermediate concentration of the Cu₆PS₅I nanoparticles (0.05 mg/ml). In this case the ratio of the 6CB LC and 6CHBT LC electrical conductivities is about 50.