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

# Polysaccharide-based materials for structural pigments

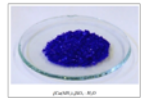
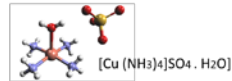
Production de pigments structurels biosourcés

## I. Colors

Where does color come from ?

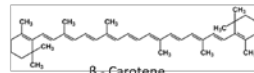
From chemistry :

- Metal coordination complex



orbitals d

- Aromatic / unsaturated molecules



$$E = h/\lambda$$

orbitals  $\pi, \pi^*$

From physics :

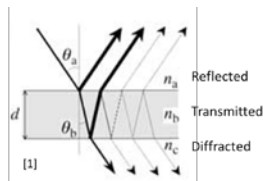


There are **constructive interferences**, meaning **maximal reflection**, if :

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

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

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

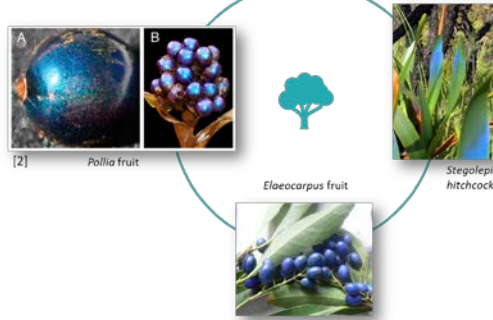


Thin film is the most simple model of interference

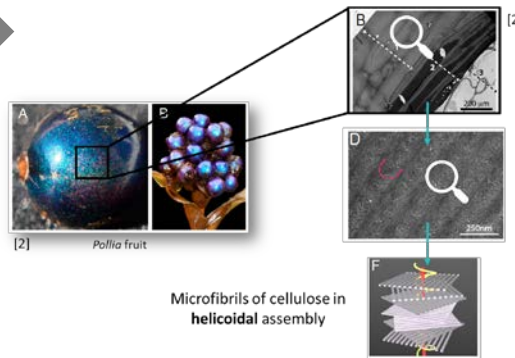
## II. Cellulose

How cellulose is related to color in Nature ?

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



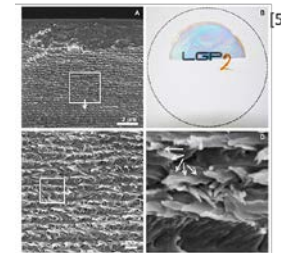
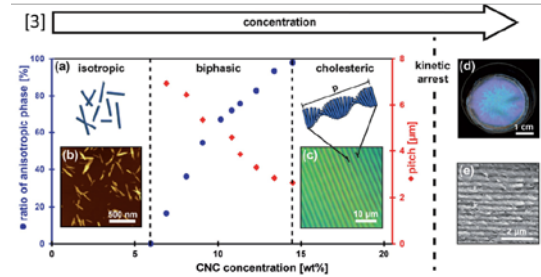
And these structural pigments are based on nanocellulose's organizations



[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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