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MODERN METHODS OF STUDYING ELECTRIC AND MAGNETIC FIELD PROPERTIES OF LIQUID CRYSTAL ALLOY COMPOUNDS

Cristina Cirtoaje[1*], Saparov Bagtyyar[2]

[1]*University Politehnica of Bucharest, Bucharest, Romania.*
[2]*Oguz Han Engineering and Technology University of Turkmenistan, Ashgabat, Turkmenistan.*

[*]Corresponding author

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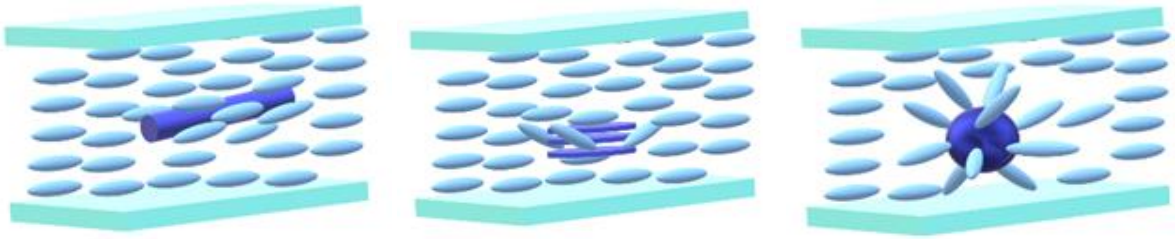
New composite materials obtained by mixing liquid crystals with various microparticles and nanoparticles have become one of the important materials in biomedicine and modern display technologies, including the chemical industry. The use of liquid crystals mixed with dyes, ferromagnetic and ferroelectric particles, carbon-based nanoparticles, etc. on the screens of televisions, computers, and mobile phones helps to capture high-resolution images in a short time [1].

Depending on the size and concentration of the mixture of liquid crystals and nanoparticles, the mechanical (elasticity), electro-optical, and magneto-optical properties of the mixture change under the influence of external electric and magnetic fields and laser rays [2].

When a mixture of liquid crystals is exposed to an external field, the molecules change the direction of their axes in a direction parallel to the field's lines of force. This transition is called the Fréedericksz transition [3]. These transition conditions were determined depending on the intensity of the laser beam applied to the sample and the variation of the external electric or magnetic field. Experiments are also carried out in mixing liquid crystals with various microparticles and nanoparticles.

Due to their soft nature and relatively weak anchoring forces between molecules, the liquid crystal composites can be hardly investigated by any microscopy techniques such as atomic force microscopy (AFM). Thus we can only obtain most part of the information from indirect measurements such as optical transmission, nonlinear optical effects induced by external fields or temperature gradients, Freedericksz transitions or dynamic behavior under any external stimuli.

Figure 1 indicates the orientation of liquid crystals on different nanoparticle's surface.



a) b) c)

Figure 1. LC molecules alignment on nanoparticle's surface: a) carbon nanotube, b) graphene, c) quantum dot

Mixtures of liquid crystals with single-walled carbon nanotubes are used in liquid crystal media. The dependence of the Fréedericksz transition conditions and relaxation times of this

mixture on the variation of the external impact area, particle size, and concentration was studied [1].

Also, the physical properties of multi-walled carbon nanotubes [3], ferroelectric nanoparticles [4], $CoFe_2O_4$ ferromagnetic nanoparticles [5] or nanodiamonds [6], etc. were studied. Experiments were carried out with different sizes and concentrations of these particles.

Currently, in addition to the use of liquid crystals and silver nanoparticles in bio-imaging and quantum computing [7], considering their future use in various fields, the possibilities of studying the properties of liquid crystals through research are great.

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