МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
СУМСЬКИЙ ДЕРЖАВНИЙ УНІВЕРСИТЕТ

ФІЗИКА, ЕЛЕКТРОНІКА, ЕЛЕКТРОТЕХНІКА

ФЕЕ :: 2017

МАТЕРІАЛИ
та програма

НАУКОВО-ТЕХНІЧНОЇ КОНФЕРЕНЦІЇ

(Суми, 17–21 квітня 2017 року)

Суми
Сумський державний університет
2017

Electrical conductivity of "liquid crystal – Cu_6PS_5I superionic nanoparticles" composites

Mashiko V.V., *Student*; Studenyak I.P., *Professor*
Uzhhorod National University, Uzhhorod

One of the promising methods to extend the liquid crystal (LC) functionality is introduction of the nanoparticles. Thus, nanoparticles of superionic conductors with argyrodyte structure, in particular Cu_6PS_5I, can help to extend functional properties of LC. They are characterized by high electrical conductivity as well as ferroelastic and nonlinear optical properties. Therefore, the aim of this work was to study the influence of Cu_6PS_5I nanoparticles on the electrical conductivity of 6CB and 6CHBT liquid crystals.

6CB and 6CHBT liquid crystals without/with Cu_6PS_5I 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 crystals 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 $10\text{-}10^6$ Hz at 293 K using the oscilloscopic technique.

It is shown that unlike 6CHBT LC with Cu_6PS_5Inanoparticles the electrical conductivity of 6CB LC with Cu_6PS_5Inanoparticles is a monotonic function of nanoparticles concentration. Moreover the conductivity of 6CB LC with Cu_6PS_5I nanoparticles is much higher than the conductivity of 6CHBT LC at the same concentration of nanoparticles (the maximum value of these conductivity ratios is close to 50 at a concentration of Cu_6PS_5I nanoparticles equal to 0.05 mg/ml). The main reason for such effects is the generation of ions, additional to existing in 6CHBT LC. The existence of additional ions in 6CB LC is confirmed by the presence of two "plateaus" on the frequency dependence of conductivity, which the most typically appear at 0.05 and 0.1 mg/ml concentrations of Cu_6PS_5I nanoparticles.