Diluted suspensions of nano-particles in liquid crystals

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The report presents review of the results of the collaboration between Institute of Physics (Kiev, Ukraine), Liquid Crystal Institute (Kent, OH, USA), Kiev Shevchenko University and Martin Luther University (Halle, Germany). We applied the principles of nano-physics to develop advanced composite liquid crystal (LC) systems.

The inclusions in known composite LC systems produce director distortions that extend over macroscopic scales. Our research takes a fresh approach to the development and the study of composite liquid crystals. It is based on the idea of adding low-concentration nano-particles to a LC matrix. At low concentrations, the LC nano-suspensions should possess unique properties. The diluted nano-suspensions are stable, because at these low concentrations the particles only weakly interact. The nano-particles are *so small* that they do not disturb the LC orientation producing macroscopically homogeneous structure. The suspensions appear similar to a pure LC with no readily apparent evidence of dissolved particles. At the same time, the nano-particles are *so large* that they maintain the intrinsic properties of the materials from which they are made (e.g. ferromagnetism or ferroelectricity) and share their intrinsic properties with the LC matrix due to the anchoring with the LC.

We used this approach for the development and study of ferroelectric and ferromagnetic LC suspensions. We present recent experimental results of the studies of ferroelectric and ferromagnetic suspensions as well theoretical models. We found that ferroelectric suspensions possess enhanced dielectric anisotropy and reveal evident ferroelectric and paraelectric properties intrinsic to the imbedded nanoparticles. We also observed unique sensitivity of ferromagnetic suspensions to a magnetic field.

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