Dielectric spectroscopy of an aerosil dispersed smectic cyanobiphenyl

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The dielectric study of aerosil dispersed liquid crystals has shown that both surface and disorder effects stem from the presence of these network-forming nanoparticles [1]. As most results available focus on the nematic phase, we chose in this work to study nonylcyanobiphenyl (9CB), which has a smectic phase.
The interaction with the surface results in a retarded molecular relaxation, showing up as an additional low frequency process. This relaxation is seen in 9CB in the liquid and both liquid crystalline phases.
The ratio of the dielectric strengths of the two higher frequency relaxation processes in the nematic phase is used as a measure for the order in a sample. This approach can be used for the cyanobiphenyls, for which the dipole moment is mainly along the long molecular axis. Comparison of the ratio for bulk samples and aerosil dispersions shows that the aerosil dispersions are disordered, even in the presence of a strong external aligning field.
The effect of disorder can also be seen in the relaxation times in the liquid crystalline phases of 9CB. Comparison of the relaxation times shows an acceleration of the short axis relaxation in aerosil dispersed liquid crystals. This is attributed to the disturbance of the nematic order by the aerosil network. The sample appears somewhat more isotropic-like and the relaxation process evolves in the direction of the faster relaxation in the isotropic phase [1,2].
Finally, a smaller acceleration has been found in the isotropic phase of cyanobiphenyls, which we have attributed to the disturbance of the dipole-dipole interaction of these association liquid crystals [3]. We verified this for 9CB.

(1) J. Leys, C. Glorieux, J. Thoen, J. Phys.: Condens. Matter **2008**, *20*, 244111
(2) G. Sinha, J. Leys, C. Glorieux, J. Thoen, Phys. Rev. E **2005**, *72*, 051710
(3) J. Leys, C. Glorieux, J. Thoen, Phys. Rev. E **2008**, *77*, 061707