Cholesteric self-assembly of a cellulose nanocrystal suspension in a shrinking microdroplet

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Cellulose Nanocrystals (CNCs) are biosourced, colloidally stable elongated nanorods that form chiral nematic liquid crystals above a threshold concentration. Their cholesteric order can be retained upon drying to form chiral nanostructures that can display structural color. Inspired by the helicoidal architectures found in the plant cell wall,[1] we report the self-assembly of cellulose nanocrystals (CNC) into hierarchical cholesteric architectures within micron-sized aqueous droplets.[2] This confined, spherical geometry drastically affects the colloidal self-assembly process, resulting in concentric ordering within the droplet, as confirmed by simulation. This provides a quantitative tool to study in situ the pitch evolution upon concentration increase beyond what has been achieved in a planar geometry. This methodology allows us to fabricate truly hierarchical solid-state architectures, from the nanometre to the macroscopic scale using a renewable and sustainable bio-polymer.

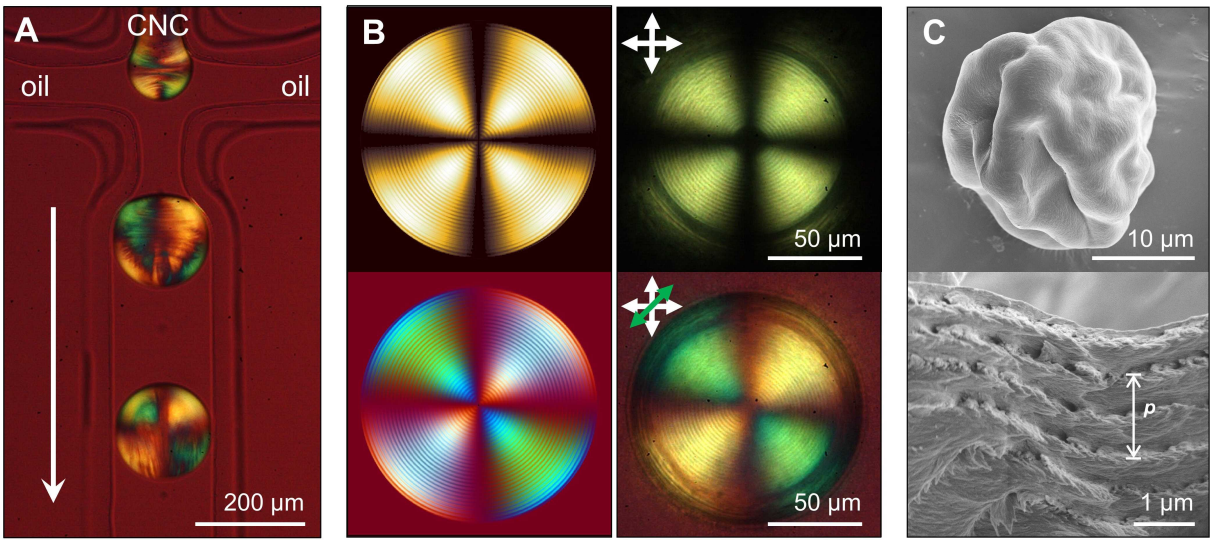

Figure: (A) Polarization optical micrograph of the generation of microfluidic droplets containing cellulose nanocrystals (CNC). (B) Comparison between the theoretical (left) and experimental (right) assembly of the cholesteric CNC suspension within a microdroplet. (C) SEM images of a dry CNC microparticle (top), showing the helicoidal assembly of CNC within the particle (bottom).

References

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