Room Temperature Liquid Crystalline Nanocomposites Studied by Different Methods

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In recent few years ferroelectric liquid crystals (FLCs) have been the subject of intense research due to their potential applications in electro-optic devices. It becomes interesting to study FLCs doped with nanoparticles in order to enhance their physical properties like spontaneous polarization, dielectric permittivity, tilt angle, switching time and so on [1,2].

In scope of this studies, calorimetric, small angle X-ray scattering (SAXS), electro-optic and dielectric measurements of $BaTiO_3$ and TiO_2 nanoparticles dispersed in ferroelectric liquid crystalline matrix will be discussed. It will be demonstrated that a small concentration of nanoparticles greatly affects the performance of the nanocomposites. A ferroelectric liquid crystalline mixture with acronym LAHS9 based on phenyl pyrimidine components was designed. DSC measurements and texture observation allowed to obtain the following phase sequence: Cr. 5.9 ^{o}C SmC* 56.8 ^{o}C SmA* 64.0 ^{o}C Is. As found, doped materials in comparison to the pure FLC showed only a slight difference in transition temperatures. Furthermore, the fan shape texture for SmC* phase has not showed significant differences between pure and doped samples. It may mean that the small concentration of solid particles of the ferroelectric material added to FLC mixture does not disturb the liquid crystalline structure. To substantiate this observation, SAXS measurements were performed to determine the layer spacing in smectic phases of both pure and doped samples.

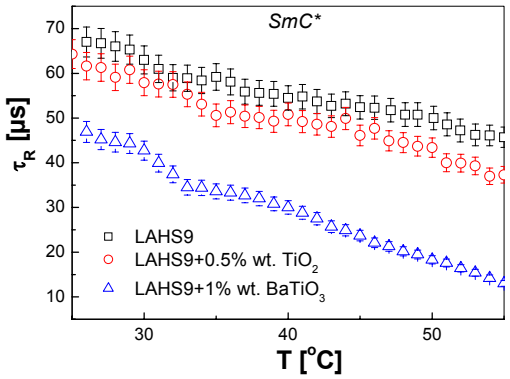

Fig. 1 Rise time versus temperature in SmC* phase

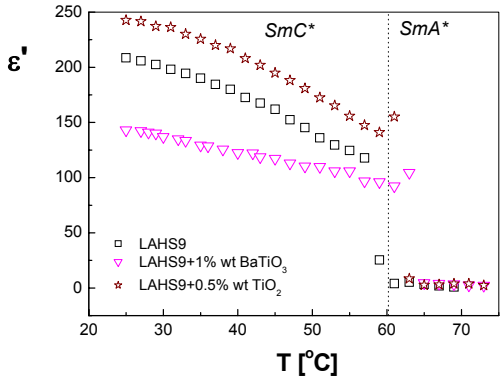

Fig. 2 Relative dielectric permittivity versus temperature taken at 100 Hz

Fig. 1 demonstrates the temperature dependence of the rise time for systems investigated. As seen the nanocomposites exhibit significantly faster response than the pure material. As an additional tool in investigation of the FLC nanocomposites, frequency domain dielectric spectroscopy was used. This method has revealed that the relative dielectric permittivity is lower for the $BaTiO_3$/FLC nanocomposite than for the pure sample (Fig.2), whereas for the TiO_2/FLC suspension dielectric permittivity is higher than for pure mixture. Other physical properties for the aforementioned FLC nanocomposites will also be discussed in detail in this presentation.

References:

(1) S. Kaur, S. P. Singh, A. M. Biradar, A. Choudhary, K. Sreenivas, *Appl. Phys. Lett.* **2007**, *91,* 023120.
(2) J. Prakash, A. Choudhary, A. Kumar, D. S. Mehta, A. M. Biradar, *Appl. Phys. Lett.* **2008**, *93*, 112904