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Polarized micro-Raman Study of the impact of Nanoparticle Shape and Concentration on the Nematic Liquid Crystalline Orientational Order

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Abstract:
Liquid Crystals (LCs) exhibit mesophases, which are intermediate between the solid and the liquid state of matter, characterized by unique physical properties such as long range orientational order coupled with anisotropic behaviour. Over the last fifteen years, scientists have shown great interest in liquid-crystalline nanotechnology and serious efforts have been devoted in order to investigate the interactions between liquid crystalline molecules and nanoparticles.

In order to explore the impact of nanoparticles of different shapes upon the nematic orientational order, we report measurements of the temperature dependence of Raman depolarization ratios in the nematic phase of the liquid crystal 5OP8OB (4-Pentyloxyphenyl-4'-Octyloxybenzoate) made of uniaxial rod-like molecules, doped with spherical hydrophobic semiconducting quantum dots CdSe-ZnS and also with hydrophobic Perfluorinated Silica Nanoplates. Both systems have been studied for various weight-concentrations. The measurement of the orientational order has been achieved by the determination of the first two expansion coefficients of the orientational distribution function, known as order parameters $\langle P_2 \rangle$ and $\langle P_4 \rangle$. The order parameters have been calculated by the Raman depolarization ratios in a direct way, since the polarized Raman spectra provided information on the macroscopic symmetry of the nanocomposite materials.

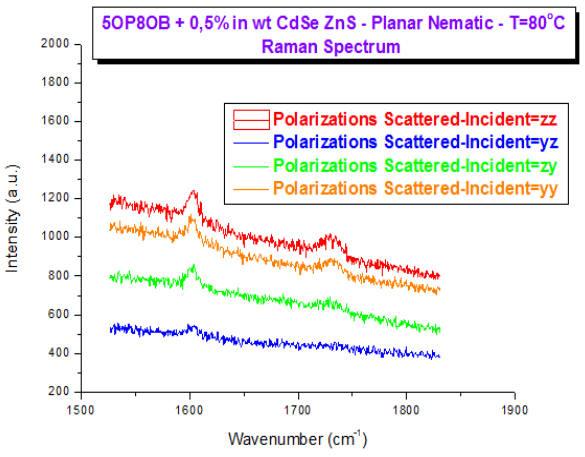

Fig.1: Polarized & Depolarized Raman Spectra of the Nanocomposite Nematic 5OP8OB with 0,5 % in wt CdSe-ZnS quantum dots at 80°C, (z -direction: parallel to the molecular axis of symmetry, y direction: perpendicular to the molecular axis of symmetry)

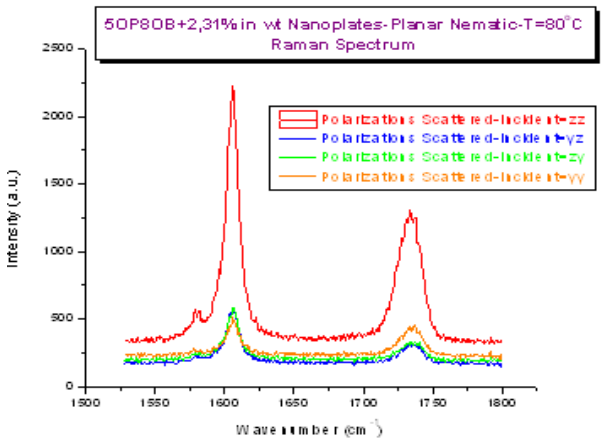

Fig.2: Polarized & Depolarized Raman Spectra of the Nanocomposite Nematic 5OP8OB with 2,3 % in wt Perfluorinated Silica Nanoplates at 80°C,(z -direction: parallel to the molecular axis of symmetry, y direction: perpendicular to the molecular axis of symmetry)

The analysis and the evaluation of our experimental measurements performed by a polarized micro-Raman technique, show that both, shape and nanoparticle concentration have a critical impact on the nematic liquid crystalline order.