Influence of the Anisotropy of Magnetic Particles on the Isotropic-Nematic Phase Transition in Liquid Crystal

N. Tomašovičová, V. Gdovinová, V. Závišová, M. Ťmko, N. Ėber, T. Tóth-Katona, J. Jadzyn and P. Kopčanský

1 Institute of Experimental Physics, Slovak Academy of Sciences, Watsonova 47, 040 01 Kosice, Slovakia
2 Institute for Solid State Physics and Optics, Wigner Research Centre for Physics, Hungarian Academy of Sciences, H-1525 Budapest, P.O.Box 49, Hungary
3 Institute of Molecular Physics, Polish Academy of Sciences, 16 Smoluchowskiego str., 60179 Poznan, Poland

Properties of magnetic nanoparticles significantly depend on their size, shape and structure. Doping liquid crystals with nanoparticles (NPs) in low volume concentrations has been shown to be a promising method to modify the properties of liquid crystals. The presence of nanoparticles in liquid crystal changes the existing properties or introduce some new features for the composite mixtures.

Recently a mean-field theory has been developed to describe the influence of embedded nanoparticles on the orientation order and on the isotropic–nematic phase transition of the host liquid crystal [1]. It was shown that spherically isotropic nanoparticles effectively dilute the liquid crystal medium and decrease the isotropic–nematic transition temperature. On the contrary, anisotropic nanoparticles become aligned by the nematic host and, reciprocally, improve the liquid crystal alignment.

Here we report on the experimental justification of some predictions of the above theory. The nematic liquid crystal 4-(trans-4’-n-hexylcyclohexyl)-isothiocyanatobenzene (6CHBT) was doped with spherical and rod-like magnetic nanoparticles. The phase transitions from the isotropic to the nematic phase were observed by polarizing microscope (see figure) as well as by capacitance measurements.

We have found a significant influence of the magnetic particles shape as well as their volume concentration on the temperature of the isotropic-nematic phase transition. Moreover, the obtained results are in accordance with the theoretical expectations described in [1].

Dependence of the isotropic-nematic phase transition temperature on the particles concentration

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* presenting author; E-mail: nhudak@saske.sk