

# Assemblages supramoléculaires et polymères pour l'interface avec la biologie

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Présentation équipe GDR B2i – 1<sup>er</sup> Juillet

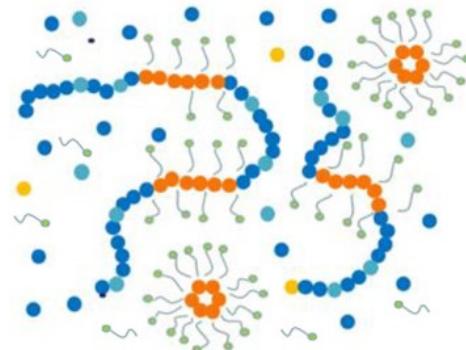


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## **Chimie et physicochimie de la « matière molle »**

- Polymères
  - Amphiphiles

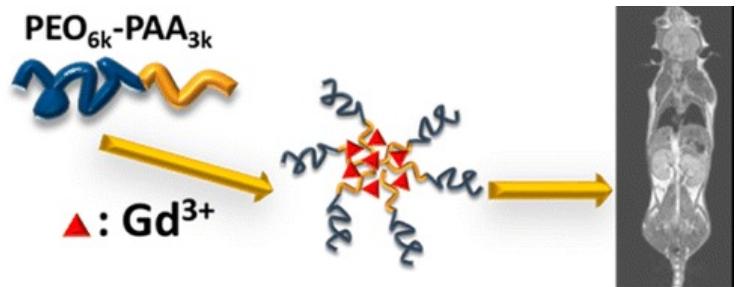


M. Destargac, S. Harrisson et al.

- Synthèse et caractérisation chimique
  - Auto-assemblages en solution
  - Gels
  - Auto-assemblages avec particules/ ions inorganiques
  - Formulations

## En lien avec les organismes vivants

- Vectorisation (médicaments hydrophobes, IRM...)
  - Gels pour culture cellulaire
  - Interactions plastiques – organismes vivants
  - Auto-assemblages et polymères en lien avec des réactions enzymatiques



## Photochimie et chimie analytique

### Photochimie

- Degradation par voie photochimique

Microplastiques

Dépollution

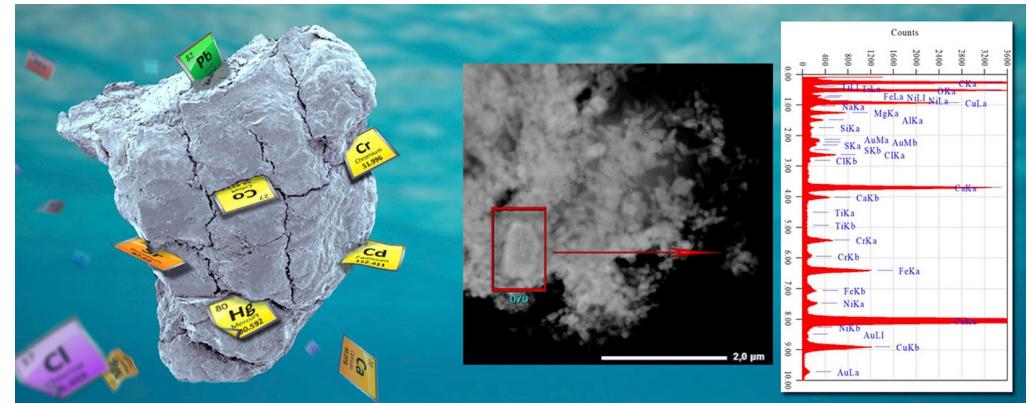
Photo-oxydation

- Molécules photostimulables

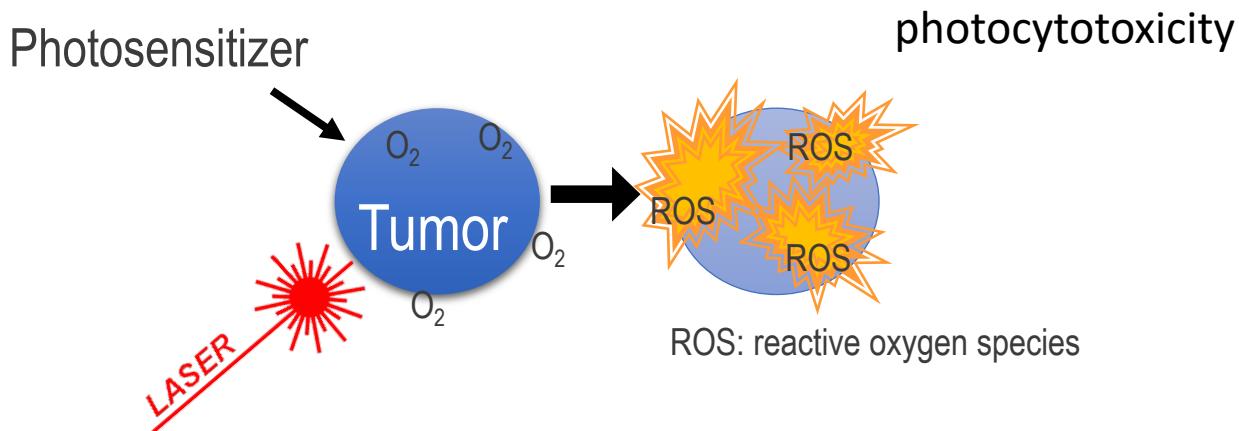
- Chimie analytique

Impact du stress oxidatif sur les peptides

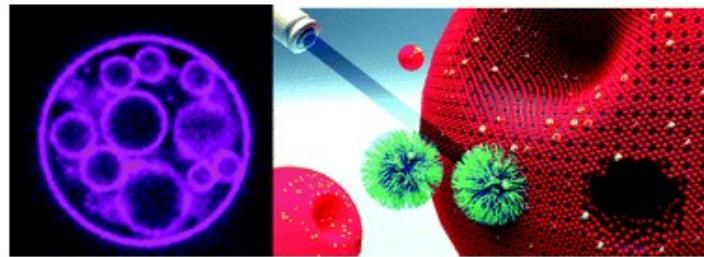
et leur auto-assemblage >> mécanismes de la maladie d'Alzheimer



A. Ter Halle, Expedition 7<sup>ème</sup> Continent



J. Royes-Mir et al. *ChemPhotoChem* 1 311-316 (2017)



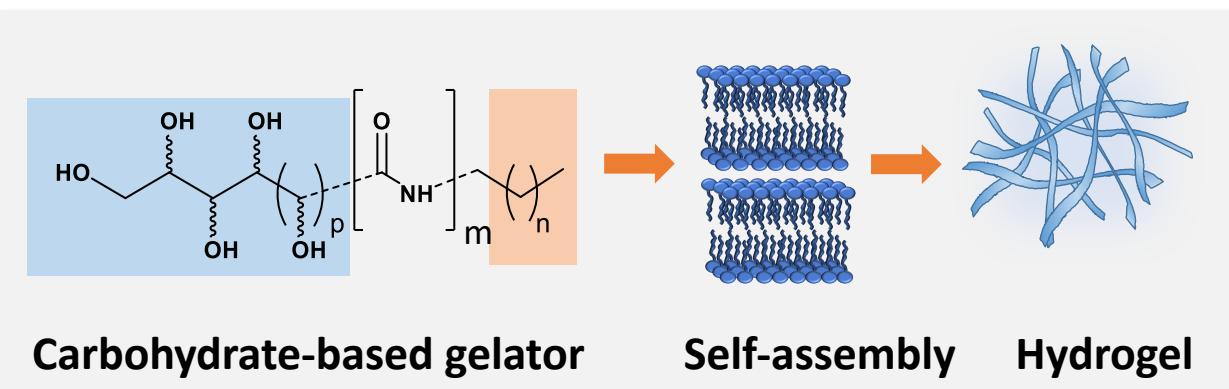
IMRCP: P. Vicendo, L. Gibot, A.F. Mingotaud, B. Lonetti et al.

*IMRCP; J.D. Marty et al.*

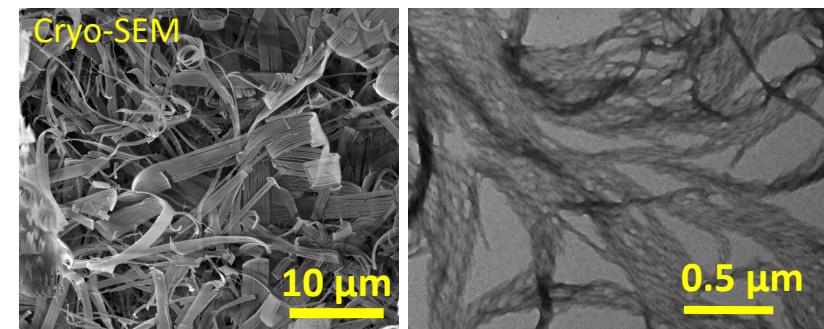
The diagram shows three vesicle structures. On the left, a circular vesicle labeled 'Micelles' has a red core and a blue shell. Below it, the text reads 'Micelles' and 'd = 20 - 30 nm'. In the center, a larger circular vesicle labeled 'Polymersomes' has a red core, a blue middle layer, and a red outer shell. Below it, the text reads 'Polymersomes' and 'd = 100 - 150 nm'. On the right, a curved, elongated vesicle labeled 'Wormlike micelles' has a red core and a blue shell. Below it, the text reads 'Wormlike micelles' and 'd<sub>H</sub> = 80 - 200 nm'.

M. Dionzou et al., *Soft Matter* **12**, 2166–2176 (2016)  
 U. Till et al. *RSC Advances* **6** 69984-98 (2016)

# Supramolecular gels for cell culture



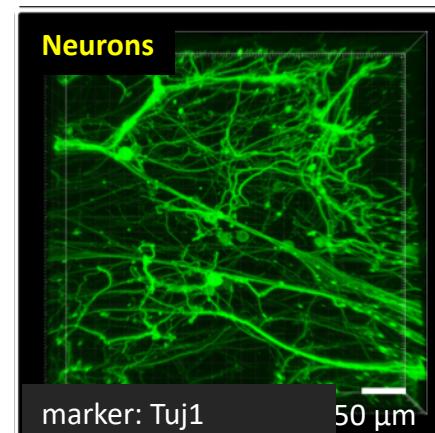
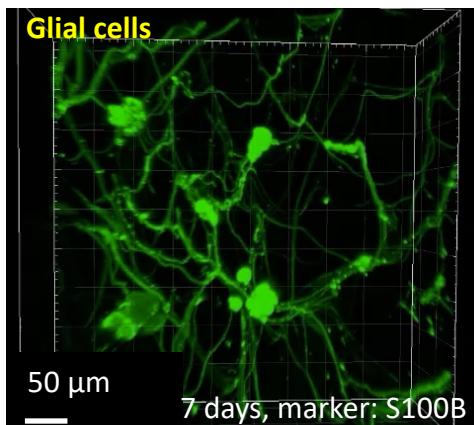
 100°C  
Dissolution in water  
then cooling  
>> Gel formation



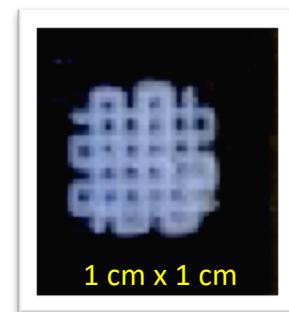
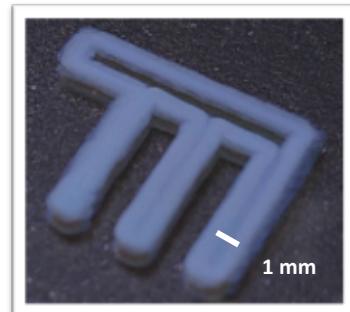
- **No polymer**, no permanent cross-links
  - Variety of fibers morphology at the nano/micrometric scale
  - Very soft, fragile, porous, dynamic, loose networks

*J. Fitemann, A. Chalard, D. Bordignon, J.M. Martin (IMRCP)  
L. Vaysse (Restore), I. Loubinoux (Tonic), INSERM  
L. Malaquin, P. Joseph (LAAS)*

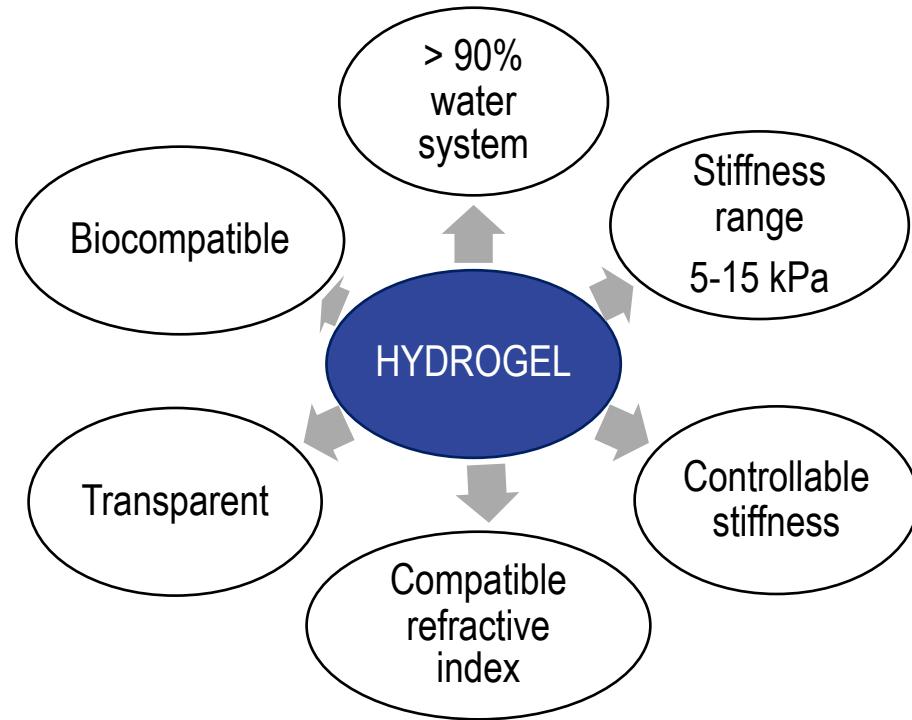
## Cell culture



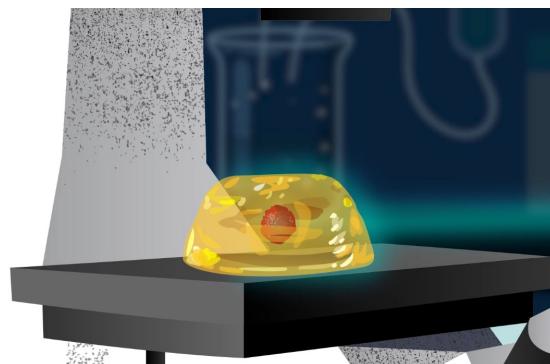
## 3D printing



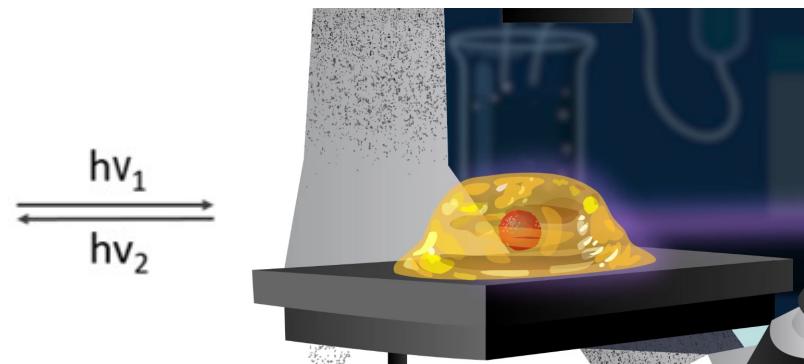
# Photo-responsive hydrogels



# Assess the role of mechanical stress on biological tissues



# Stiffer hydrogel



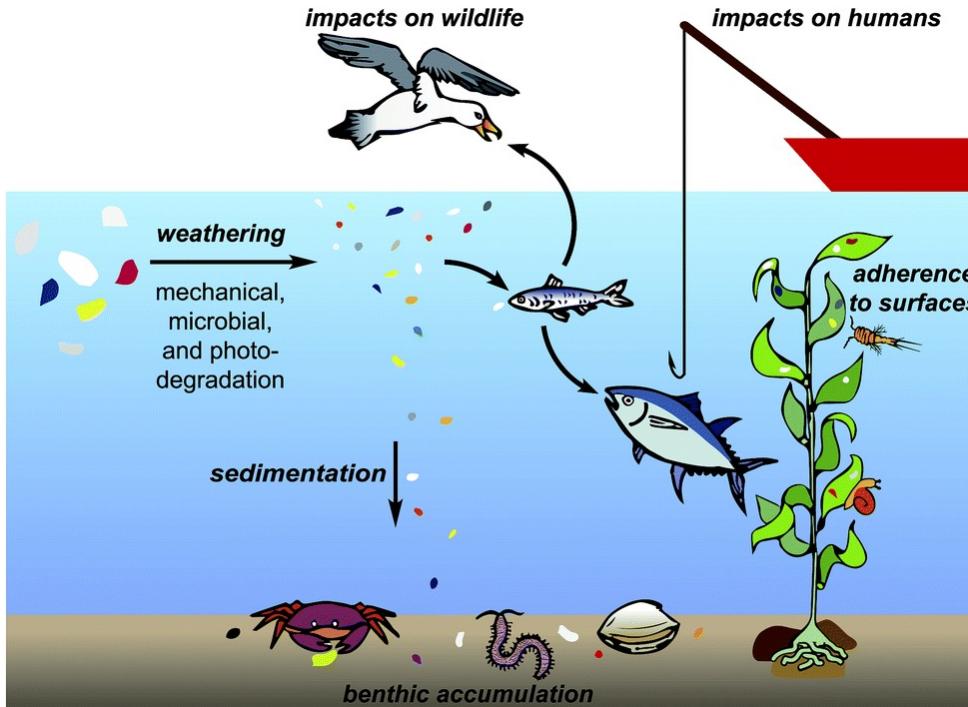
## Softer hydrogel

J. Royes-Mir et al. *ChemPhotoChem* **1** 311-316 (2017)

*IMRCP: A.F. Mingotaud et al.  
ITAV: C. Lorenzo, C. Séverac*

# Micro and nanoplastics in the environment

## *Fate of the plastic materials in the environment ?*



## *Objects after weathering*

**Size**  $1\mu\text{m} < \text{size} < 5\text{mm}$  : Microplastics  
Less than  $1\mu\text{m}$  : Nanoplastics

### *Irrregular shape*

## *Surface chemistry ? Interaction with plancton? Sequestration in the soil?*

## « Realistic » micro/nanoplastics: HD-polyethylene labelled with Er-UCNP

**HDPE** : the most common plastic

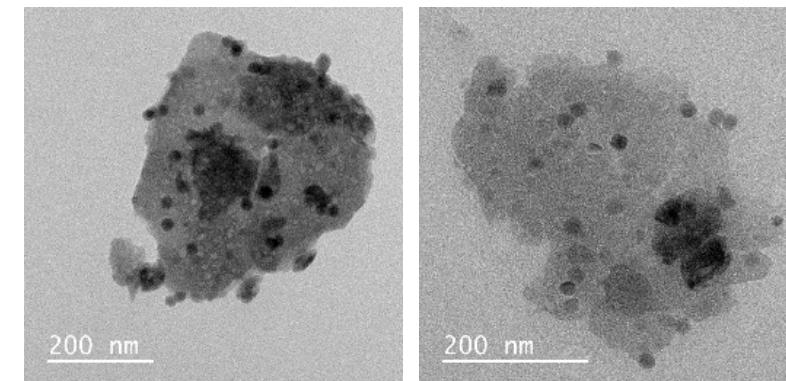
**UCNP tag**: inorganic inert luminescent monodisperse nanomaterial suitable for NIR monitoring in vis-absorbing medium (ex living tissues); **Green** emission thanks to erbium doping

## Method

*Top-down approach : grinding & « soft » ball miling*

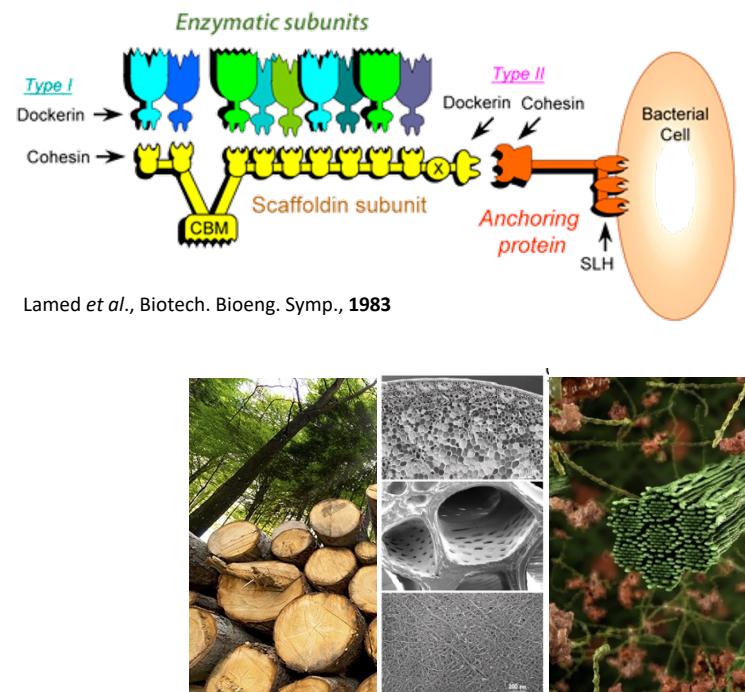
## ***Sizing : filtration steps***

## TEM: HDPE + 5% loading UCNPs

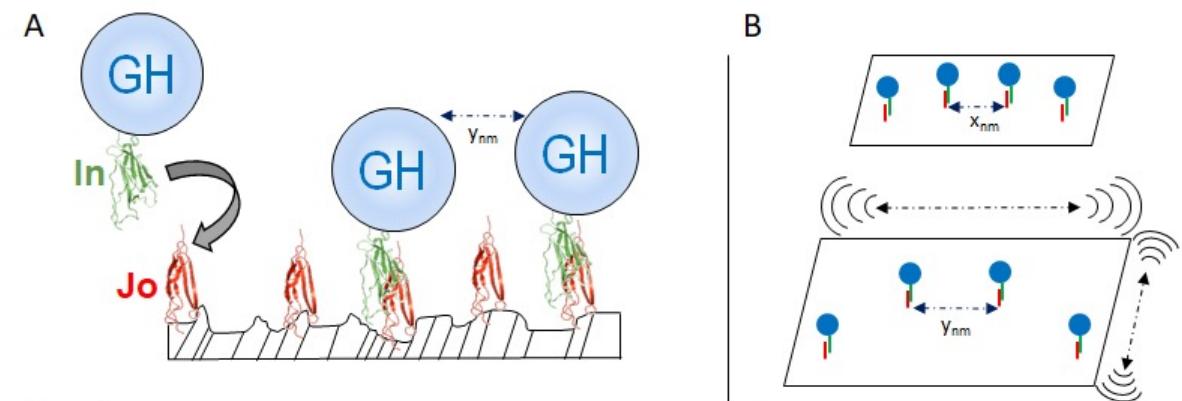


# Enzymatic synergy mimics

# Enzyme synergy obtained in nature by spatial proximity



# Synthetic mimics by grafting enzymes on an elastic surface ?



## Enzyme grafting

## Control of spatial proximity by simple stretching ?

Merci pour votre attention !



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