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

Colloidal Liquid Crystals based on End-Tethered Cellulose Nanocrystals

Justin O. Zoppe[1,*]

[1] *Materials Interfaces & Colloid Engineering Group (INTERCOLL), Department of Materials Science & Engineering, Universitat Politècnica de Catalunya (UPC), Carrer de Colom 11, 08222 Terrassa, Spain*

**Corresponding author e-mail: justin.zoppe@upc.edu*

Cellulose nanocrystals (CNCs) are intriguing nanomaterials due to both their outstanding thermomechanical properties and their ability to self-assemble into cholesteric liquid crystal (LC) phases [1]. Their lyotropic LC phases are further preserved in solid films upon evaporation-induced self-assembly, generating photonic properties with feature sizes interacting in the UV-visible region. CNCs prepared from cellulose I allomorphs (CNC-I) have a right-handed twist along their longitudinal axis, which typically favors the formation of left-handed LC phases. Recent work has shown that CNCs prepared from cellulose II allomorphs (CNC-II) exhibit left-handed twists and can form right-handed LC phases [2]. While the forces governing CNC assembly include entropy, van der Waals attraction and electrostatic repulsion due to anionic surface charges, the reducing end groups (REGs) of cellulose chains provide a unique opportunity to tune their LC phases via steric repulsion or even depletion forces through the grafting of end-tethered polymers [3]. Inspired by theoretical descriptions of symmetric and asymmetric nanorods with end-tethered polymers [4], we present our work on the synthesis and self-assembly of polymer end-tethered CNC allomorphs produced from plant sources. These materials are produced by a combination of crystal allomorph transformations and reducing end group (REG) modification with hydrophilic polymers [5]. In addition to CNC-I with parallel chain arrangements, we apply Mercerization of cellulosic fibers, followed by acid hydrolysis, to produce CNC-II with anti-parallel chains. Through treatment of CNCs with ethylenediamine, we further generate CNC-III allomorphs. We highlight our recent work on the grafting of polyethylene glycol analogues onto the REGs of CNC allomorphs (see Figure 1), to correlate building block morphology to LC phase characteristics. Polymer end-tethered CNC allomorphs offer a promising platform for assembling inorganic nanomaterials for heterogeneous enantioselective catalysts, chiral plasmonics and chiral sensing applications.

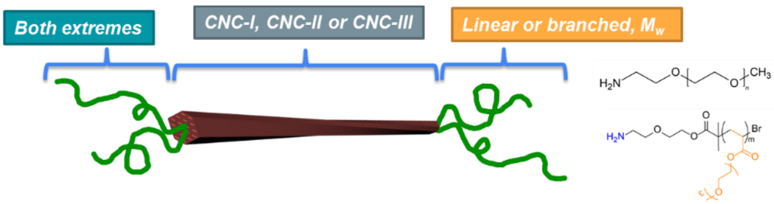

Figure 1. Illustration of a polymer end-tethered cellulose nanocrystal allomorph with building block variables and end-tether chemical structures.

References

[1] B. Frka-Petesic, T.G. Parton, C. Honorato-Rios *et al*, *Chemical Reviews* **123**, 12595-12756 (2023).
[2] L. Wei, L. Zhou, P. Chen *et al*, *ACS Nano* **19**, 42941-42950 (2025).
[3] J.O. Zoppe, *Acc. Mater. Res*. **5**, 385-391 (2024).
[4] L. He, L. Zhang, Y. Ye *et al*, *J. Phys. Chem. B* **114**, 7189-7200 (2010).
[5] G. Delepierre, H. Traeger, J. Adamcik *et al*, *Biomacromolecules* **22**, 3552-3564 (2021).

Acknowledgments

This work was supported by the European Research Council (ERC) under grant agreement No. 101087368 (https://doi.org/10.3030/101087368).