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Ph.D. thesis (2020-2023)
LGP2 (A. Dufresne; C. Sillard)

Polysaccharide-based materials for structural pigments

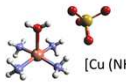
Production de pigments structurels biosourcés

I. Colors

Where does color come from ?

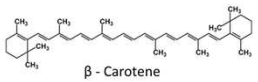
From chemistry :

- Metal coordination complex

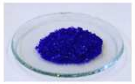


$[Cu(NH_3)_4]SO_4 . H_2O$

- Aromatic / unsaturated molecules



β - Carotene



orbitals d

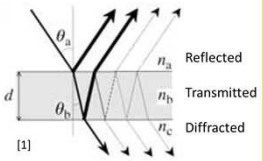
$E = h/\lambda$

orbitals π, π*

From physics :

There are **constructive interferences**, meaning **maximal reflection**, if :

$$2n_b d\cos\theta_b = m\lambda \quad [1]$$



Thin film is the most simple model of interference

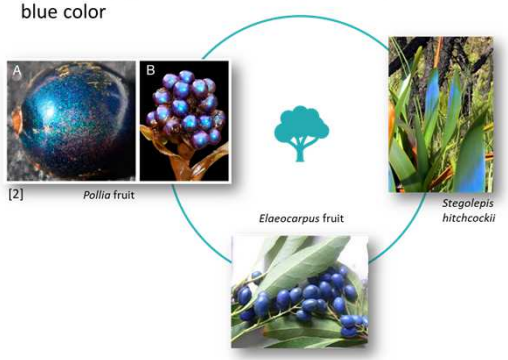
Color **changes** with **viewer angle** and **thickness**

[1] : Kinoshita et Yoshioka, « Structural Colors in Nature ».

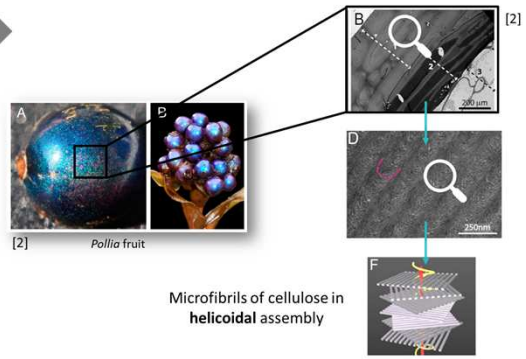
II. Cellulose

How cellulose is related to color in Nature ?

- **Structural** pigments are used by **plants** to produce **iridescent** blue color



And these structural pigments are based on nanocellulose's organizations

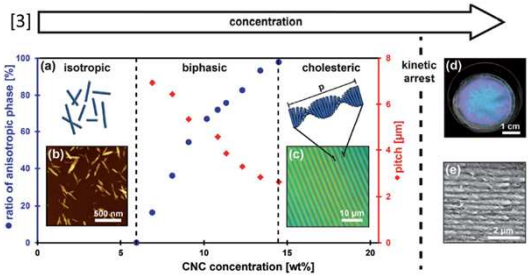


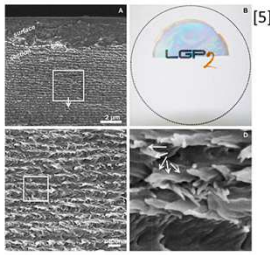
- **Pattern periodicity** allows Bragg diffraction and **iridescent** colors

[2] : Vignolini et al., « Pointillist Structural Color in Pollia Fruit ».

III. Structural pigments

Iridescent films of CNCs have already been made





[3] : Parker et al., « The Self-Assembly of Cellulose Nanocrystals ».
[5] : Bardet et al., « Engineered Pigments Based on Iridescent Cellulose Nanocrystal Films ».

But what about non-iridescent structural colors ?

This is the purpose of this PhD

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