Influence of the size and the attached organic tail of modified diamond nanoparticles on the physical properties of liquid crystals

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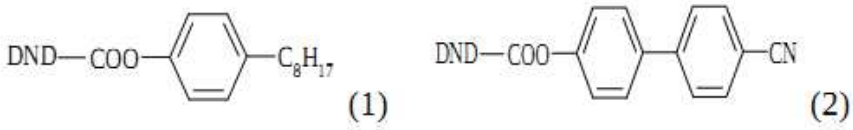
A lot of different kind of nanoparticles have been prepared and investigated during recent years. Diamond is one of the most popular materials which can exist in the form of nanoscale particles too. Special class of nanodiamond material with characteristic sizes of 4 to 5 nm, often called in the literature “ultradispersed diamond” (UDD) or “detonation nanodiamond” (DND), were produced by detonation of carbon-containing explosives [1]. The resulting conglomerates formed by nanoparticles ranged from 50 to 100 nm. Three major steps in the conversion of carbon-containing explosives to modern DND products include synthesis, postsynthesis processing, and modification.

For functionalization of DND, we attached via grafting a carboxylate group leading to only one carboxylate group at 5000-6000 carbon units. Via ozonolysis carbon atoms at the surface of the DND could be transferred in different steps to further carboxylate groups resulting in an increase of those by a factor 2-3. Activation of-COOH surface functional groups allowed the attachment of different organic tails as can be seen below:



Dielectric and electro-optical properties of nematic liquid crystalline mixtures (LCMs) doped with diamond nanoparticles have been investigated. It is established that the effect of DND on the dielectric properties depends on the size of nanoparticles and type of tails like organic molecules. It was found that nanoparticles of small size 4 to 5 nm do not significantly affect on the parameters of LCMs. At the same time, the conglomerates on the basis of nanoparticles (50-100 nm) depending on the polarity of the tails could increase or decrease the dielectric anisotropy (see Fig.1) and the response time of LCMs by 20-30%. Mixture NLC-1 contains varying amounts of nanoparticles 1 and mixture NLC-2 contains varying amounts of nanoparticles 2.

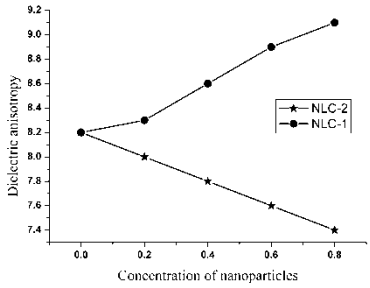


Fig.1. Dependence of the dielectric anisotropy of LCMs on the concentration and type of DND.

References

1. O.A. Shenderova, V.V. Zhirnov and D.W.Brenner, Carbon nanostructures, *Crit. Rev. Solid State Mater. Sci.*, 27, 227 (2002).