Liquid Crystalline-ZnO Nanoparticle Hybrids

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ZnO is a well known wide-gap semiconductor with a band-gap value of 3.37 eV displaying luminescent properties in the near UV and visible regions of the spectrum.[1] Such nanoparticles (NPs) are highly interesting in the manufacture of electronic and photonic devices.[2,3] Combining ZnO NPs and liquid crystals (LCs) may lead to new hybrids with unique properties and controlled organization.[4,5] To elaborate such materials two strategies can be envisaged; a) combining preformed ZnO NPs with a compatible LC and b) the *in-situ* growth of NPs inside the liquid crystalline host. We have developed both strategies using the thermotropic liquid crystal 4'-(6-aminohexyloxy) biphenyl-4-carbonitrile ($6OCBNH_2$) as host and obtained new organic/inorganic organized materials. The general synthesis of ZnO NPs is being carried out *via* a straight forward organometallic method previously reported by our group. [6]

First strategy involved the mixing of a solution of OA-protected ZnO nanoparticles with a solution of $6OCBNH_2$. The ligand exchange was confirmed by ^{1}H-NMR and DOSY experiments. Dispersion of these NPs in $6OCBNH_2$ did not disrupt the mesomorphic behaviour of the latter as proven by DSC and POM. The combination of ZnO NPs and $6OCBNH_2$ in solution does not quench the optical properties of any of the components and we therefore obtain a hybrid material that exhibits interesting emission properties in the UV region of the spectrum.

The second strategy was the direct synthesis of ZnO NPs in $6OCBNH_2$. This has resulted in the formation of well dispersed spherical nanoparticles of an average diameter of 5 nm. The formation of ZnO inside the LC host had no unfavourable effects on the luminescent properties of ZnO. Emissions corresponding to a variety of regions in the visible spectrum, depending on excitation wavelength, were observed. The *in-situ* growth of ZnO NPs in LC mixtures ($6OCBNH_2$/5CB) is currently being investigated.

To our knowledge we have developed novel liquid crystal hybrid materials containing ZnO NPs. Besides their interesting optical properties, we have the possibility to control the organization of particles using the alignment properties of the LC.

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