52. Däitsch Konferenz iwwer Flëssegkristallen
52. Deutsche Arbeitstagung Flüssigkristalle
52nd German Liquid Crystal Conference
University of Luxembourg, Belval Campus
Esch-Uelzecht (LU), 08–10 April 2026
GLCC2026

Influence of goethite nanorods on the electro- and magneto- optical behavior of cholesteric liquid crystal

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The precise control of self-assembled functional superstructures in liquid crystals (LCs) represents a fundamental challenge in modern soft matter physics. While cholesteric liquid crystals (CLCs) are intrinsically responsive to external stimuli, their sensitivity to magnetic fields is frequently constrained by the low diamagnetic anisotropy of the constituent molecules [1]. This limitation hinders the efficient magnetic tuning of the helical pitch and the associated photonic bandgap. In this study, we present a ferro CLC system designed to overcome these constraints. The matrix consists of the nematic LC E7 doped with a chiral agent (CB15) in the concentration range of 0.8–1.2 vol.%, inducing a stable helical arrangement. To enhance field responsiveness, goethite (α-FeOOH) nanorods were incorporated at a volume fraction of 10^{-3}. These nanoparticles are characterized by a high aspect ratio, a permanent magnetic moment along their long axis, and a unique field-induced magnetic moment directed orthogonally to the rod [2]. Obtained results demonstrate that goethite nanoparticles significantly modify the helical unwinding dynamics. We observed a consistent shift in the critical field strengths required for helical distortion in doped systems compared to pure CLC matrices (Fig. 1). This shift confirms a robust orientational coupling between the goethite nanorods and the LC director. Our findings highlight the potential of nanoparticle doping for the development of high-sensitivity electro- and magneto-controlled switches and next-generation sensors, where structural self-assembly can be manipulated with high precision at room temperature.

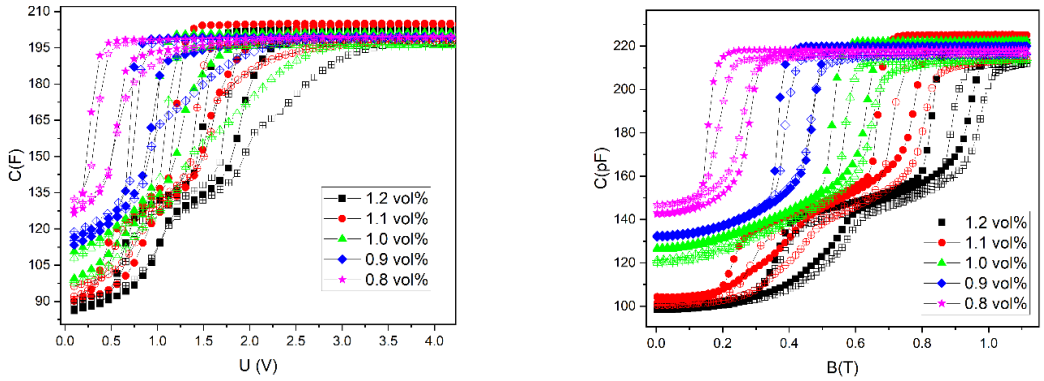

Fig. 1 *Electric and magnetic field dependence of the capacitance for undoped (solid symbols) and goethite-doped (open symbols) cholesteric liquid crystals at varying CB15 concentrations.*

References

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Acknowledgments

This work was funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I03-03-V04-00298. D. A. Petrov's contribution to this work was supported by Ministry of Science and Higher Education of the Russian Federation (Project No. FSNF-2024-0001).