Dielectric properties of nematic liquid crystal ZLI-2293 filled with TiO_2/Me^{n+} nanoparticles

T. Gavrilko[a], G. Puchkovska[a], V. Shymanovska[a], J. Baran[b], A. Hauser[c], H. Kresse[c]

[a]*Institute of Physics, NASU, 46 Nauki Prosp., 03028 Kyiv, Ukraine*
[b]*Institute of Low Temperature and Structure Research, PAS, 50-950 Wroclaw, Poland*
[c]*Institute of Physical Chemistry, Martin Luther University of Halle, Halle, Germany*

Organic/inorganic composites consisting of different liquid crystal (LC) and oxide nanoparticles are recently intensively studied aiming to obtain materials that find applications in electrooptic devices, nonlinear optical systems, LC display technologies *etc.*

In this report, complex dielectric permittivity and relaxation dynamics in nematic LC ZLI-2293 (Merck, Germany) filled with submicron TiO_2 particles (rutile, pure and modified by adsorption of different transition metal cations - Co^{2+}, Cu^{+}, Fe^{3+}, Cr^{2+}) were studied. The size of the TiO_2 particles was determined by AFM and appeared to be 200–400 nm. Dielectric measurements were made in a frequency range from 10 Hz to 10 MHz with temperature variable from 252 to 368 K. We measured the complex dielectric functions of the samples $\varepsilon^*(\omega) = \varepsilon'(\omega) - i\varepsilon''(\omega)$ with $i^2 = -1$. Measurements of pure and filled LC samples were carried out in a cell where the nematic director is oriented by a magnetic or electric field perpendicular or parallel to the electric measuring field of 1 V. According to FTIR results [1], functional CN groups of the LC are sensitive to the presence of TiO_2 surface active sites, such as surface hydroxyl groups and metal cations. Interaction of the LC molecules with TiO_2 nanoparticles depends on the type of cation adsorbed on TiO_2 surface and results in small increase of the dielectric relaxation time. It was also found that TiO_2 nanoparticles affect not only dielectric losses, but also dielectric permittivity of the system. It can be concluded that interaction of the LC molecules with different surface active sites of inorganic particles causes essential director fluctuation in the near-surface LC layers. The effect of the pure and modified TiO_2 nanoparticles on the dielectric properties of the LC composites is discussed.

This work was supported in part by the National Academy of Sciences of Ukraine under the Program “Nanophysics and Nanoelectronics” (Project No. VC-138).

(1) T. Bezrodna, G. Puchkovska, V. Shymanovska, J. Baran *Mol. Cryst. Liq. Cryst.*, **2004**, *413*, 71-80.