

Bio-sourced hybrid Titanium dioxide nanoparticles for wall paints and sunscreen formulations

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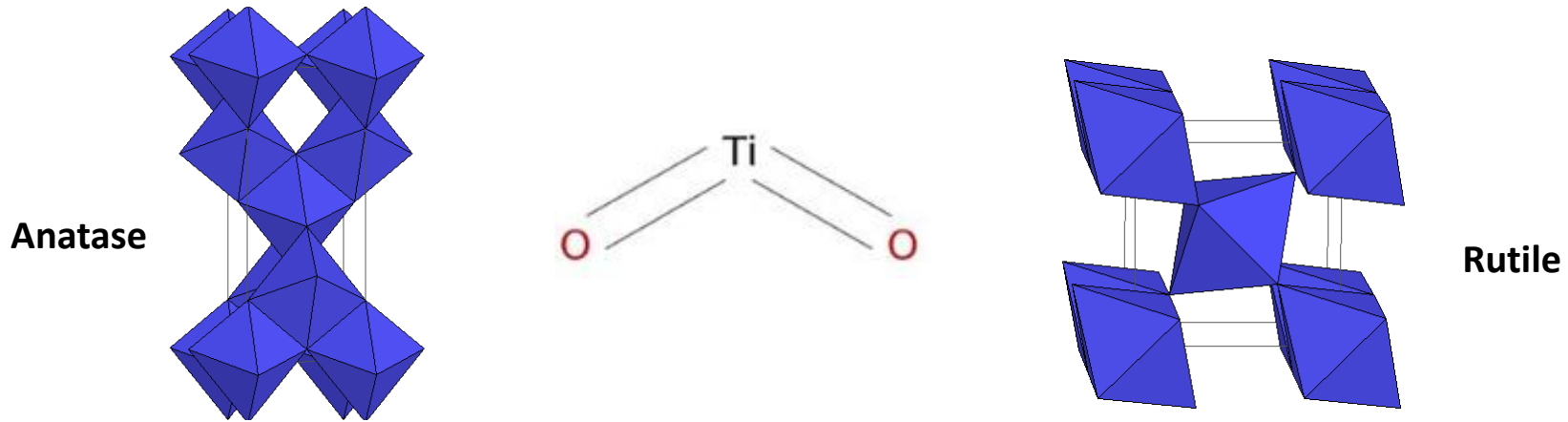
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Titanium Dioxide

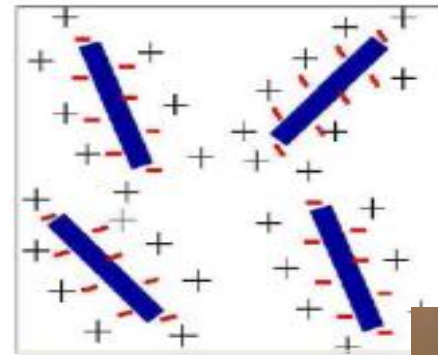
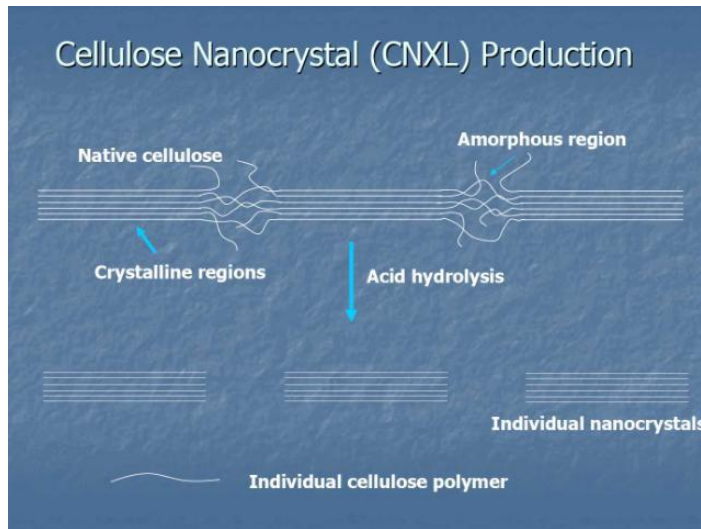
- A semiconductor in nature.
- Its natural existence in two principal polymorphs: **Anatase, Rutile**



- **TiO₂ Anatase NP** act as photocatalytic agent when exposed to UV rays
 - Applications in anti bacterial and self cleaning **wall paints/coatings** formulation ^[1]
- **TiO₂ Rutile NP** act as filter to UV rays
 - Applications in **sunscreen** and other beauty products formulation ^[2]

BIOSOURCE COMPONENT: Cellulose Nanocrystals

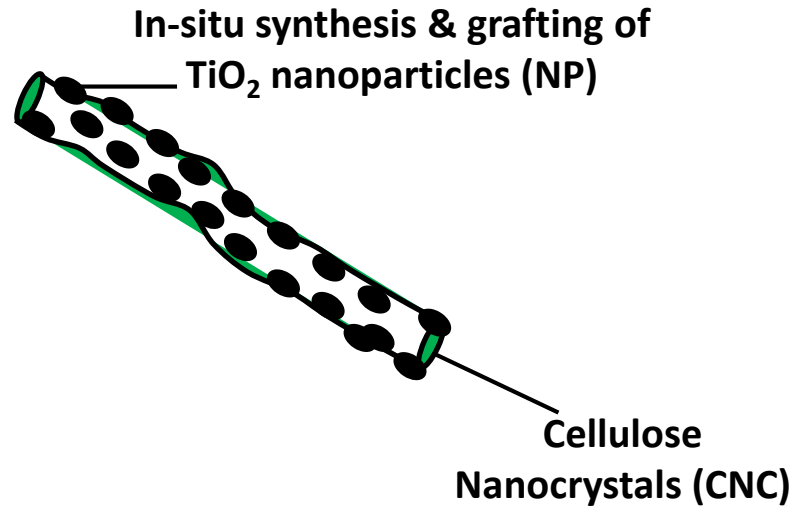
- Principal source of Cellulose Nanocrystals: Cellulose fibers
- Availability : Highly Abundant
- Acid hydrolysis yields rod-like solid nanocrystals (0.2–1 μm in length and 4–5 nm in width)



- Cellulose Nanocrystals (CNC) are hydrophilic in nature ^[3]
 - Highly dispersible in water

[3] Klemm et al., 2011

OBJECTIVES



- **In-situ synthesis & grafting** of Titanium dioxide nanoparticles (**TiO₂ NP**) on Cellulose Nanocrystals (**CNC**)
- **Study of interaction** between TiO₂ NP and CNC
- Optimization of the chemical synthesis process for a **maximum dispersion** and **specific surface area** of TiO₂ NP

What's the need of such a hybrid structure ?

TiO₂ NP Potentially harmful [4-6] to the humans as well as to the environment upon exposure [7-11]

- Ingestion (medicine, candies, food packings...)
- Dermal contact (sunscreen...)
- Inhalation (release during mechanical solicitations and environmental weathering of NP reinforced wall paints)

By associating TiO₂ NP with CNC, we **BELIEVE** the **overall toxicity can be reduced !!**



A large consumer products range is treated with TiO₂ NP !!

[4] Oberdorster et al., 2005

[5] Kaegi et al., 2008

[6] Mohamed et al., 2012

[7] Shandilya et al., 2015a

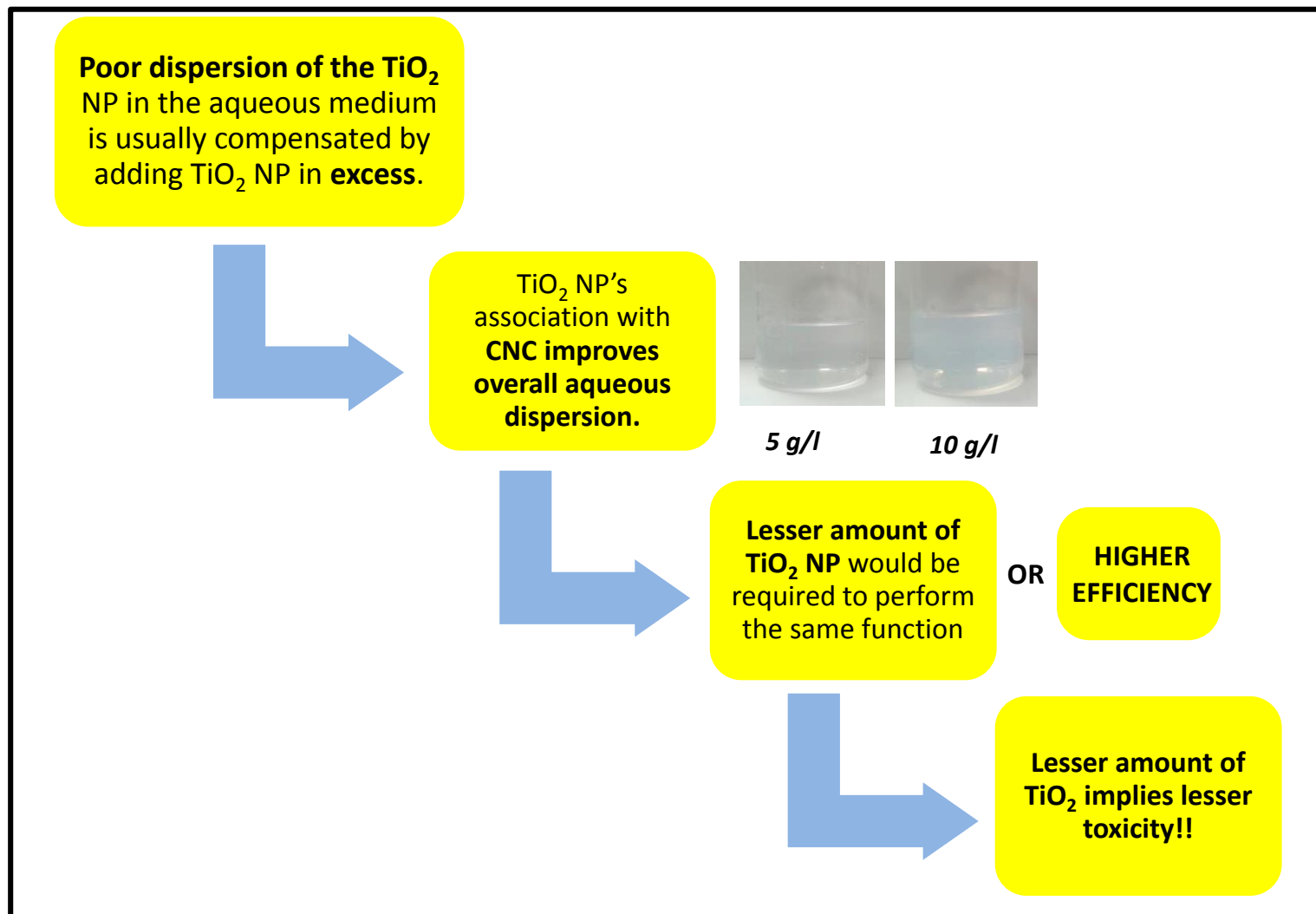
[8] Le Bihan et al. 2014

[9] Shandilya et al., 2016

[10] Shandilya et al., 2015b

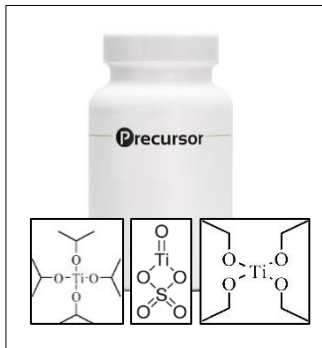
[11] Shandilya et al., 2014

Can Cellulose Nanocrystals grafting reduce the overall toxicity?

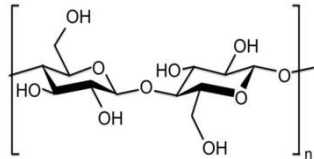


SYNTHESIS METHOD

1



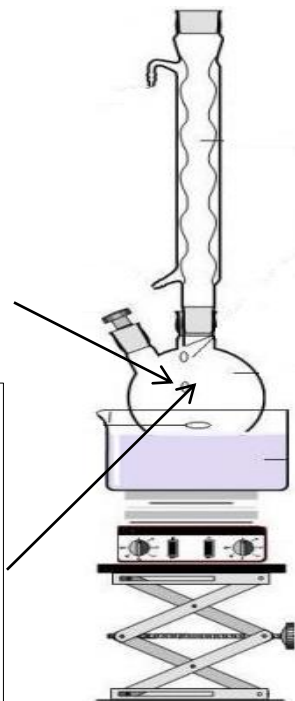
Cellulose
nanocrystals
water dispersion



+

Acid

(H_2SO_4 or HNO_3)



Temperature
< 100°C

2

Cleaned repeatedly with water
and centrifugation



Finally obtained gel

CHARACTERIZATION TECHNIQUES

1. **XRD analysis** to determine TiO_2 crystal structure: Rutile or Anatase

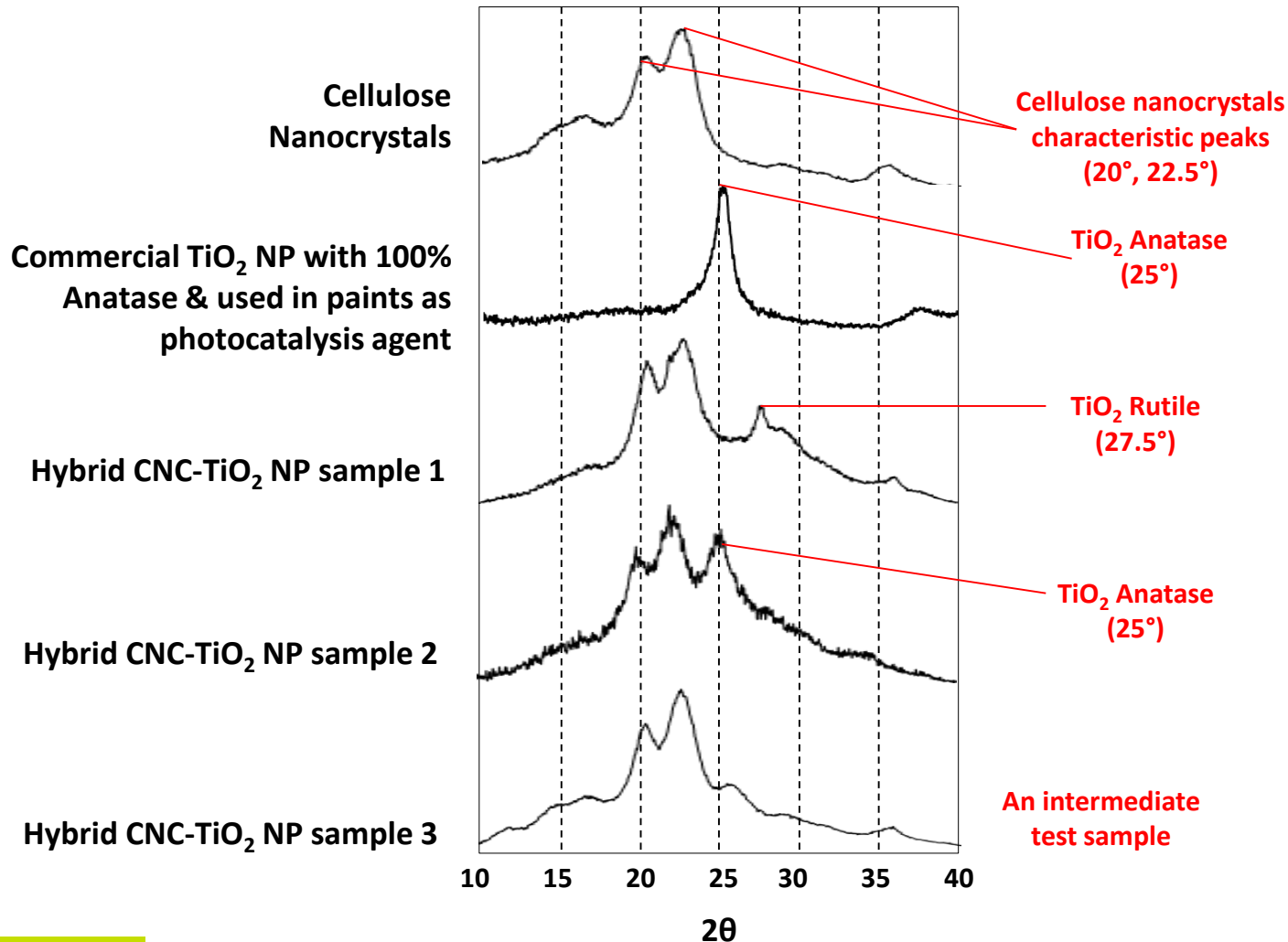
2. **TGA** to determine TiO_2 mass content

3. **TEM analysis** to determine morphology/microscopic structure

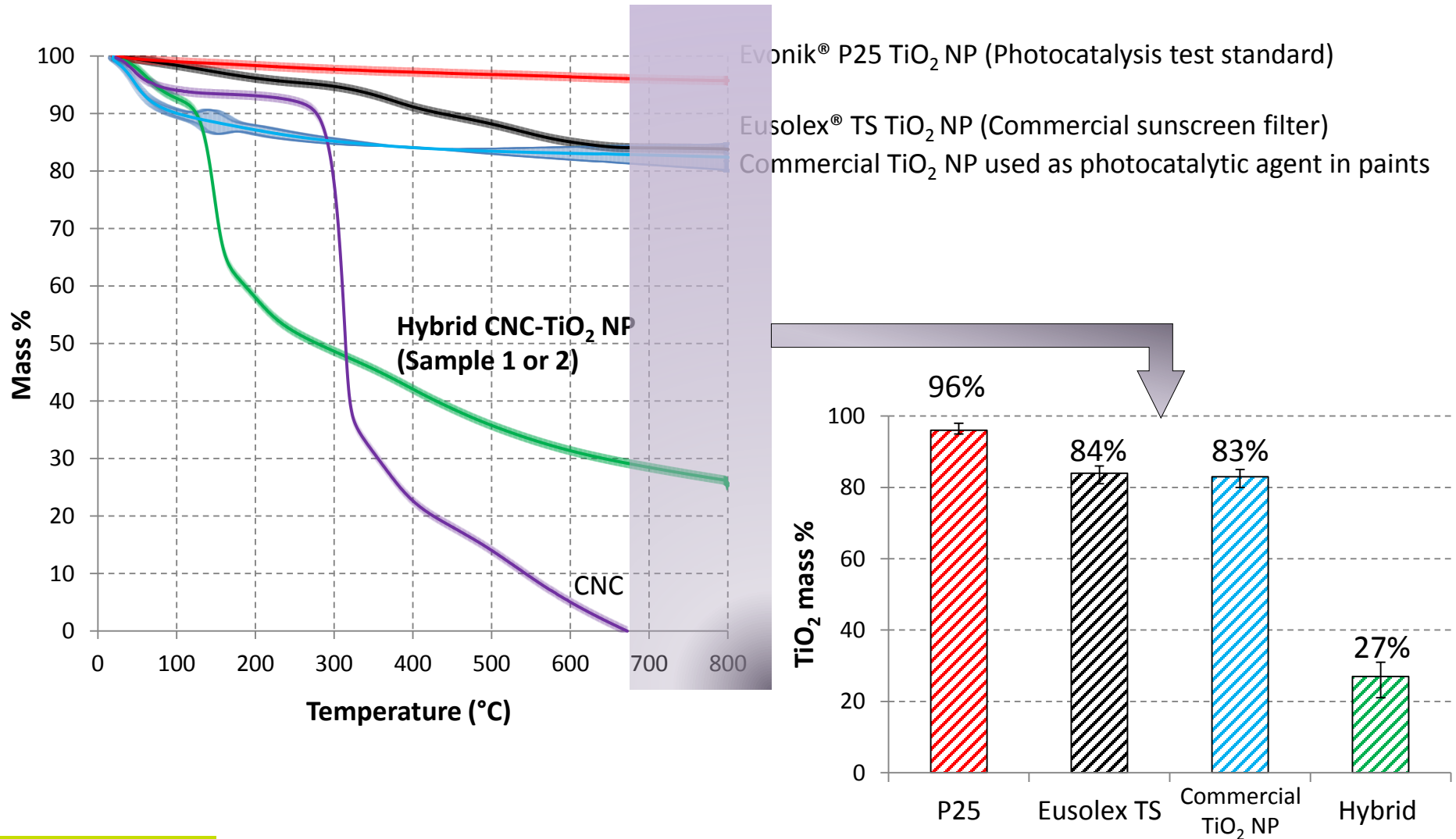
4. **UV-Vis Spectrometry** to determine the potential for :

- a) UV absorbance (for rutile)
- b) Photocatalysis (for anatase)

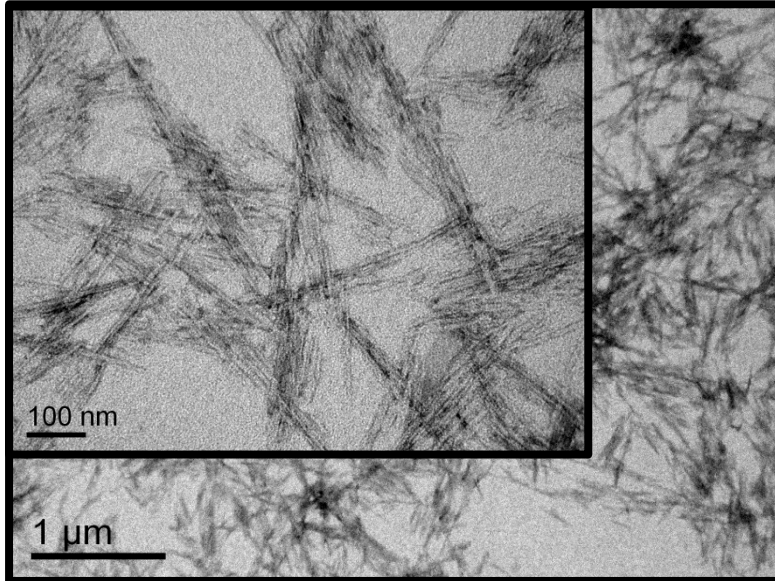
X-RAY DIFFRACTION- CRYSTAL STATE



THERMOGRAVIMETRY ANALYSIS- TiO₂ mass %

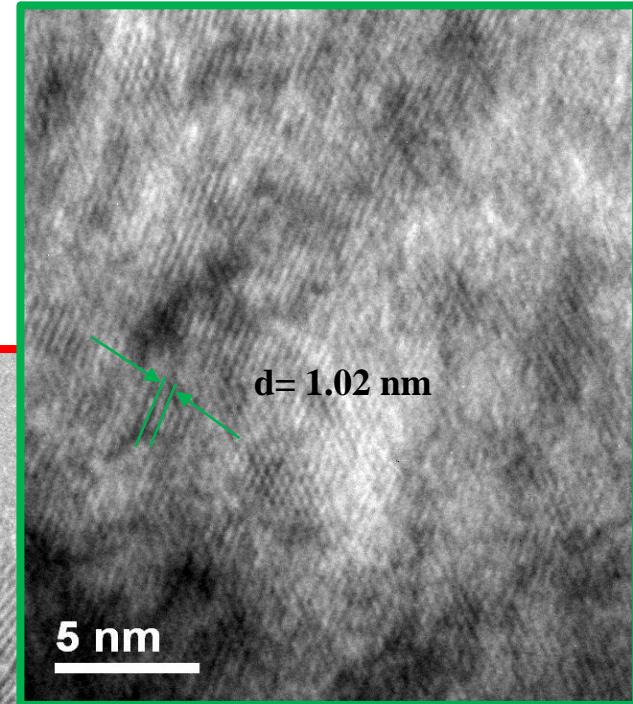
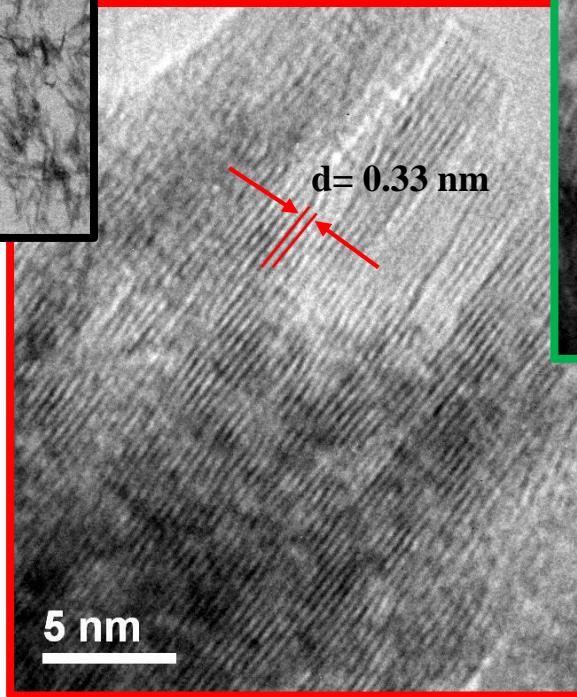


TRANSMISSION ELECTRON MICROSCOPY



Test sample 1 and 2

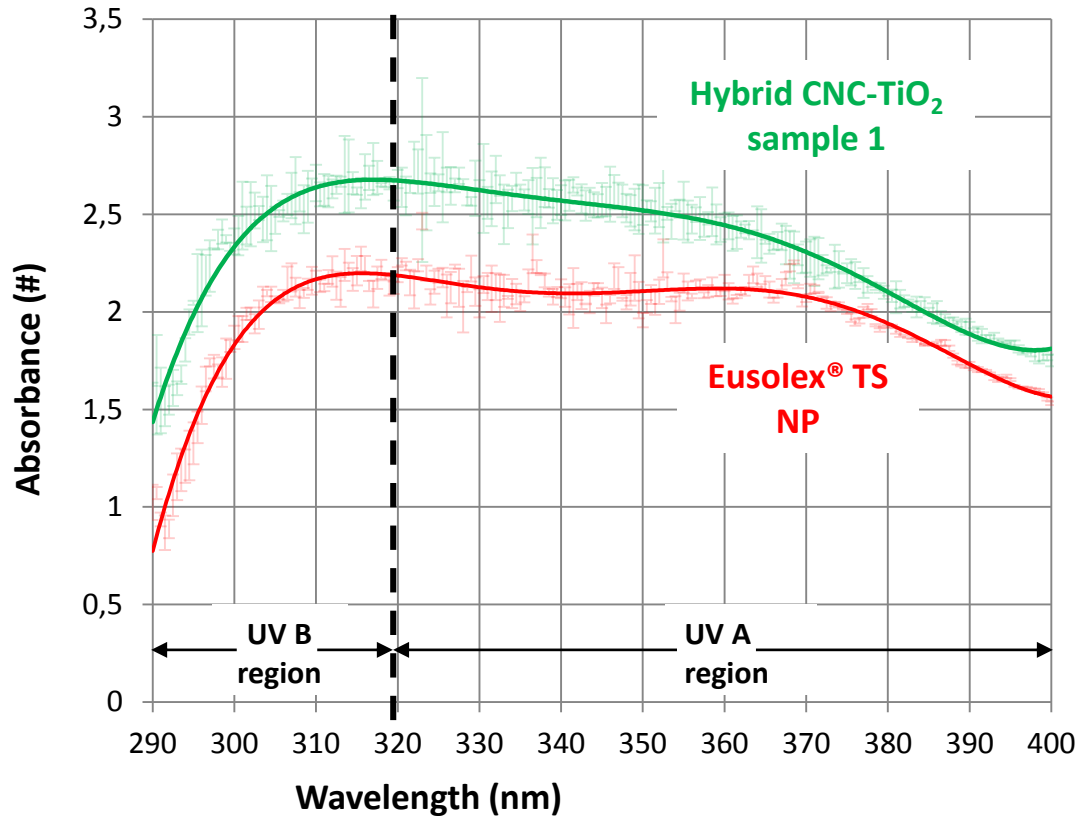
Test sample 1
Complete Rutile formation



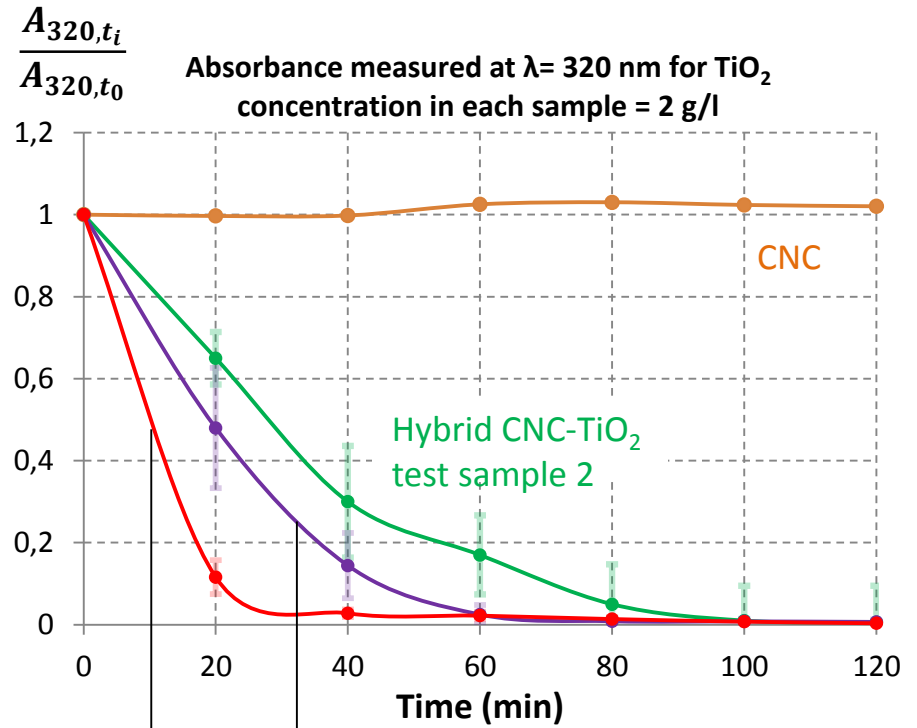
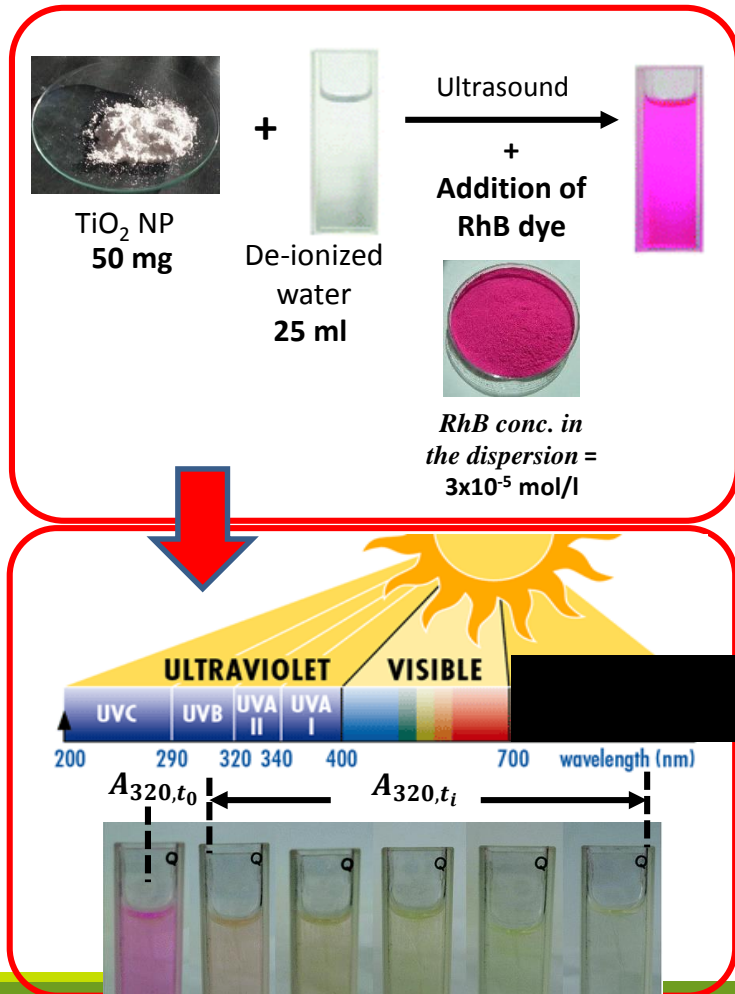
Test sample 2
Complete Anatase formation

UV-VIS Spectroscopy (UV absorbance capacity of TiO₂ Rutile)

for a TiO₂ concentration of 0.055 g/l



UV-VIS Spectroscopy (Photocatalytic potential of TiO₂ Anatase)



P25

Commercial TiO₂ NP used in paints as photocatalyst



THANK YOU FOR YOUR ATTENTION

THIS WORK HAS BEEN CARRIED OUT IN THE FRAMEWORK OF THE LABEX SERENADE (ANR-11-LABX-0064) AND THE A*MIDEX PROJECT (ANR-11-IDEX-0001-02), FUNDED BY THE FRENCH GOVERNMENT PROGRAM, INVESTISSEMENTS D'AVENIR, AND MANAGED BY THE FRENCH NATIONAL RESEARCH AGENCY (ANR).



It's always good to go towards nature

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