Dynamically controlled iridescence of cellulose nanocrystal assemblies with electric field

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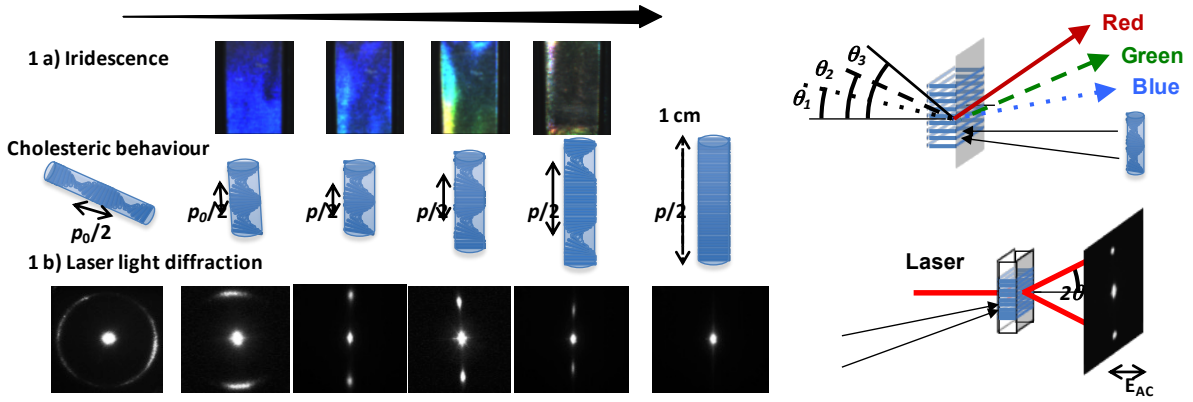
Natural structures are often made of hierarchically organized assemblies of nanometric elements, with precise functions, like the helicoids in the iridescent beetle shells. Cellulose nanocrystals (CNCs), isolated e.g. by sulphuric acid hydrolysis from cellulosic fibers, are one of the typical model of chiral nanorods with dimensions of 2-50 nm in diameter for up to several microns in length depending on their biological origin [1]. When dispersed in apolar solvents using surfactants, CNCs spontaneously phase-separate into chiral nematic structures, but at much higher concentrations than in those already observed in aqueous media. The chiral pitch decreases to a few microns, revealing a stronger chiral interaction [2] and beautiful iridescent colors in suspension.

Additionally, CNCs can be oriented by relatively modest electric fields [3]. Recently, we also showed that these colloids bear a permanent dipole as high as 4000 Debye [4]. Combining this orientation features with the self-organization properties, we showed that it is not only possible to orient the cholesteric domains, but also to unwind the cholesteric axis to any desired pitch value as shown by laser light diffraction and iridescence. These spectacular features allow the controlled production of iridescent substrate with tailored properties, and even a dynamical control of the orientation.



References

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