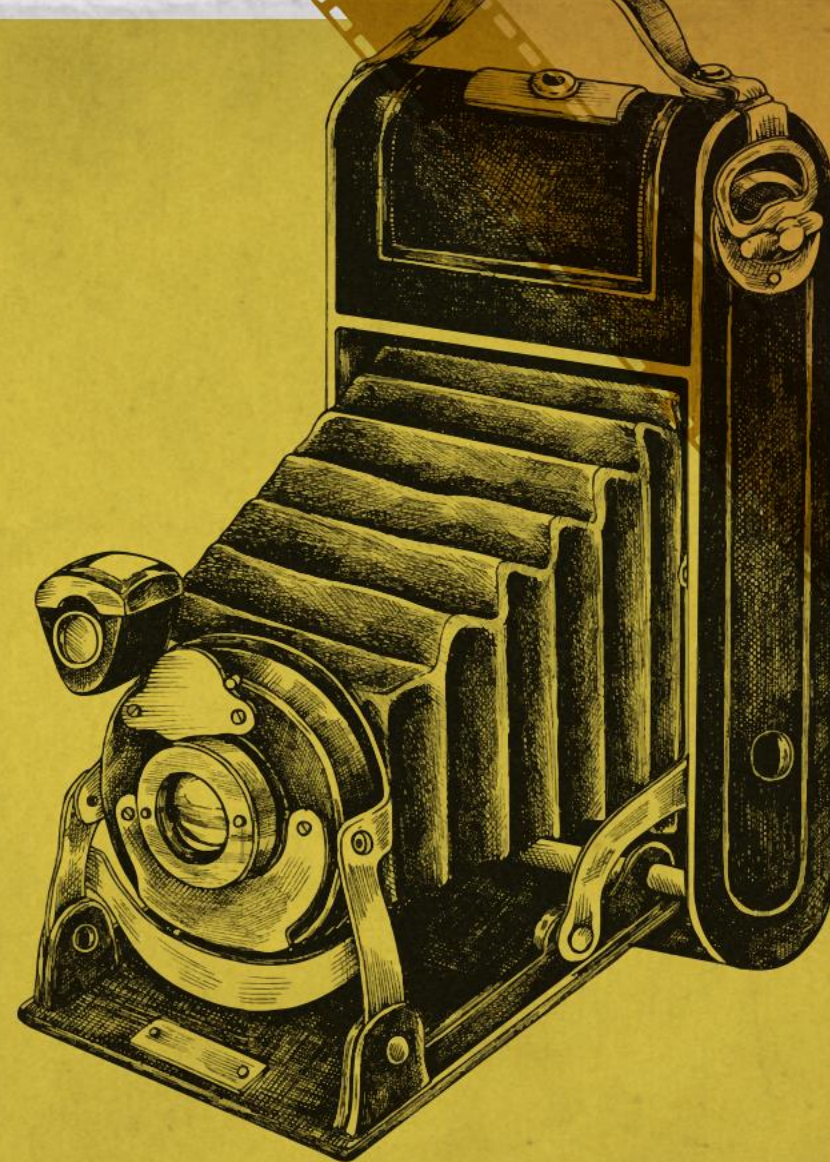
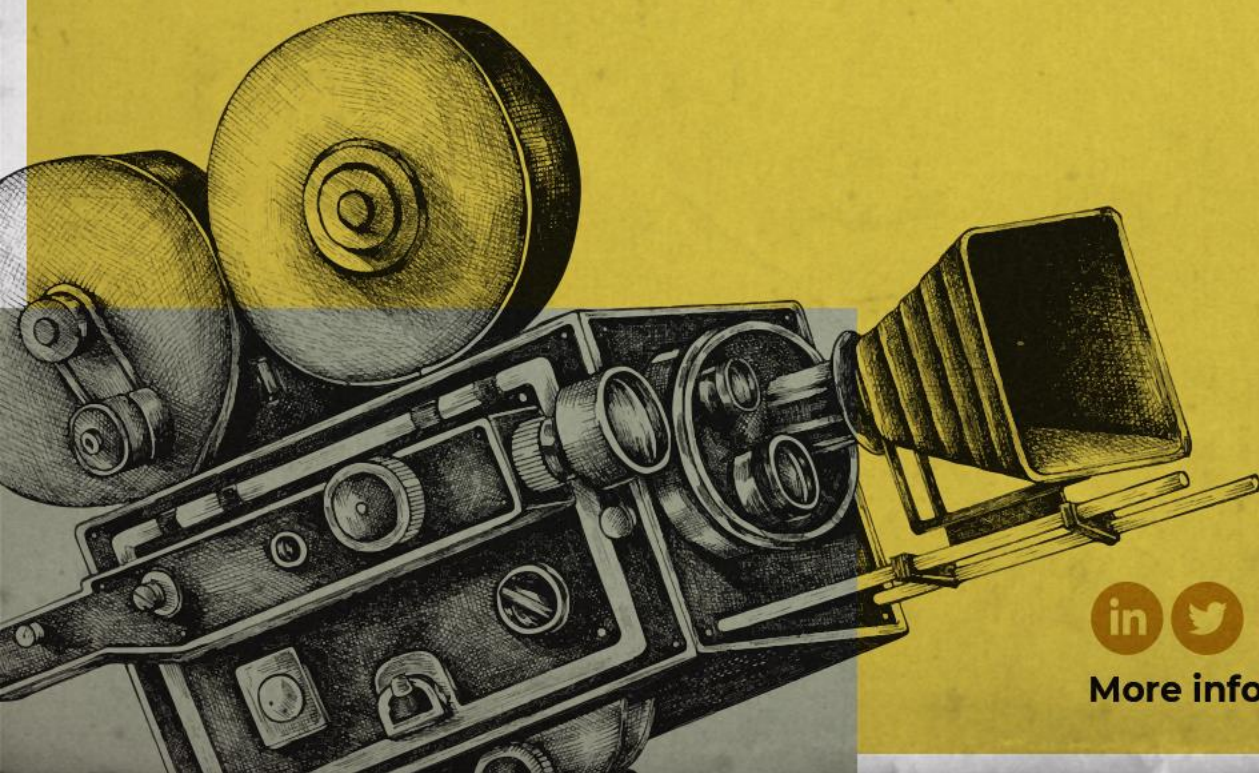


25<sup>TH</sup> MAY / 2022 ◊ VALENCIA, SPAIN

# FINAL WORKSHOP

The NEMOSINE innovative  
package for cultural  
heritage preservation



More info at: [nemosineproject.eu](https://nemosineproject.eu)



NEMOSINE has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 760801.





## FINAL WORKSHOP:

The NEMOSINE innovative package and solutions for 20th century cultural heritage preservation.



NEMOSINE has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 760801.

# Design of porous adsorbents by assembling MOFs with gelatin for the capture of acetic acid.

**Subharanjan Biswas, Eddy Dumas, Nathalie Steunou**

*Institut Lavoisier, University Versailles St-Quentin en Yvelines  
& University Paris Saclay*

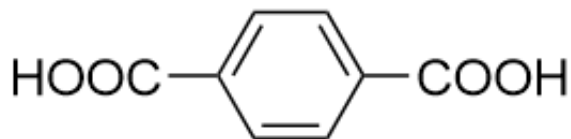
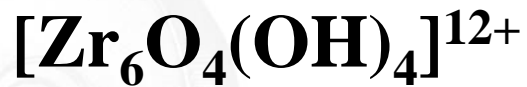
**université**  
PARIS-SACLAY

UNIVERSITÉ DE  
VERSAILLES  
ST-QUENTIN-EN-YVELINES

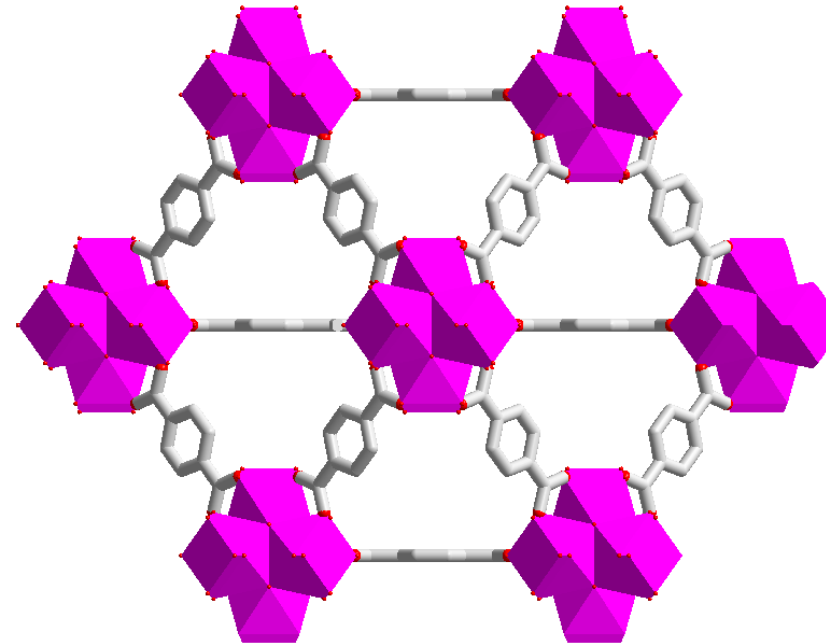


# MOFs FOR THE CAPTURE OF ACETIC ACID

## UiO-66



terephthalic acid



Cubic structure

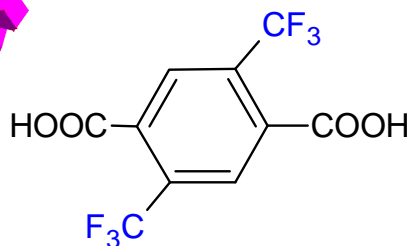
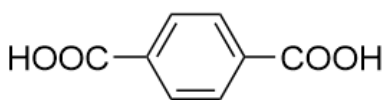
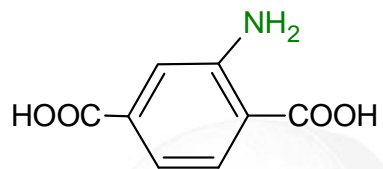
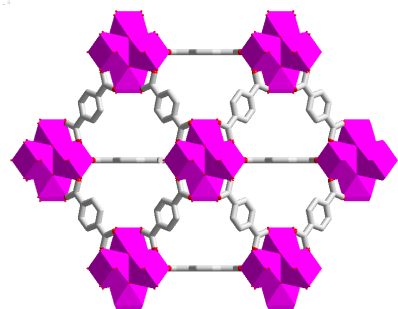
Microporosité 3D

Oh cage  
Ø= 12 Å

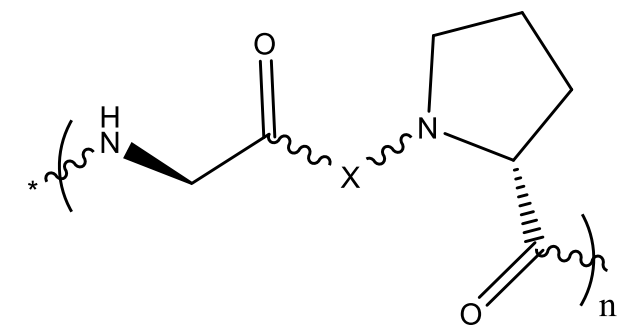
Td cage  
Ø= 7.5 Å

# MOFs FOR THE CAPTURE OF ACETIC ACID

**UiO-66(Zr)-X**  
 $X = \text{H}, \text{NH}_2, (\text{CF}_3)_2$



**Gelatin**  
 $(\text{Gly-X-Pro})_n$



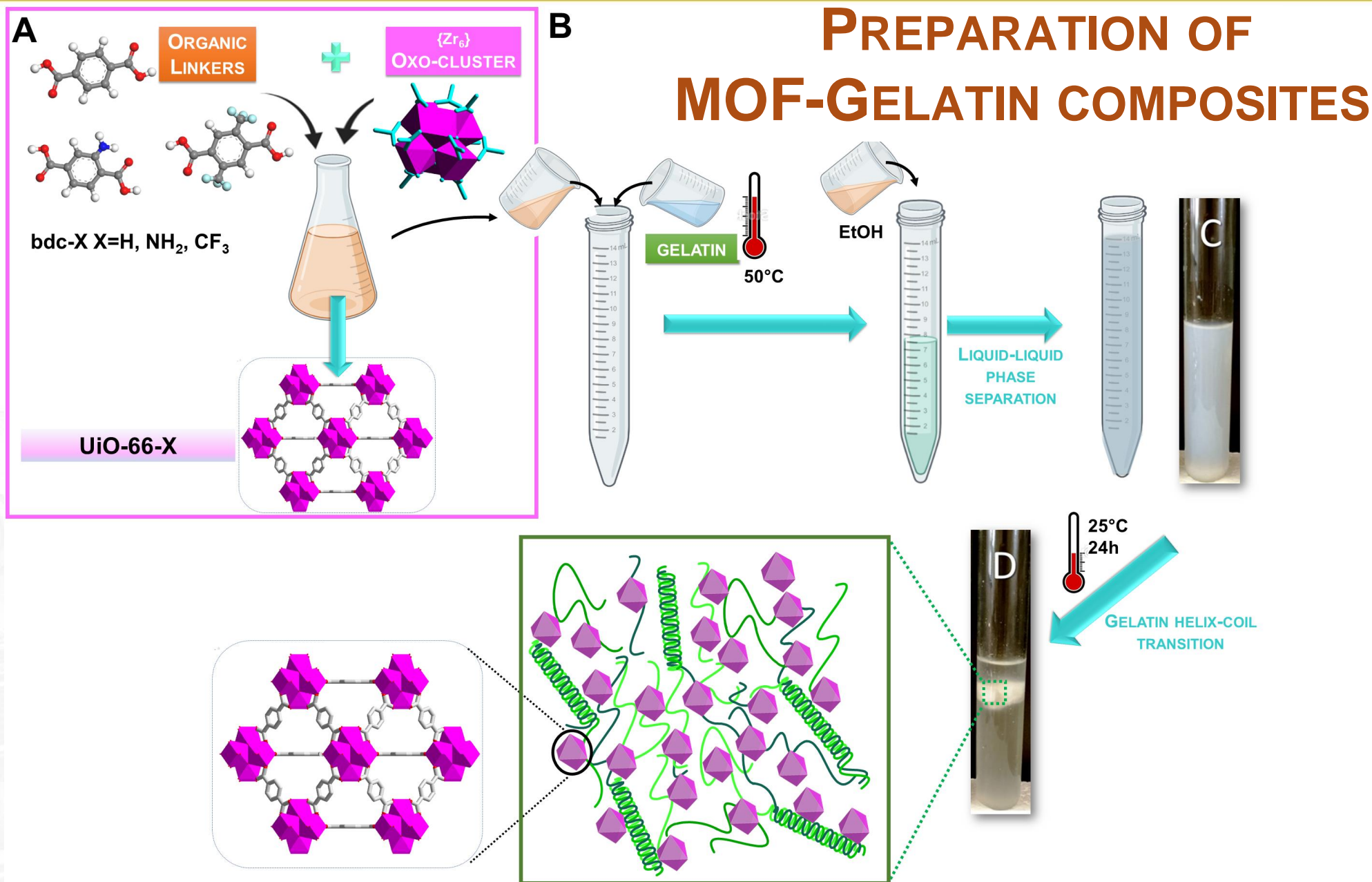
hydrophilic

hydrophobic

**Hydrophilic-hydrophobic  
balance**

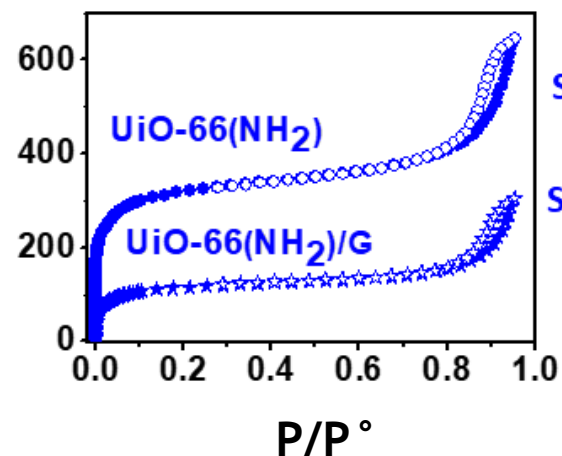
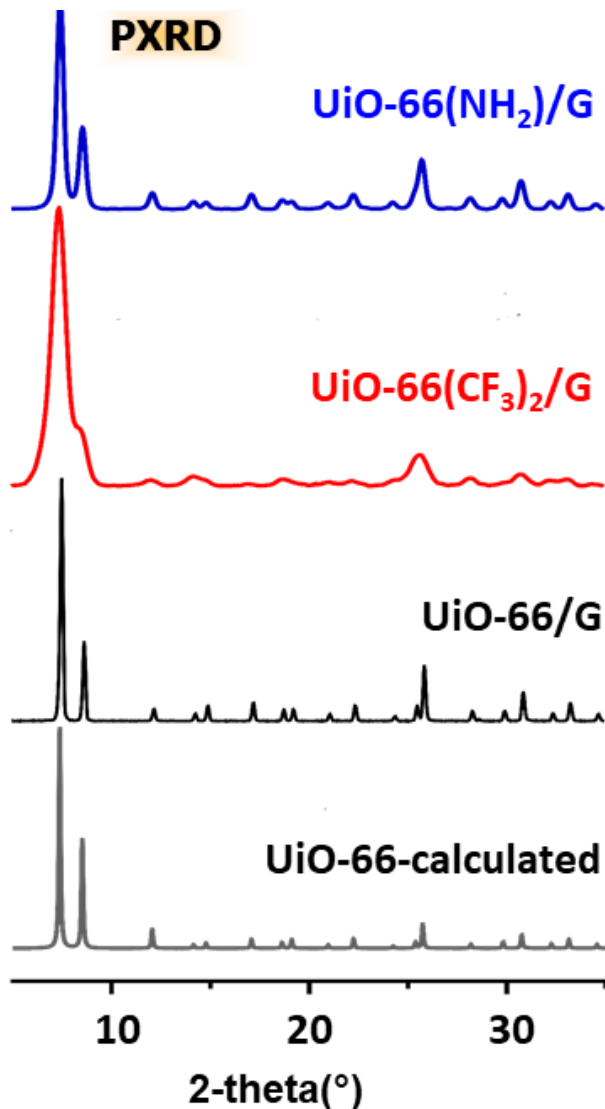
- good acetic acid adsorption capacity under humidity
- high water/thermal stability

**Water Soluble,  
Green polymer  
Good mechanical properties**

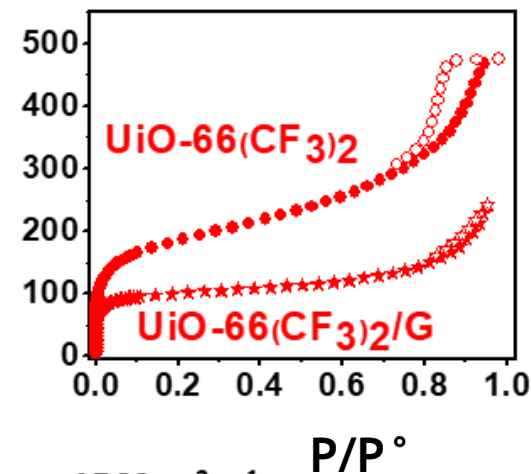
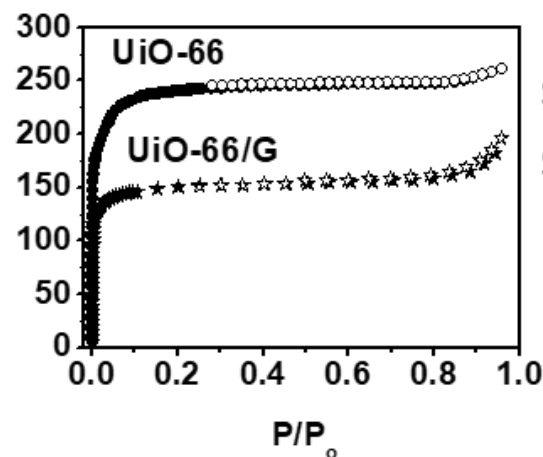




# CHARACTERIZATION OF UiO-66/GELATIN COMPOSITES


 $S_{\text{BET}} = 1243 \text{ m}^2 \cdot \text{g}^{-1}$ 
 $S_{\text{BET}} = 790 \text{ m}^2 \cdot \text{g}^{-1}$ 

**N<sub>2</sub> sorption isotherm**


 $S_{\text{BET}} = 649 \text{ m}^2 \cdot \text{g}^{-1}$ 
 $S_{\text{BET}} = 397 \text{ m}^2 \cdot \text{g}^{-1}$ 

 $S_{\text{BET}} = 1560 \text{ m}^2 \cdot \text{g}^{-1}$ 
 $S_{\text{BET}} = 1083 \text{ m}^2 \cdot \text{g}^{-1}$ 

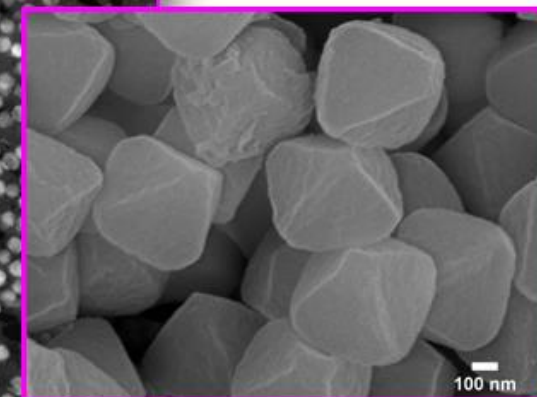
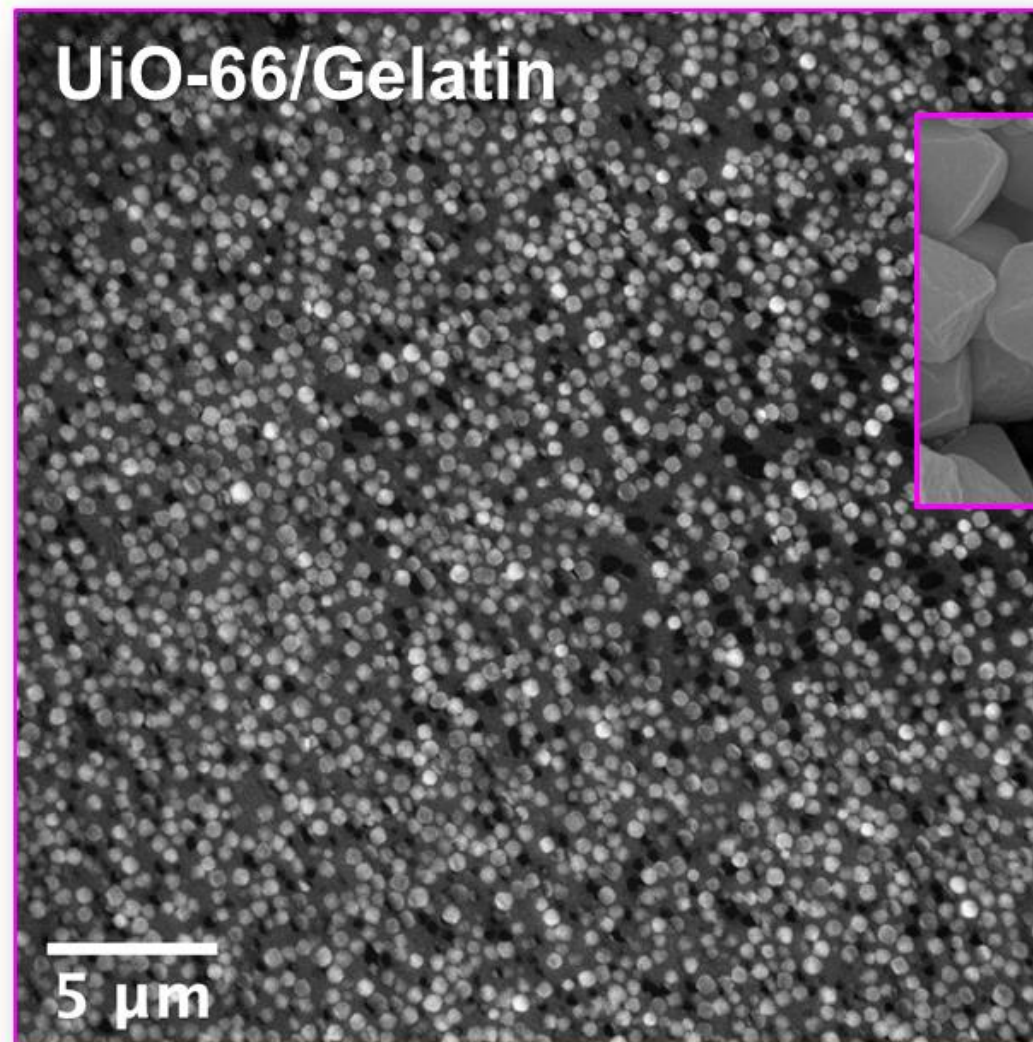
- Good crystallinity
- high porosity

# CHARACTERIZATION OF UiO-66/GELATIN COMPOSITES

## Ultra-microtomy TEM

## MOF Loading (TGA and ICP-AES)

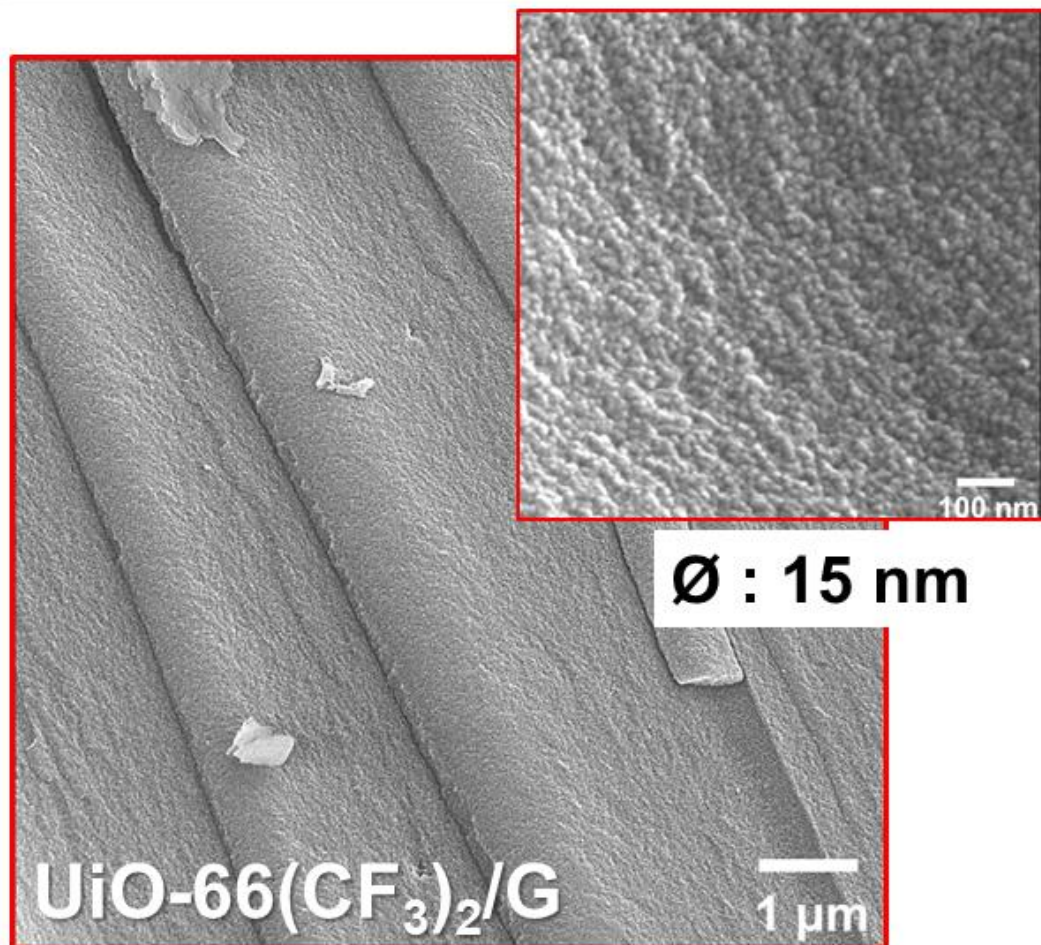
**88 wt% of UiO-66**



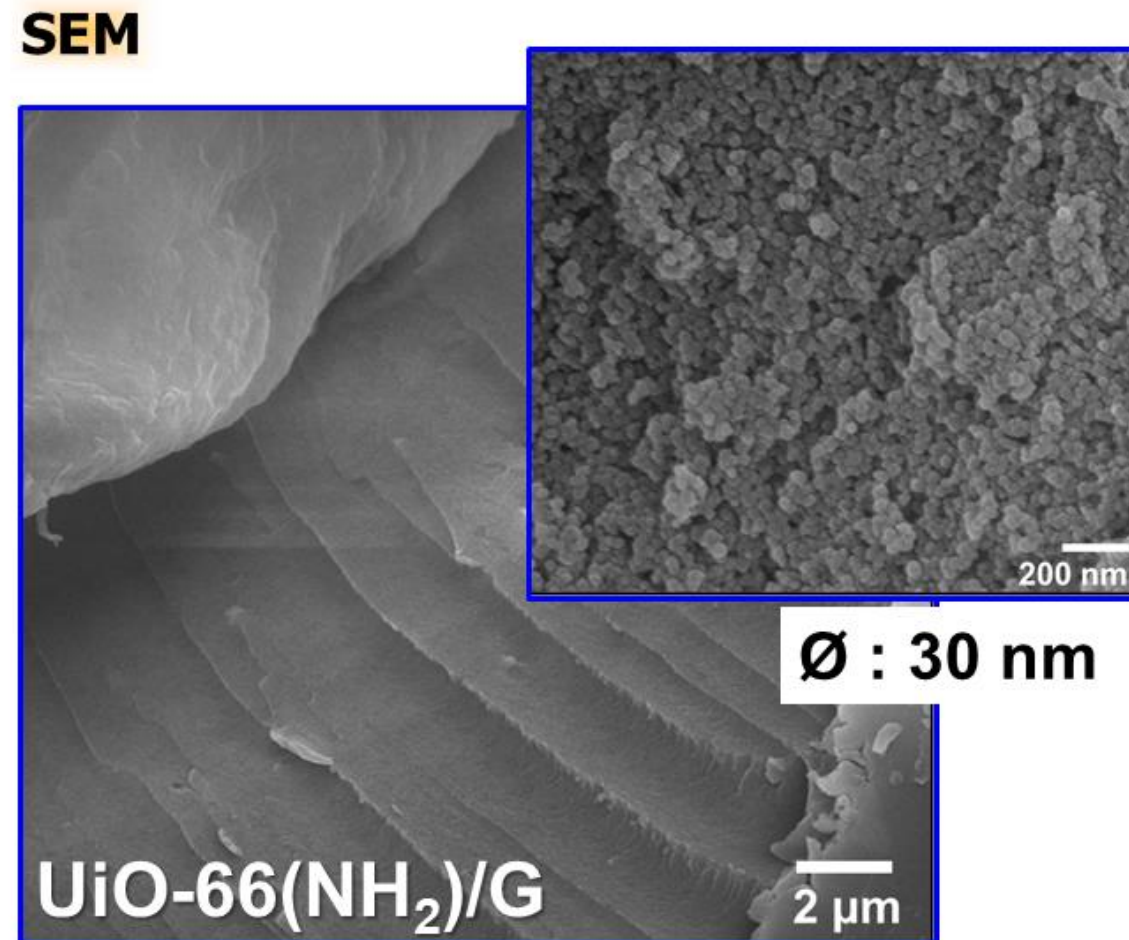
**Ø : 350 nm**



# CHARACTERIZATION OF UiO-66/GELATIN COMPOSITES



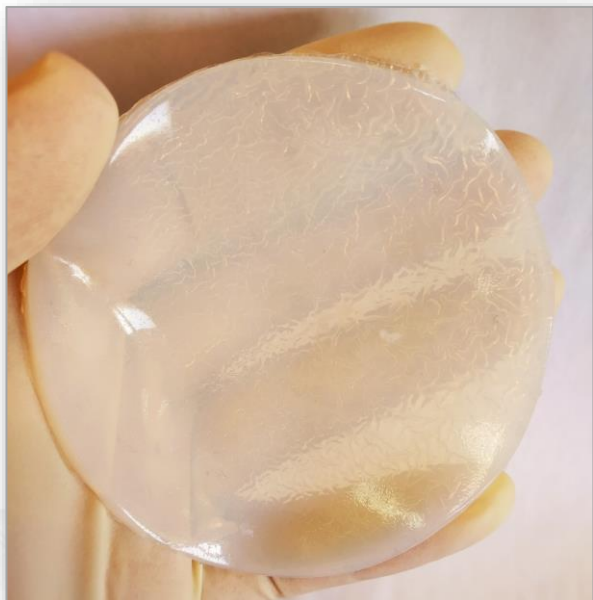
**wt % MOF : 91 %**



**wt % MOF : 70 %**



# SHAPING OF UiO-66/GELATIN COMPOSITES



*Film and coating*

**UiO-66/G**



**UiO-66(CF<sub>3</sub>)<sub>2</sub>/G**

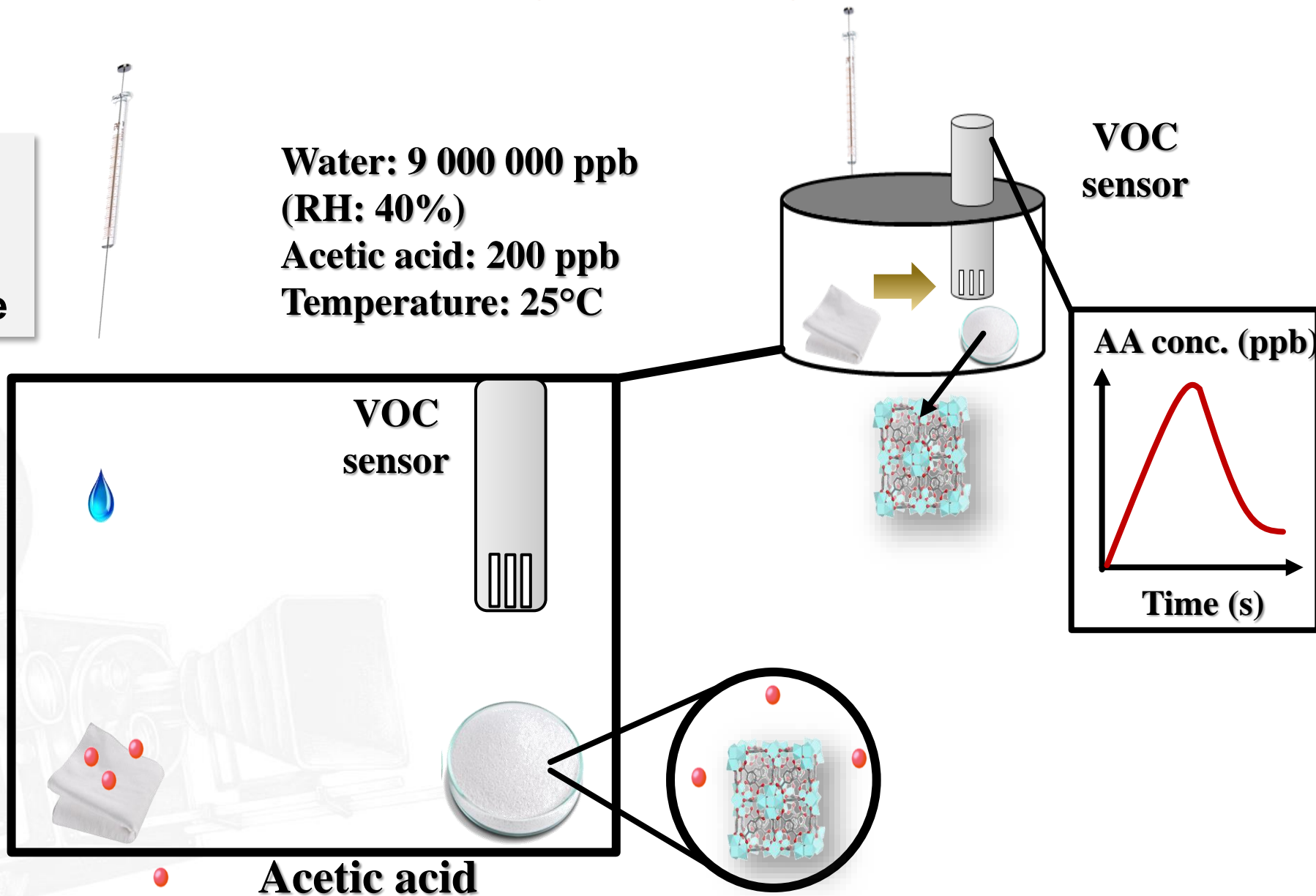


*Tablets*

# ADSORPTION EFFICIENCY OF MOFs FOR ACOH IN HUMID CONDITIONS

C. Freitas,  
A. Al Mohtar  
M. Pinto,  
Univ. Lisbonne

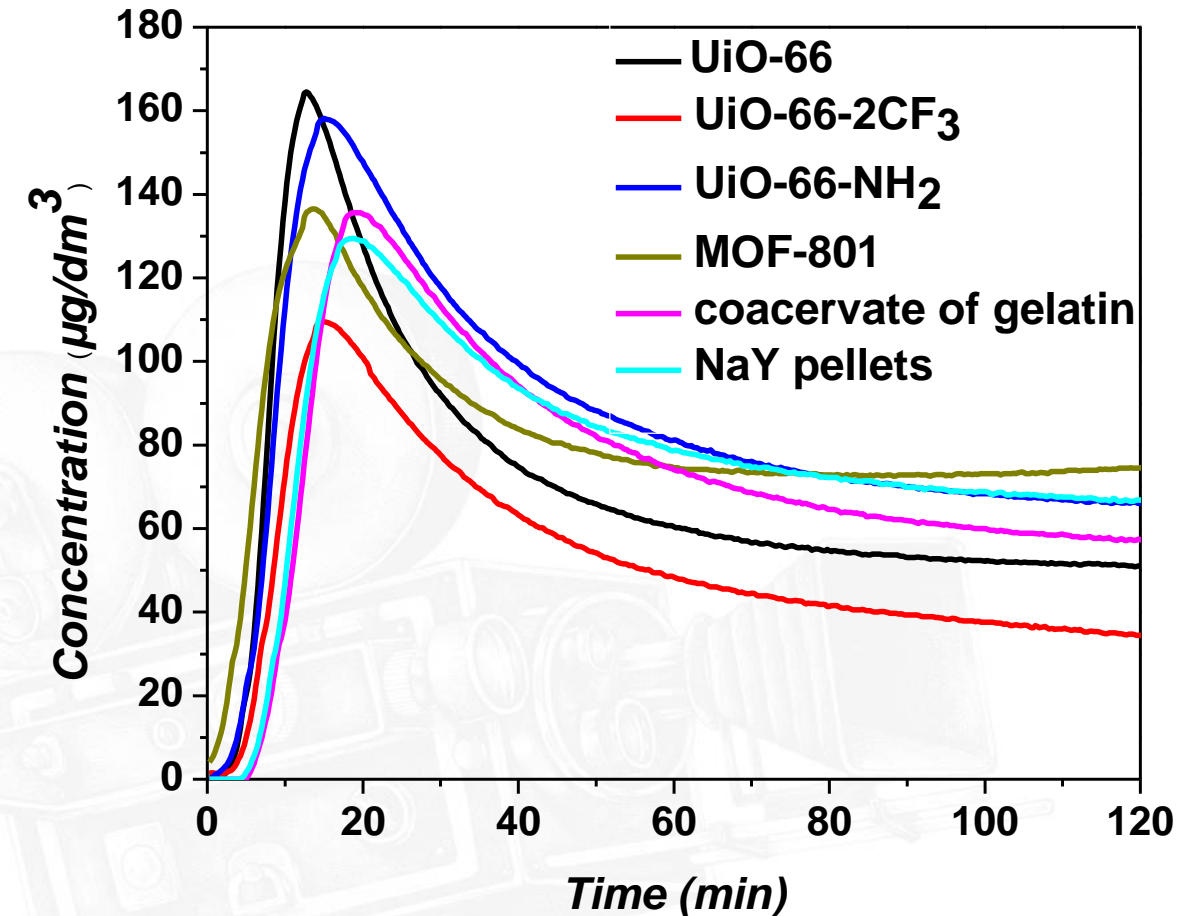
Water: 9 000 000 ppb  
(RH: 40%)  
Acetic acid: 200 ppb  
Temperature: 25°C



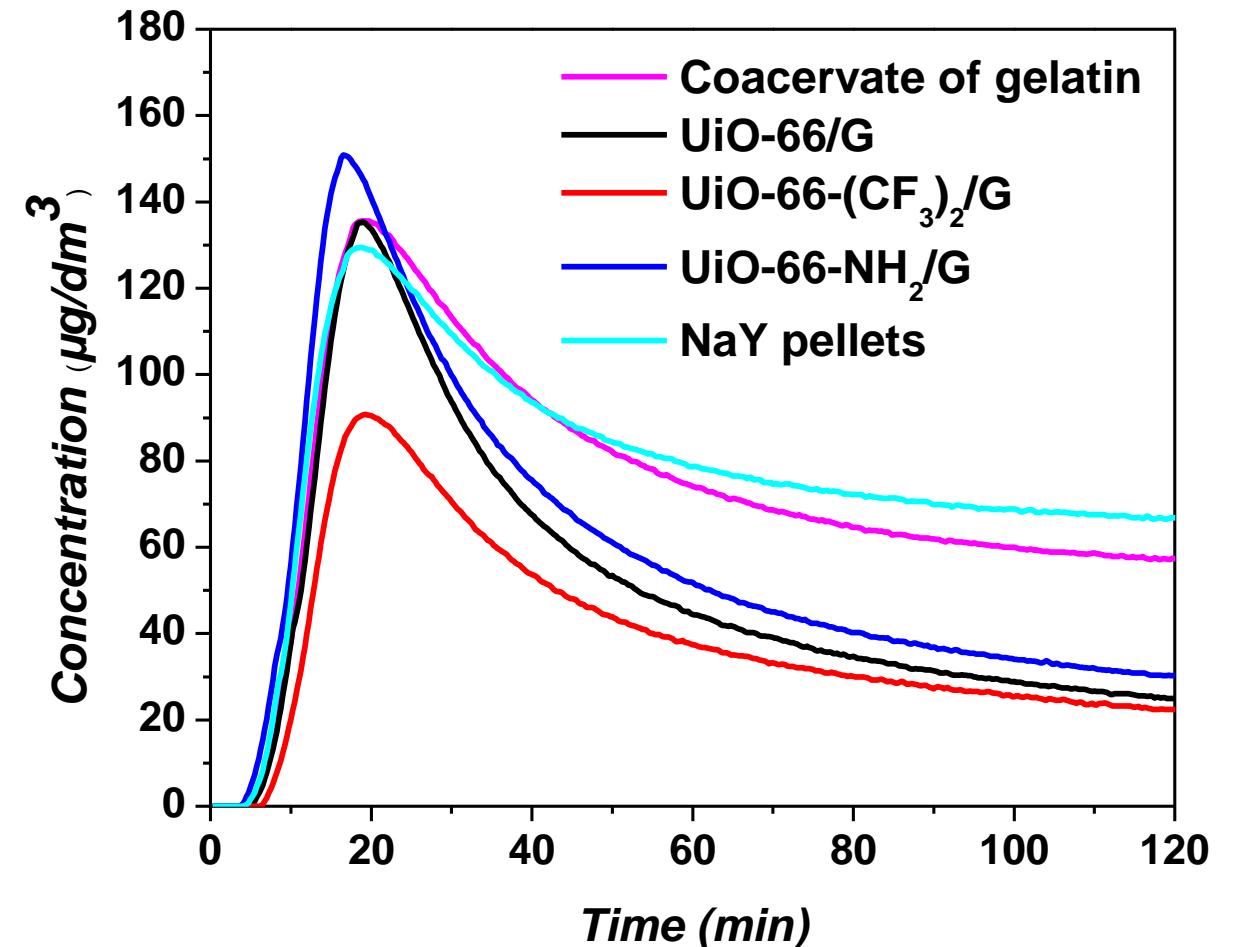


# ADSORPTION EFFICIENCY OF MOFs-GELATIN COMPOSITES FOR ACOH IN HUMID CONDITIONS

## Pure MOFs



## MOFs/G composites





## CONCLUSIONS

- ☐ **MOFs-gelatin composites with a high MOF loading, good cristallinity and high porosity.**
- ☐ **Homogeneous distribution of MOFs nanoparticles in the gelatin matrix.**
- ☐ **Shaping of these composites (tablets, films)**
- ☐ **High efficiency of these composites for the selective capture of acetic acid under humid ambient conditions**
- ☐ **Article recently submitted**





Ali Saad



## FINAL WORKSHOP:

The NEMOSINE innovative package and solutions for 20th century cultural heritage preservation.



NEMOSINE has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 760801.

# Acknowledgements



**université**  
PARIS-SACLAY

UNIVERSITÉ DE  
VERSAILLES  
ST-QUENTIN-EN-YVELINES

**S. Biswas,  
A. Saad  
M. Haouas,  
C. Livage  
E. Dumas  
C. Sicard**

## IMAP, Paris

**H. Zhao,  
G. Mouchaham,  
C. Serre**

## Univ. Lisbonne

**C. Freitas,  
A. Al Mohtar  
M. Pinto,**

## ICGM, Montpellier

**C. Vieira Soares,  
G. Maurin**

## IMPMC, Paris

**N. Menguy,**

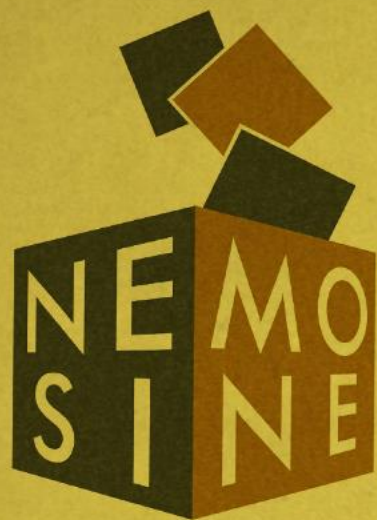
## MSC, Paris Diderot

**F. Carn**

## INRA, Jouy en Josas

**C. Longin**





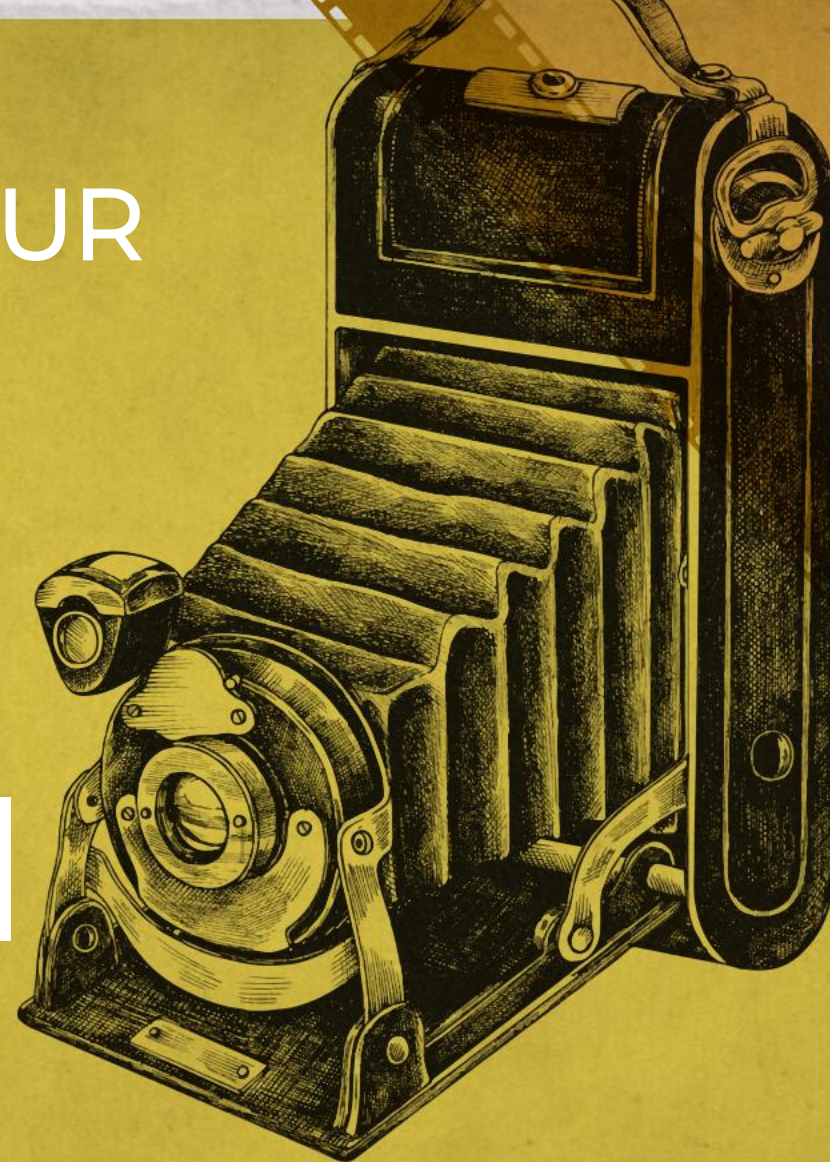
# THANKS FOR YOUR ATTENTION

**Nathalie Steunou**

**nathalie.steunou@uvsq.fr**



**université**  
PARIS-SACLAY



More info at: **nemosineproject.eu**



NEMOSINE has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 760801.