Magnetic Field Induced Isotropic-Nematic Transition in Ferronematics Based on a Bent-Core Mesogen

P. Kopčanský[1,*], N. Tomašovičová[1], M.Timko[1], V. Závišová[1], N. Éber[2], T. Tóth-Katona[2], K. Fodor-Csorba[2], A. Vajda[2], J. Honkonen[3] and X. Chaud[4]

[1] *Institute of Experimental Physics, Slovak Academy of Sciences, Watsonova 47, 040 01 Kosice, Slovakia*
[2] *Institute for Solid State Physics and Optics, Wigner Research Centre for Physics, Hungarian Academy of Sciences, H-1525 Budapest, P.O.Box 49, Hungary*
[3] *Department of Physics, Helsinki University, Helsinki, Finland*
[4] *High Magnetic Field Laboratory, CNRS, 25 Avenue des Martyrs, Grenoble, France*

Recently, a consistent molecular mean-field model has been developed by Raikher et al. for the field-induced shift of the temperature of the equilibrium isotropic-nematic (IN) phase transition (clearing point) in ferronematics [1]. It has been shown that depending on the anchoring conditions on the particle surface, the particles might either increase or decrease the clearing temperature of the suspension and that the expected range of the effect depends on the material parameters of the ferronematic.
In our previous work [2] we have proven that ferronematics composed of calamitic liquid crystals and rod-like magnetic nanoparticles can be just as effective in demonstrating the magnetic field induced isotropic-nematic phase transition as undoped bent-core nematics [3]. The magnetic field for the induction of IN transition was in range of 10 T while for pure calamitic liquid crystals magnetic fields of order of 100 T are required as simple thermodynamic model predicts [2].

In the presented work we investigate the influence of an external magnetic field on the isotropic-nematic phase transition temperature of the bent-core 4,6-dichloro-1,3-phenylene bis (4'-(10-undecenyloxy) biphenyl-4-carboxylate, - 11DClPBBC) liquid crystal doped with spherical magnetic particles of various volume concentration. The obtained results show for example a very big reduction of the critical field of the magnetic Freedericksz transition from 1.05 T to 0.36 T due to doping (for volume concentration 2×10^{-4} and thickness of sample D=5 μm). We induced IN phase transition by means of magnetic field up to 10 T also. Moreover, the experimental results justify the theoretically predicted negative shift in the temperature of the IN phase transition too. The measured quadratic behaviour of shift of IN phase transition temperature was explained by means of mean field model as well as simple thermodynamic model in paper [2].
This work was supported by project VEGA 0045, the Slovak Research and Development Agency under the contract No. APVV-0171-10, the Ministry of Education Agency for Structural Funds of EU in frame of projects 26220120021, 26220120033 and 26110230097, the Grenoble High Magnetic Field Laboratory (CRETA), the Hungarian Research Fund OTKA K81250, and the EU M-era.Net - MACOSYS.

References:
[1] Y.L. Raikher, V.I. Stepanov and A.N. Zakhlevnykh, *Mean-field description of the order–disorder phase transition in ferronematics*, Soft Matter 9, 177 (2013)
[2] P. Kopčanský, N. Tomašovičová, M. Koneracká, V. Závišová, M. Timko, M. Hnatič, N. Éber, T. Tóth-Katona, J. Jadzyn, J. Honkonen, E. Beaugnon, X. Chaud, *Magnetic-Field Induced Isotropic to Nematic Phase Transition in Ferronematics*, IEEE T. Magn. 47, 4409 (2011).
[3] T. Ostapenko, D. B.Wiant, S. N. Sprunt, A. Jákli, and J.T. Gleeson, *Magnetic-Field Induced Isotropic to Nematic Liquid Crystal Phase Transition*, Phys. Rev. Lett. 101, 247801 (2008).

* presenting author; E-mail: kopcan@saske.sk