Alignment of Single Wall Carbon Nanotubes in a chromonic liquid crystal

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Single Wall Carbon Nanotubes (SWNTs) display remarkable anisotropic features (mechanical, optical and conductivity properties). Exploiting them at a macroscopic scale in composite materials requires both a good dispersion of individual tubes and a control of their orientational order at a large scale. The use of a liquid crystal as a structured solvent for aligning the tubes is attractive and several studies have already examined the dispersion of SWNTs in thermotropic or lyotropic liquid crystals. Dispersing the nanotubes at an individual scale is however not straightforward in organic solvents (and in thermotropic liquid crystals) where bundles and a reaggregation are usually observed. The use of lyotropic liquid crystals is then favored since excellent SWNTs dispersions are usually achieved in water with surfactants and strong sonication. The large amount of amphiphilic molecules however may destabilize the SWNTs, severely limiting the amount of doping. An accurate study of the orientation of individual nanotubes in a LC is therefore still an open challenge.

In this work, we used Disodium Chromoglycate (DSCG), a chromonic liquid crystal (LCLC) to disperse a large SWNT concentration (more than 0.1 %) in an aqueous nematic phase. We characterized the quality of the dispersions using the strong photoluminescence, characteristic of individual tubes only. The doped nematics and their orientation were studied by polarizing microscopy, polarized Raman and photoluminescence spectroscopies. In aligned cells, both photoluminescence and Raman signals were shown to be extremely polarized with typical polarization ratios of a few tens. A quantitative approach [1,2] allowed us to determine accurately the order parameter of the tubes, which was found to be in the range 0.9-1. We will discuss the origin of such an high value.

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