Nanocomposites and nanomaterials

Effects of inorganic particles based on carbon nanotubes on photoluminescence properties of 5CB nematic liquid crystal

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Recently, the unique properties of carbon nanotubes (NT) such as self-organization and formation of connected networks are of great interest. Nanocomposites, containing NT, are widely used as conductive functional materials, electrical switchers, gas and pressure sensors, etc. Use of organic insulator matrix filled with conductive NT allows to create the composite materials with improved thermal or electrical characteristics. In addition, doping of liquid crystals by carbon NT results in a decrease of the driving voltage and the response time of electro-optic devices.

However, NT forms large clusters in organic media, not allowing produce homogeneous systems and impairing electrical or thermal material characteristics. This problem is regulated by introduction of electrically inactive clay filler (organomodified montmorillonite (OMMT)) that has higher affinity for dispersing medium than NT themselves. Addition of OMMT particles significantly enhanced the composite structure homogeneity resulting in the increasing electrical conductivity in more than one order of magnitude.

This work deals with the investigations of photoluminescence properties of 5CB nematic liquid crystal in the composites, based on carbon nanotubes and hybrid nanoparticles, consisted of NT and OMMT platelets. Photoluminescence of the 5CB+NT composite was shown to be characterized by excimer emission of 5CB molecules. Addition of NT to liquid crystal media results in significant decrease of photoluminescence intensity, but does not practically affect structural alignment of the organic bulk. Hybrid particles NT–OMMT form a homogeneous coagulation network in the composite with 5CB and considerably distort nematic structure of the liquid crystal. The appearance of 5CB molecule twisted conformations, typical of liquid crystal monomers, is observed. Presence of the mentioned 5CB conformers in the system, and also weaker interactions between the liquid crystal molecules and inorganic filler explain photoluminescence intensity growth of the 5CB+NT–OMMT composite, compared with the corresponding characteristics of initial liquid crystal substance.

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