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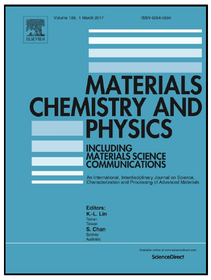


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# Lyotropic liquid crystal based on Zinc Oxide nanoparticles obtained by microwave solvothermal synthesis

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## Absract

The ZnO nanoparticles, obtained by microwave solvothermal synthesis, were used for the liquid crystal phase preparation. The structure of the material was investigated by X-ray diffraction (XRD), helium pycnometry, specific surface area (SSA), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM). The stability of aqueous suspensions was monitored by Multiple Light Scattering (MLS) technique and the average agglomerate size in suspensions was obtained by dynamic light scattering (DLS) technique. The lyotropic columnar hexagonal phase was formed by doping ZnO nanoparticles into the cetylpiridinium chloride/water/hexanol system. The structure of this phase was confirmed by x-ray diffraction. The luminescent properties of the LC phase were compared with properties of ZnO nanoparticles isolated in solution and analogues lyotropic system without nanoparticles.

Keywords: luminescence, oxides, organic compounds, x-ray scattering, optical properties, nanostructures.

## 1.Introduction

The adding of the nanoparticles to the liquid crystal (LC) host is one of the methods to obtain hybrid materials with electro-optical, electric and dielectric properties. This is done by dispersion of nanotubes, new photonic and electronics materials were tested [1] [2]. The concentrations of nanoparticles less than 0.1(wt)% in LC host leads to nonlinear optical effects, that can be applied in designing electro-optical devices [3-5]. There are a lot of techniques for dispersing nanotubes in aqueous suspensions. Some of these techniques are developed and discussed by authors in [6-9]. The covalent side wall functionalization, ions and surfactants are usually used to prevent agglomeration and sedimentation processes in the aqueous media, and thus they stabilize the dispersed nanoparticles [8, 10, 11].

Zinc oxide (ZnO) is the compound with wide bandgap (3.4 eV) and high bond energy (60 meV). Whereas a stable wurtzite structure of ZnO with lattice spacing, when a = 0.325 nm and c = 0.521 nm, causes a mechanical and thermal stability at room temperature. This is used in engineering light emitting devices, ultraviolet (UV) light emitters, piezoelectric devices, chemical sensors, solar cells and transparent electronics [12, 13]. Because of the unique luminescent properties ZnO is an additive in commercial paints. Since zinc oxide was categorized as a non-toxic material it is also widely used in numerous cosmetics and medicine products including lubricants and ointments. According to [14] there is no evidence of carcinogenicity, genotoxicity and reproduction toxicity on humans, like eye or skin chafing. ZnO nanoparticles. Due to their good biocompatibility and low cost, have shown promising potential applications in bioimaging and drug delivery [15]. Coagulation, aggregation and sedimentation processes prevent the dispersion of nanoparticels in liquid crystal host. There is a strong evidence that ZnO nanoparticles might enhance luminescent properties of the liquid crystal phase. Luminescent properties of birefringent aqueous suspension in combination with biocompatibility might find an application in medicine, cosmetics or biosensing technology.

Here we report the first successful formation of lyotropic surfactant liquid crystal, using the zinc oxide nanoparticles. There is a large variety of methods for synthesis of ZnO nanoraticles