

# Electro- and magneto-orientational coupling and helical unwinding in ferrocholesteric nanocomposites doped with $\alpha$ -FeOOH nanorods

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The ability to control the self-assembly of functional superstructures in liquid crystals is an important aspect of modern soft matter physics. While cholesteric liquid crystals (CLC) are known for their responsiveness to external stimuli, their sensitivity to external fields—particularly magnetic ones—is often limited by the small diamagnetic anisotropy of the host molecules [1]. This inherent constraint complicates the magnetic control of CLC helical pitch and, consequently, the tuning of their photonic bandgap. To overcome this obstacle, we investigate a ferro-cholesteric system exhibiting significantly enhanced magneto-responsiveness. The composite material consists of a nematic E7 matrix doped with a chiral agent (CB15) and functionalized with goethite ( $\alpha$ -FeOOH) nanorods at a volume fraction of  $10^{-3}$ . Goethite ( $\alpha$ -FeOOH) nanoparticles (NPs) are of particular interest due to their unique magnetic architecture as they possess a permanent magnetic moment along their longitudinal axis and a field-induced moment which is directed orthogonally [2]. Our results indicate that these nanorods act as efficient magnetic transducers, mediating a robust orientational coupling with the LC director. We provide a detailed analysis of the helical unwinding under varying field strengths, observing a distinct shift in the critical fields required for structural distortion compared to undoped matrices. These findings suggest that the interplay between the nanoparticle magnetic moments and the chiral matrix allows for highly sensitive, room-temperature control of photonic bandgaps, offering a viable route for the development of advanced magneto-controlled optical switches and sensors.

## References:

[1] F. Brochard and P. G. de Gennes, *Journal de Physique* 31 (1970) 691

[2] B. J. Lemaire, et al., *Physical Review Letters* 88 (2002) 125507

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