Making the most of carbon nanotube-liquid crystal combos

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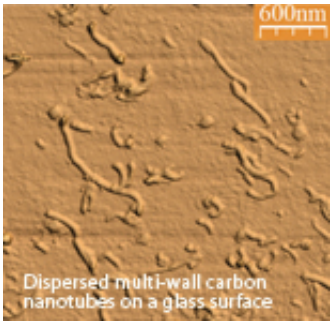

Dispersions of carbon nanotubes with liquid crystals have attracted much interest because they pave the way for creating new materials with added functionalities. Now, a study published in *European Physical Journal E* by Marina Yakemseva and colleagues at the Nanomaterials Research Institute in Ivanovo, Russia, focuses on the influence of temperature and nanotube concentration on the physical properties of such combined materials. These findings could have implications for optimising these combinations for non-display applications, such as sensors or externally stimulated switches, and novel materials that are responsive to electric, magnetic, mechanical or even optical fields.

The added functionalities of these compound materials are achieved by combining the self-organisation of a liquid crystal with the characteristics of nanotubes, which exhibit a major difference in electric

and thermal conductivity between their long and short axis. In this study, the authors focused on the electro-optic and dielectric properties of ferroelectric liquid crystal-multiwall carbon nanotube combinations.

Specifically, they studied the influence of temperature on the compound material's main physical properties, such as tilt angle, spontaneous polarisation, response time, viscosity, and the strength and frequency of its dielectric relaxation. They found that all dispersions exhibit the expected temperature dependencies with regard to their physical properties.

They also investigated the dependence of physical characteristics on nanotube concentration, which is still the subject of several contradicting reports. For increasing nanotube concentration, they observed a decrease in tilt angle, but an increase in spontaneous polarisation. This phenomenon explains the enhancement of the so-called bilinear coupling coefficient between tilt angle and spontaneous polarisation. Despite the increase in polarisation, the electro-optic response times slow down, which suggests an increase in rotational viscosity along the tilt cone. This phenomenon also accounts for the observed decrease in dielectric relaxation frequency for increasing nanotube concentration.

More information: M. Yakemseva, I. Dierking, N. Kapernaum, N. Usoltseva, F. Giesselmann (2014), Dispersions of Multi-wall Carbon Nanotubes in Ferroelectric Liquid Crystals, *European Physical Journal E* 37: 7, DOI: 10.1140/epje/i2014-14007-4

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