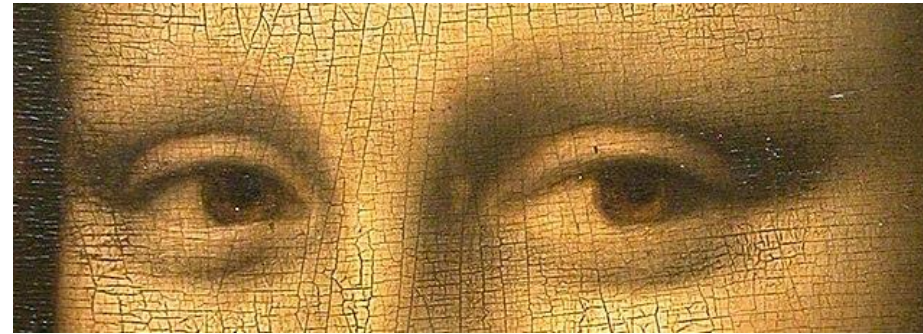


# Técnicas espectroscópicas aplicadas al estudio de materiales



**Sagrario Martínez Ramírez**  
**Ana Crespo Ibáñez**

Departamento de Espectroscopía Nuclear, Vibracional y de Medios Desordenados

Instituto de Estructura de la Materia (CSIC)

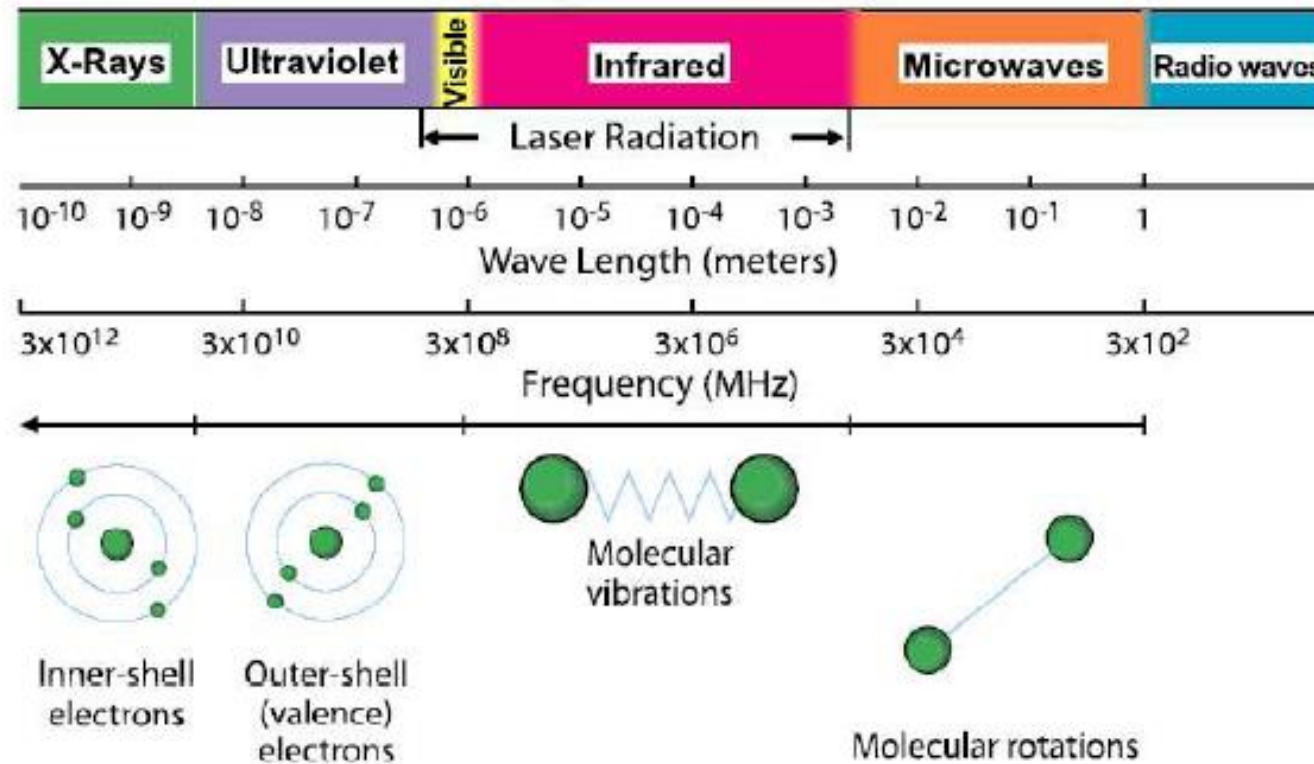
Madrid

[sagrario.martinez@csic.es](mailto:sagrario.martinez@csic.es)

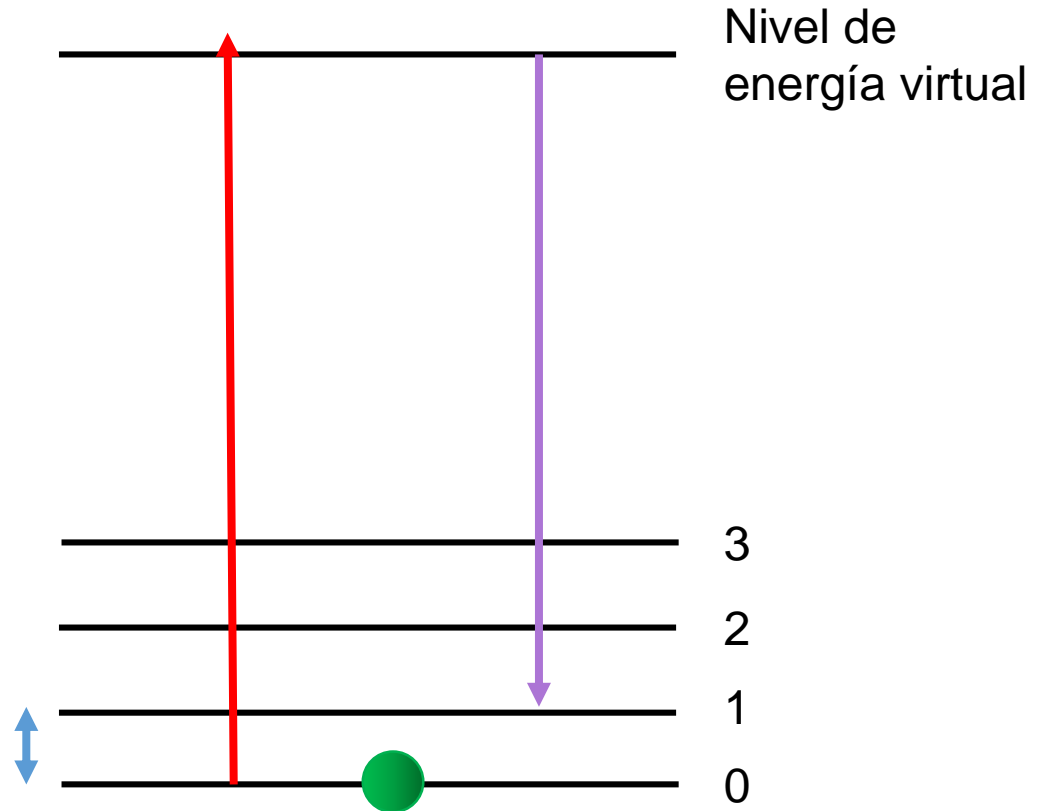
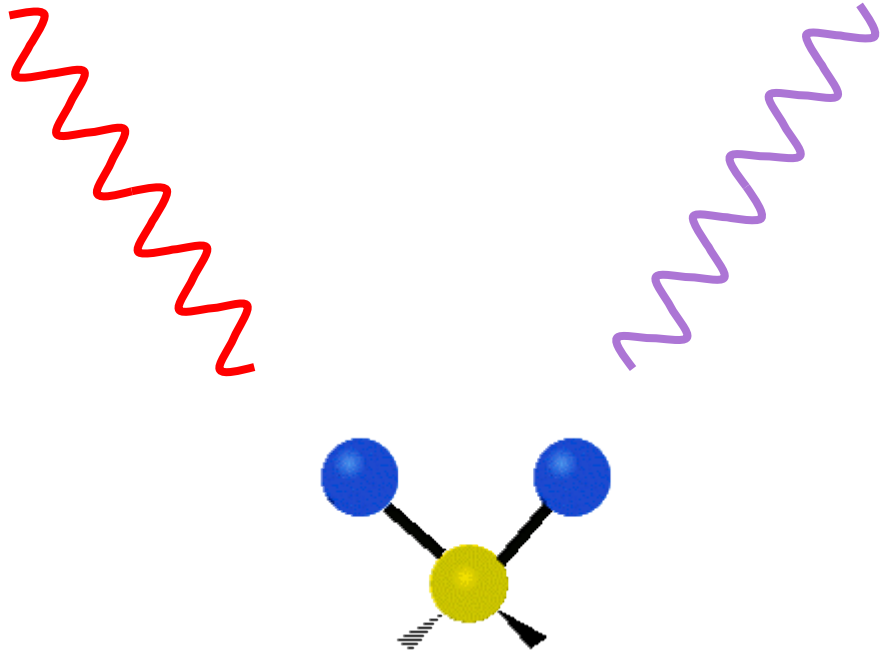
[a.crespo.i@csic.es](mailto:a.crespo.i@csic.es)

# TÉCNICAS ESPECTROSCÓPICAS

Interacción materia – radiación electromagnética

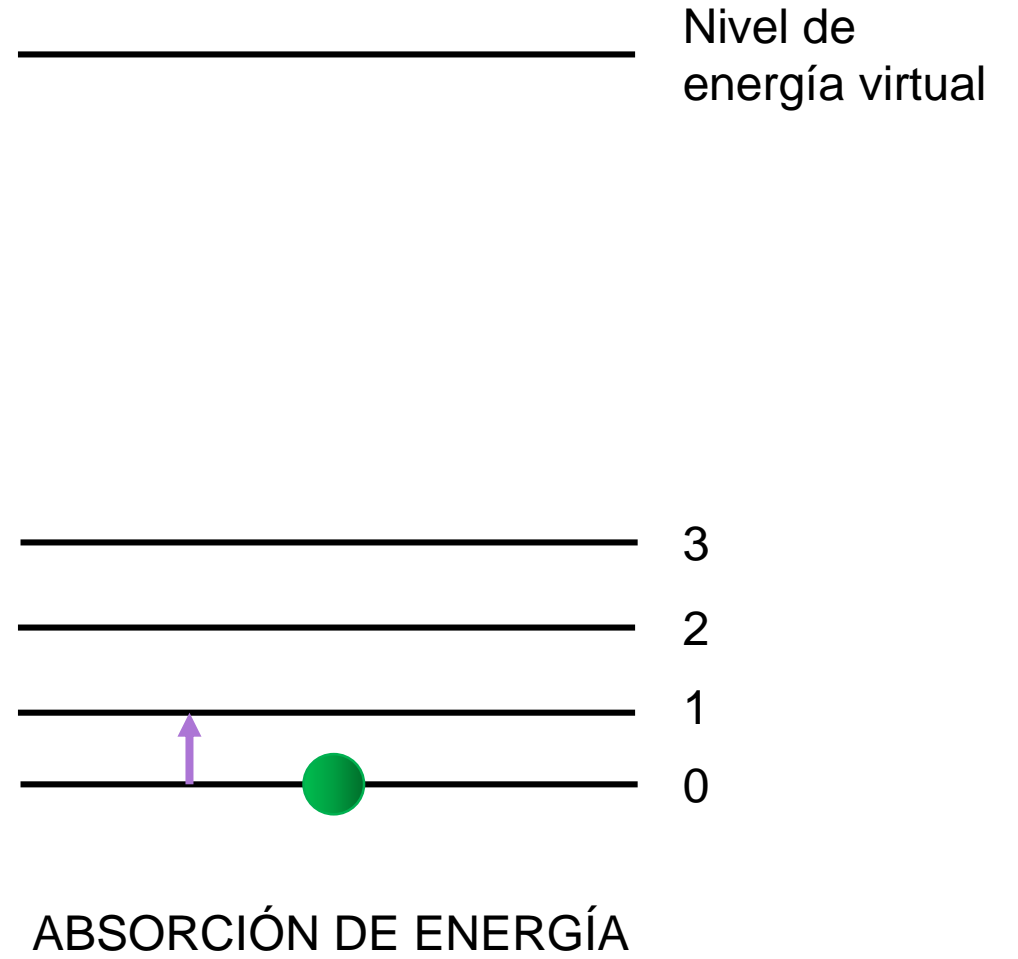
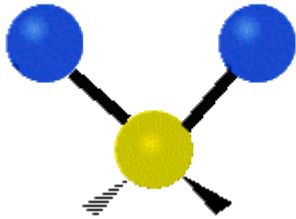
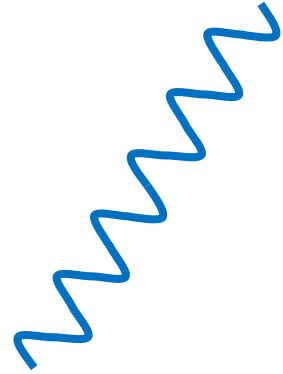
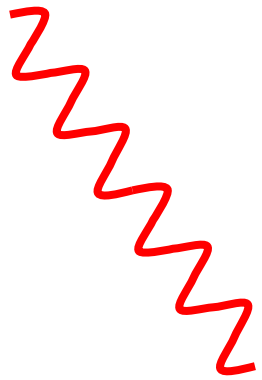


# RAMAN

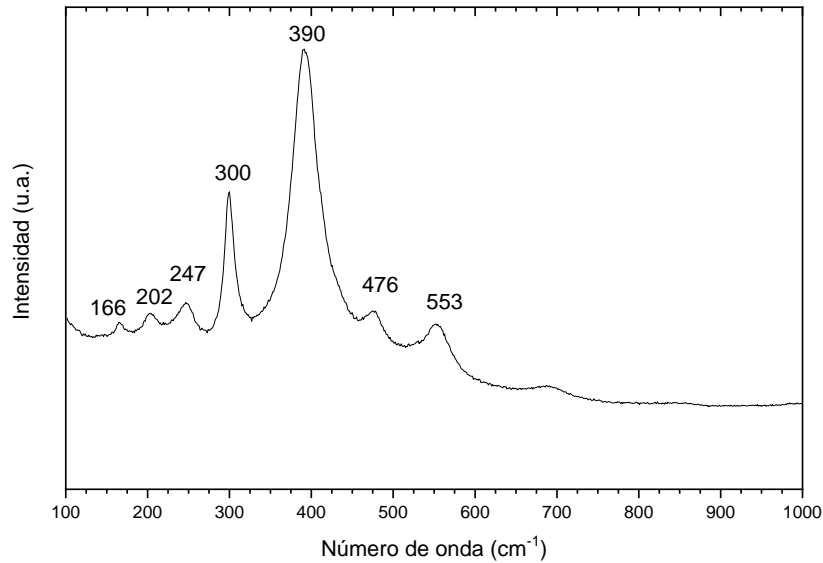


DISPERSIÓN DE ENERGÍA

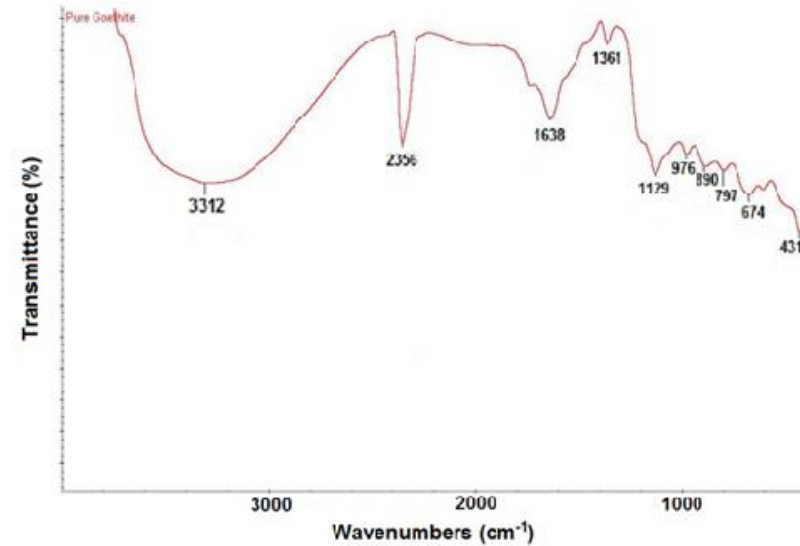
IR



## Espectro Raman

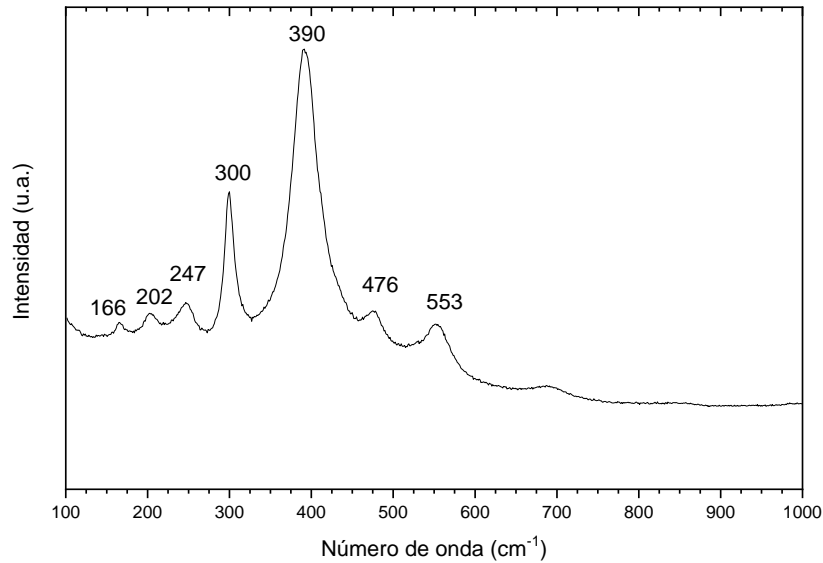


## Espectro IR



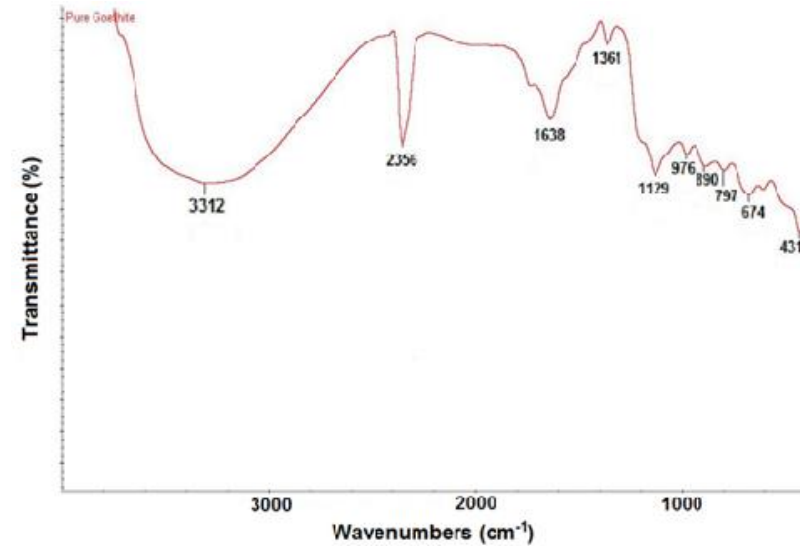
- Análisis de compuestos cristalinos y amorfos, orgánicos e inorgánicos
- Técnica no destructiva
- Sin preparación de muestra

## Espectro Raman

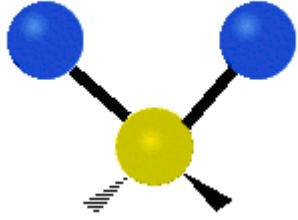


- Fluorescencia
- Permite analizar muestras húmedas
- Menor sensibilidad

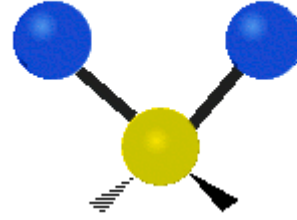
## Espectro IR



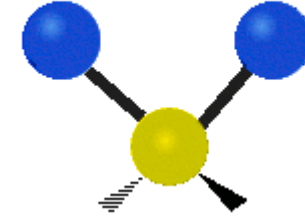
- No tiene fluorescencia
- No puede analizar muestras húmedas
- Mayor sensibilidad



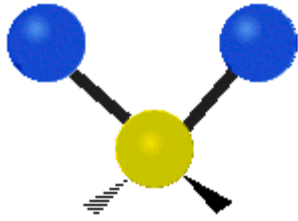
Tensión simétrica



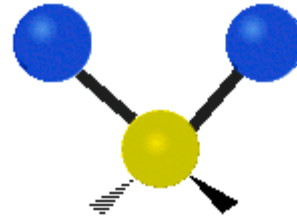
Rotación



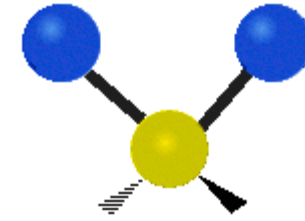
Twisting



Tensión asimétrica

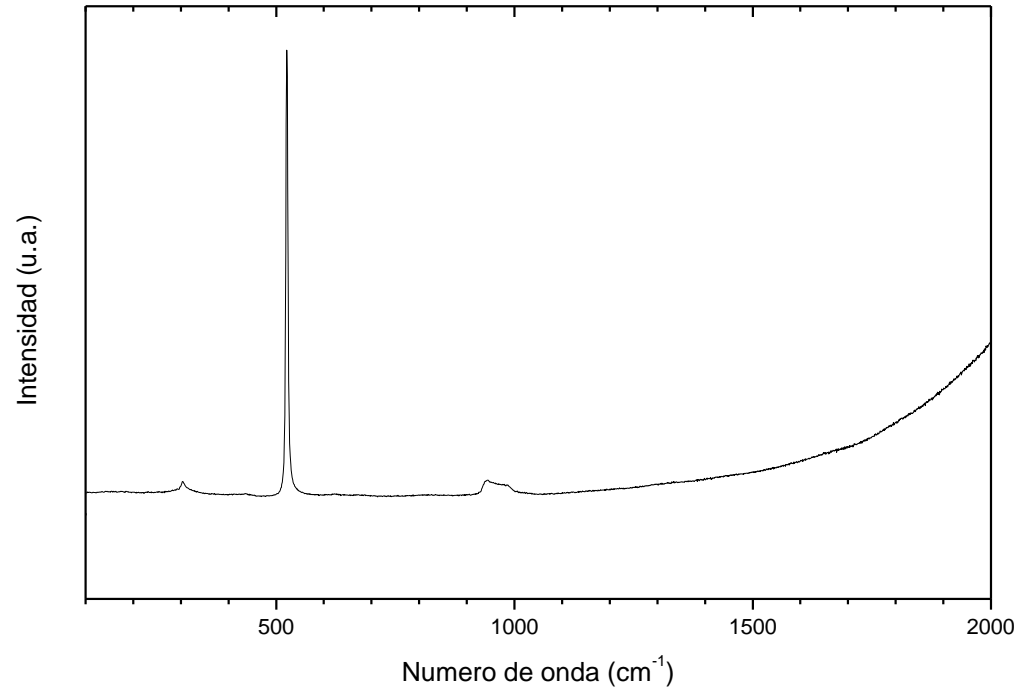
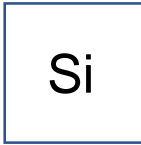


Scissoring

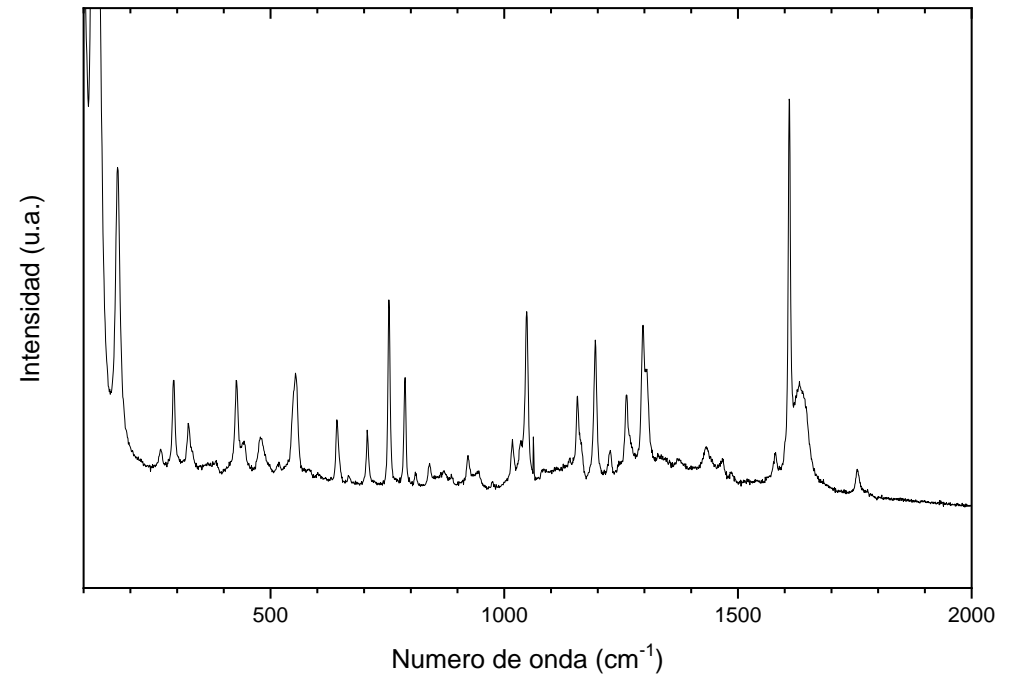
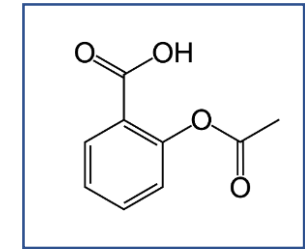


Wagging

Silicio

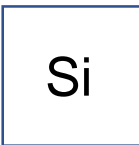


Ácido acetil salicílico

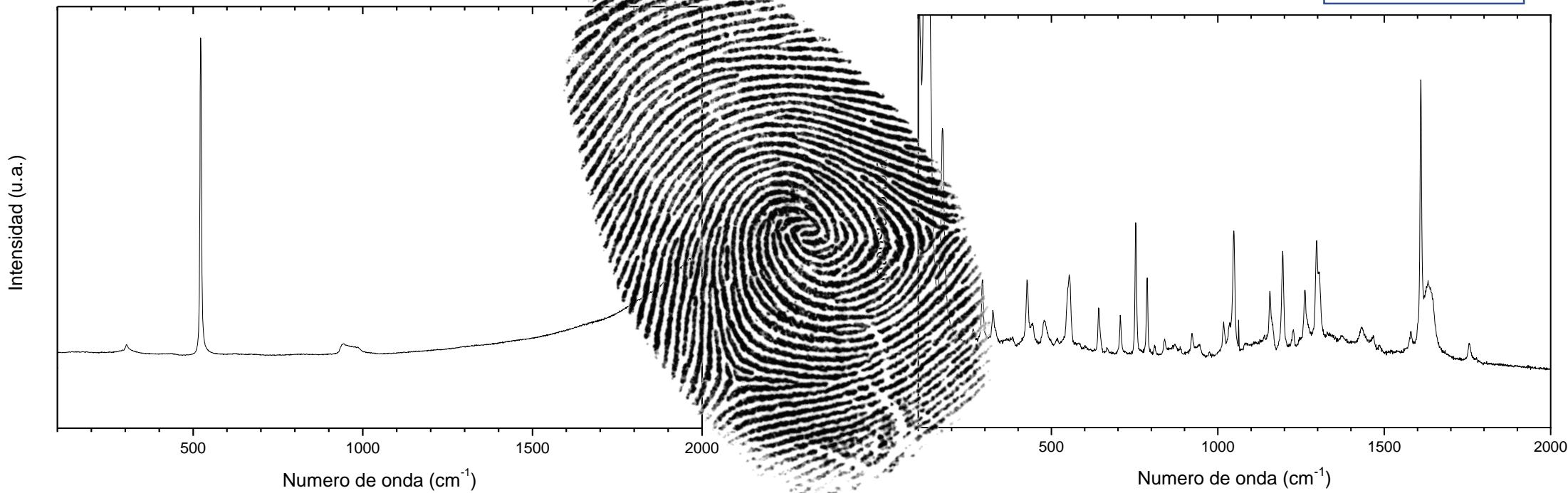
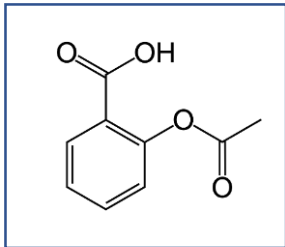




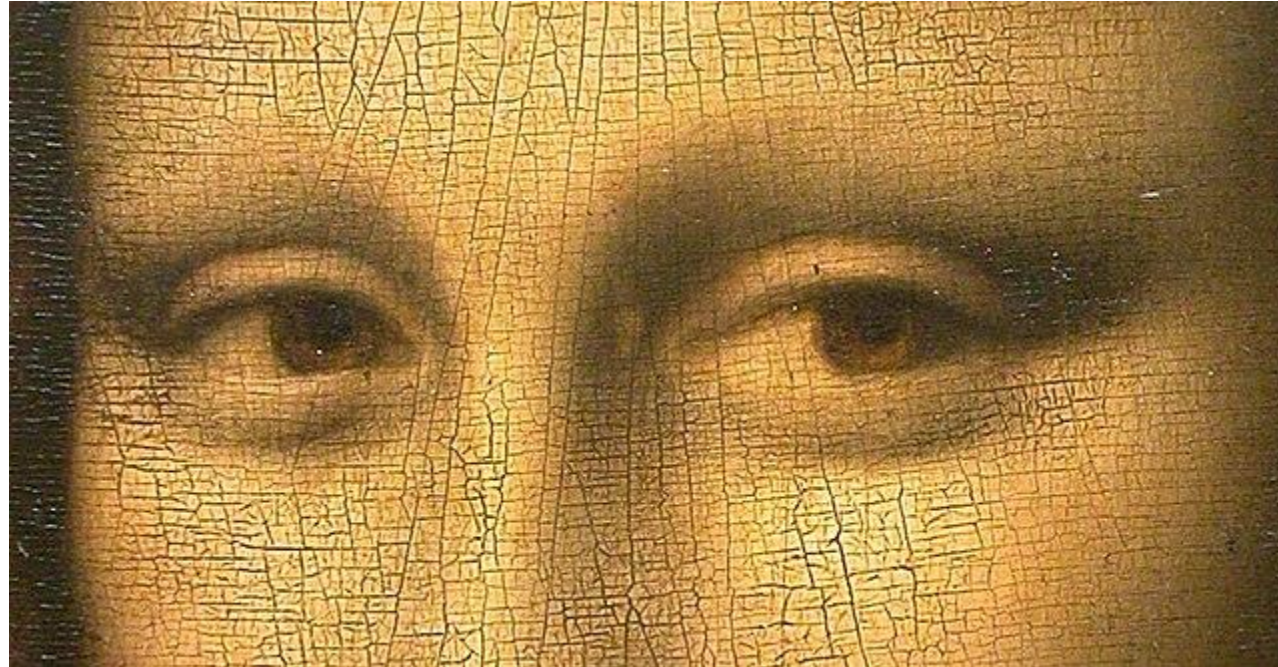
Silicio



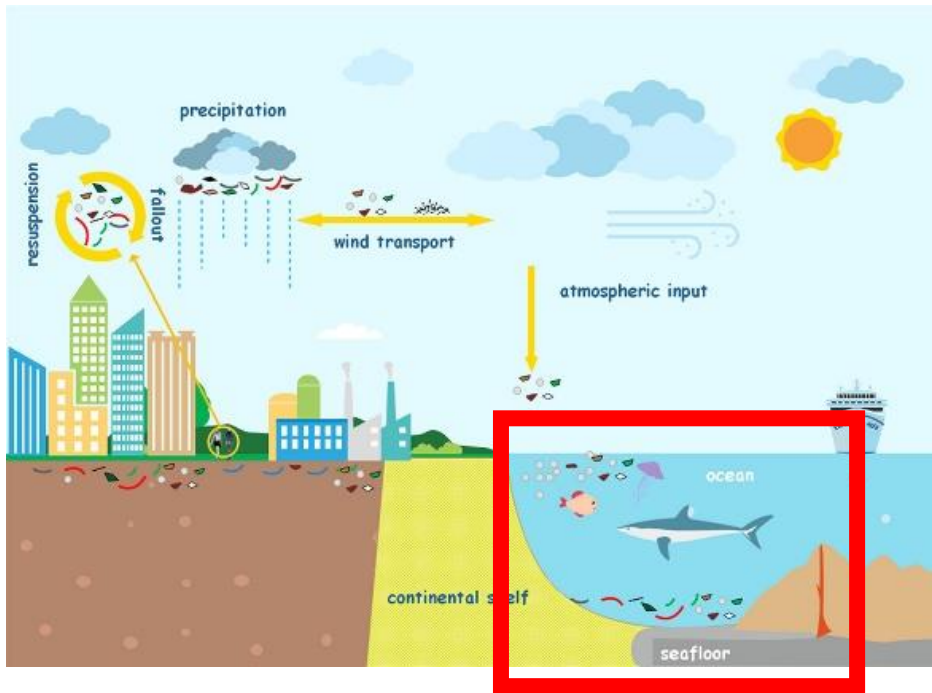
Ácido acetil salicílico



# CARACTERIZACIÓN DE MATERIALES



# ESTUDIO DE DEGRADACIÓN DE MATERIALES

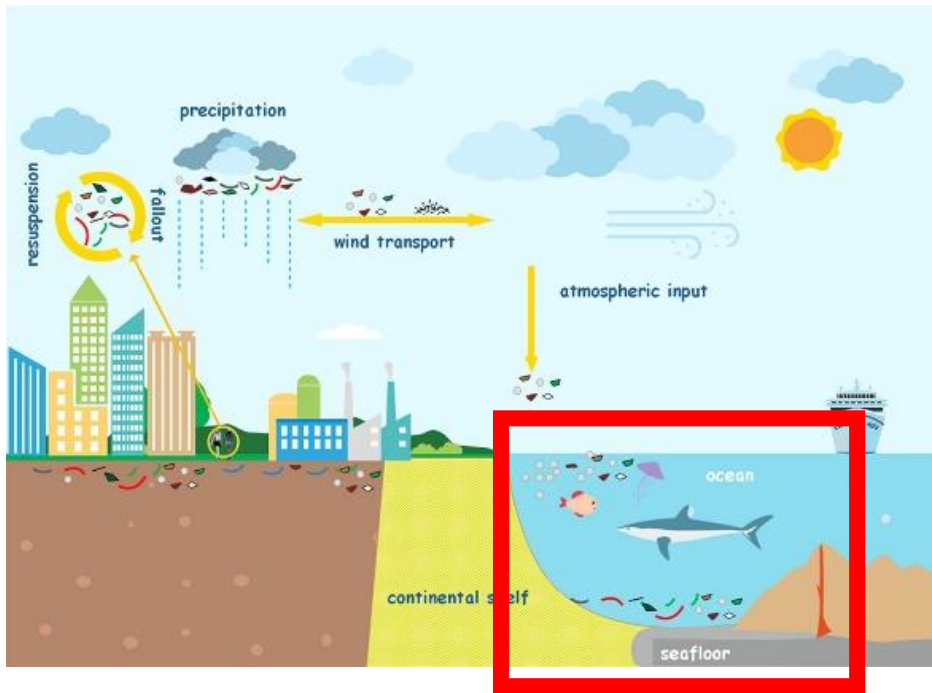


Fuente: Source and potential risk assessment of suspended atmospheric microplastics in Shanghai. Kai Liu et al. Science of The Total Environment 675 (2019) 462-471

Plástico ↔ Micro/nano plásticos



# ESTUDIO DE DEGRADACIÓN DE MATERIALES



Fuente: Source and potential risk assessment of suspended atmospheric microplastics in Shanghai. Kai Liu et al. Science of The Total Environment 675 (2019) 462-471

Plástico ↔ Micro/nano plásticos



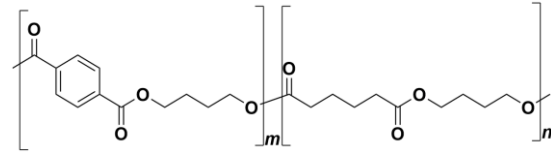
# Estudio del deterioro de plásticos biodegradables en agua de mar



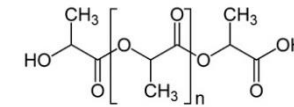
TFM Eliana Rodríguez  
(Máster en Materiales Avanzados, Nanotecnología y Fotónica, UAM)

# MUESTRAS

## PBAT



## Yuca



MUESTRAS

PBAT

Yuca

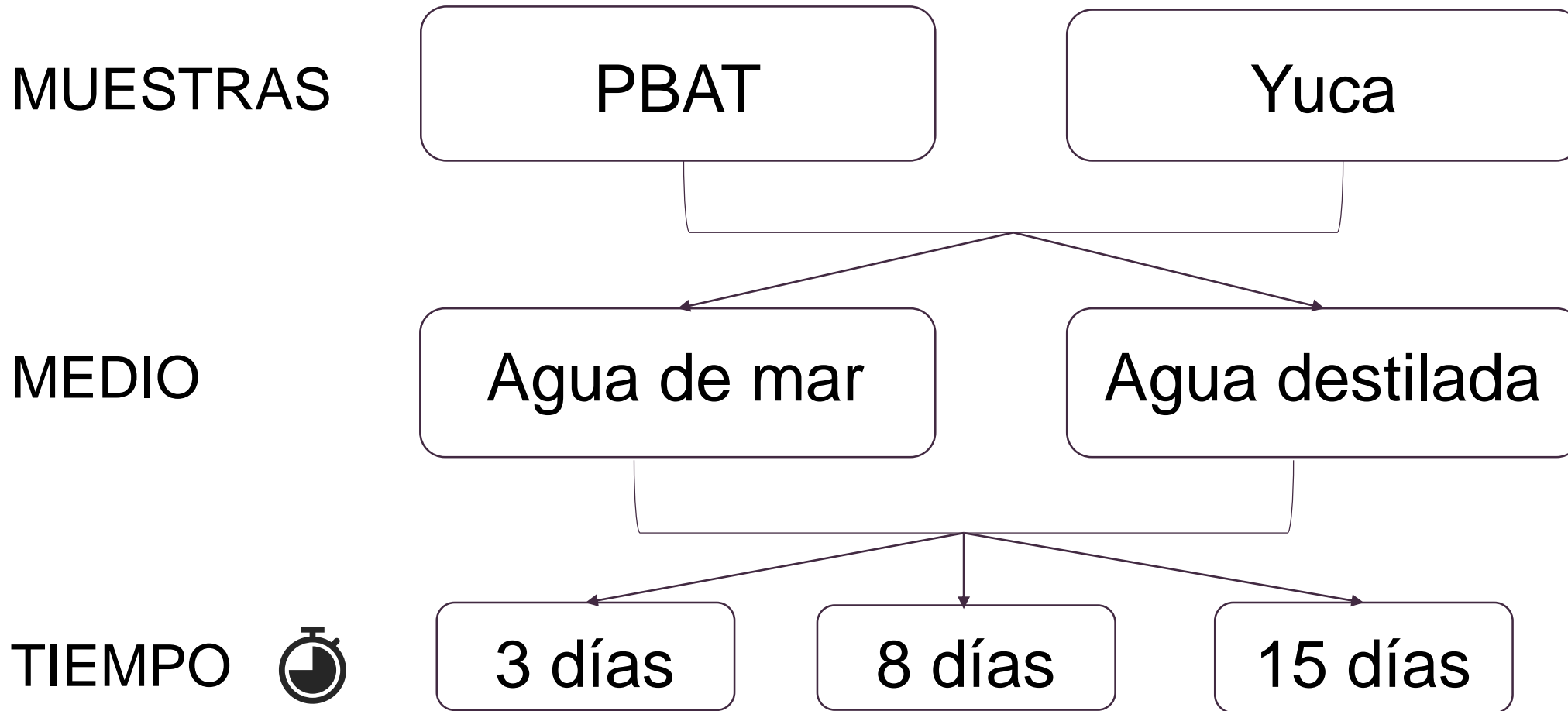
MEDIO

Agua de mar

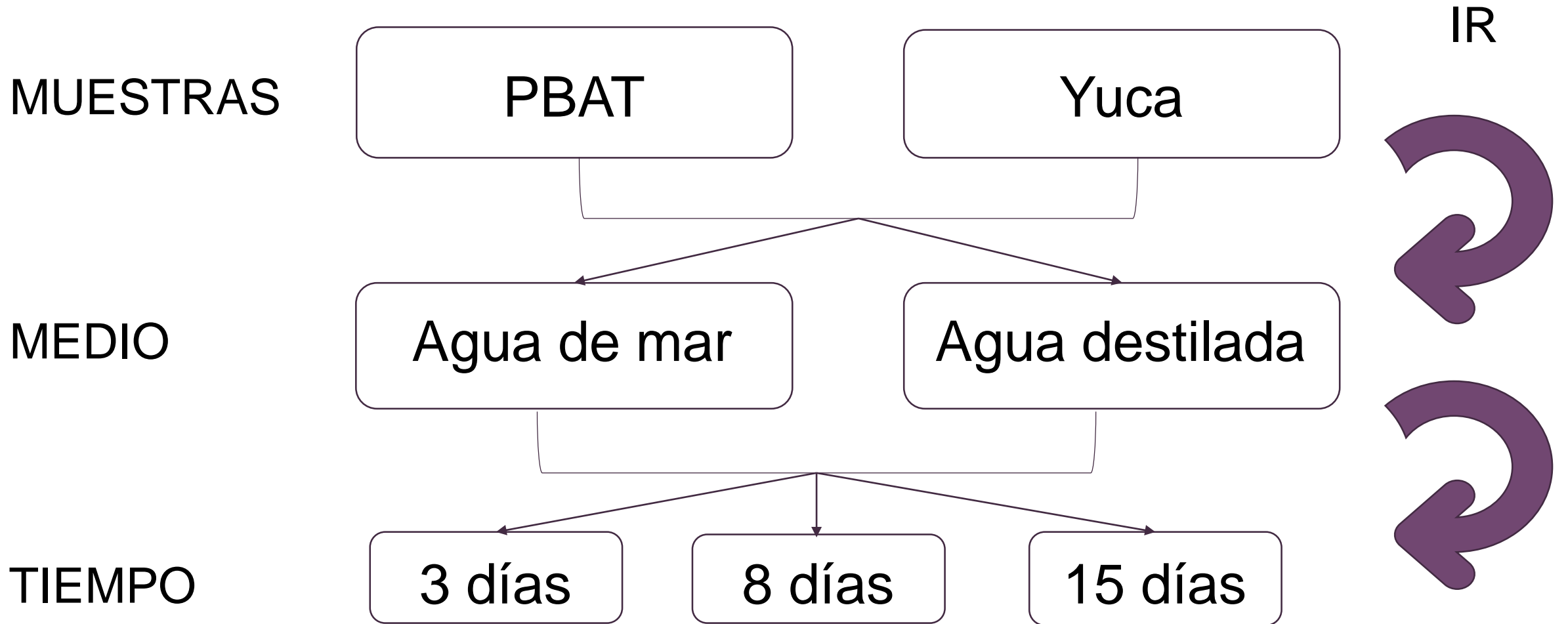


Agua destilada

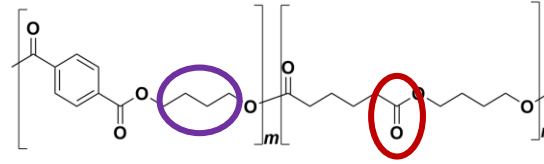




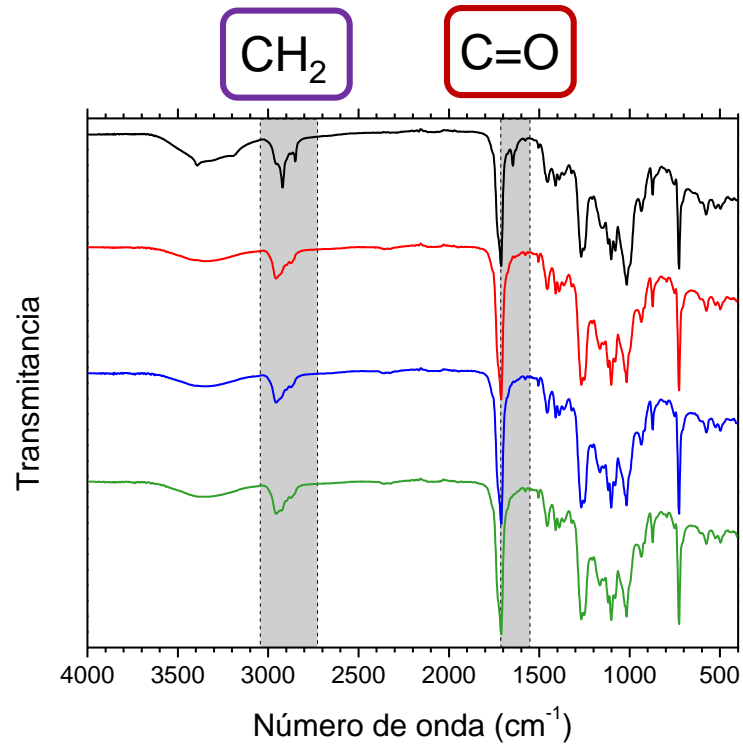




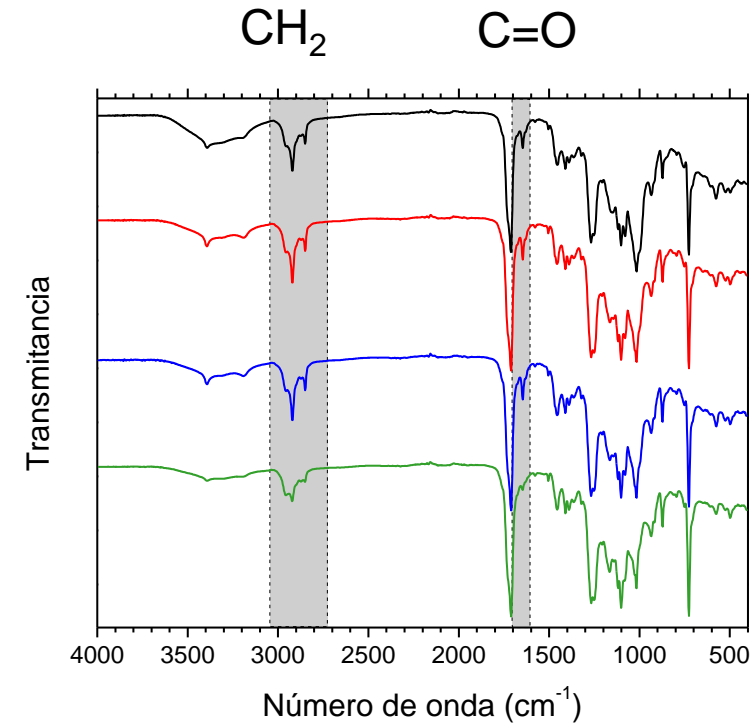
# PBAT



## Agua destilada

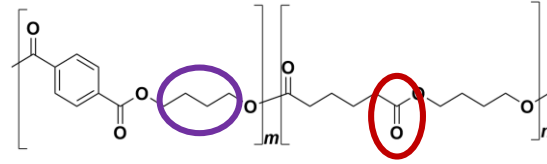


## Agua de mar



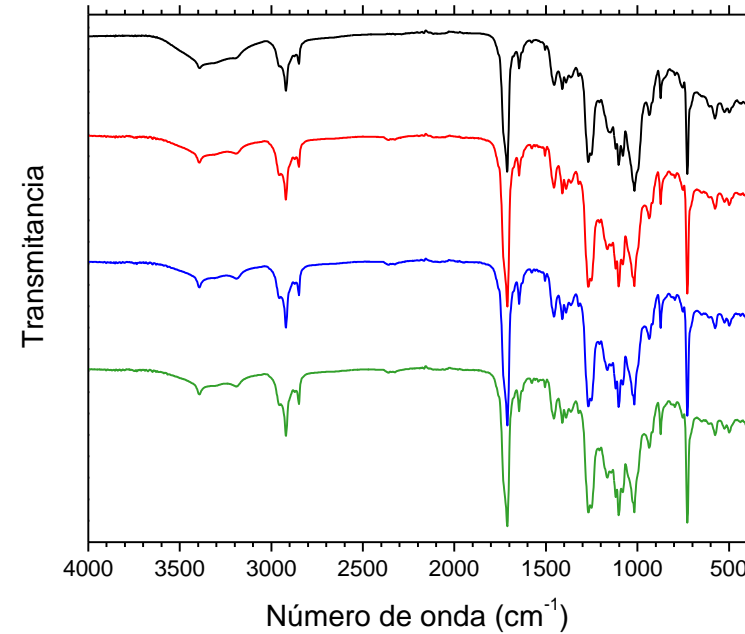
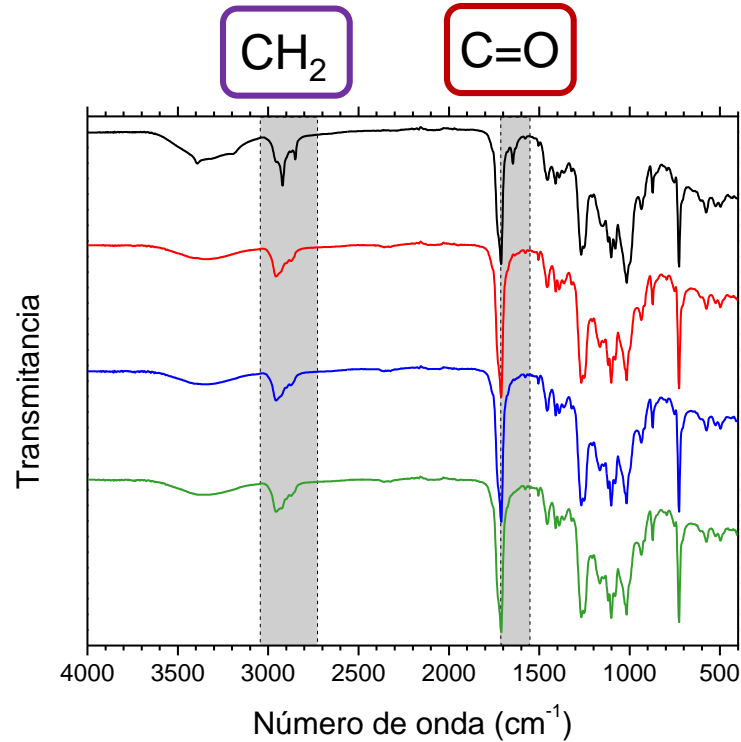
— Patrón — 3 días — 8 días — 15 días

# PBAT



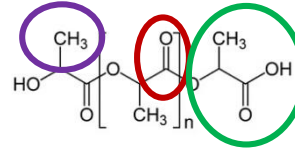
## Agua destilada pH 4.7

## Agua destilada pH7

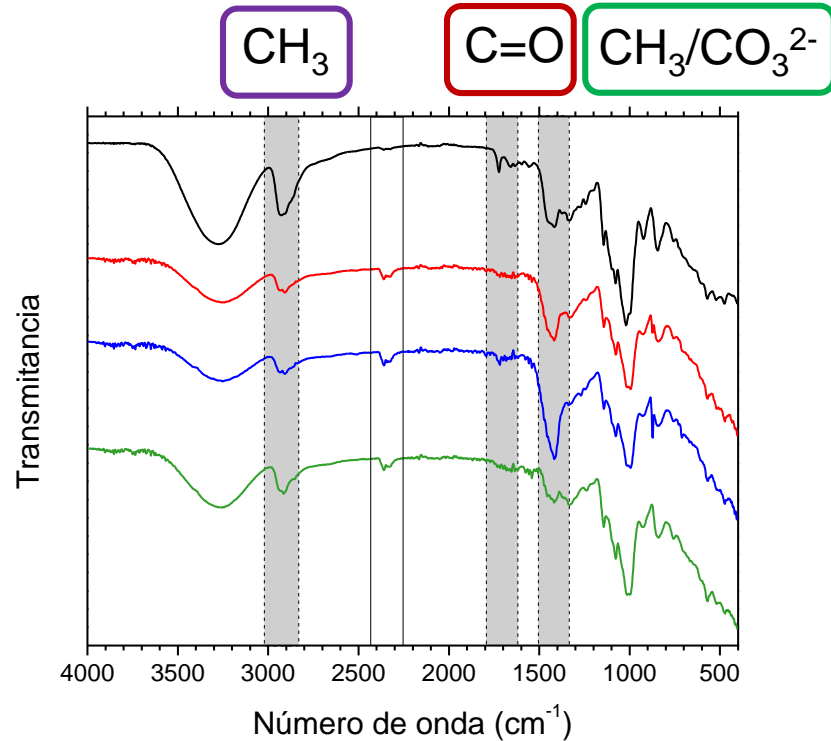


— Patrón — 3 días — 8 días — 15 días

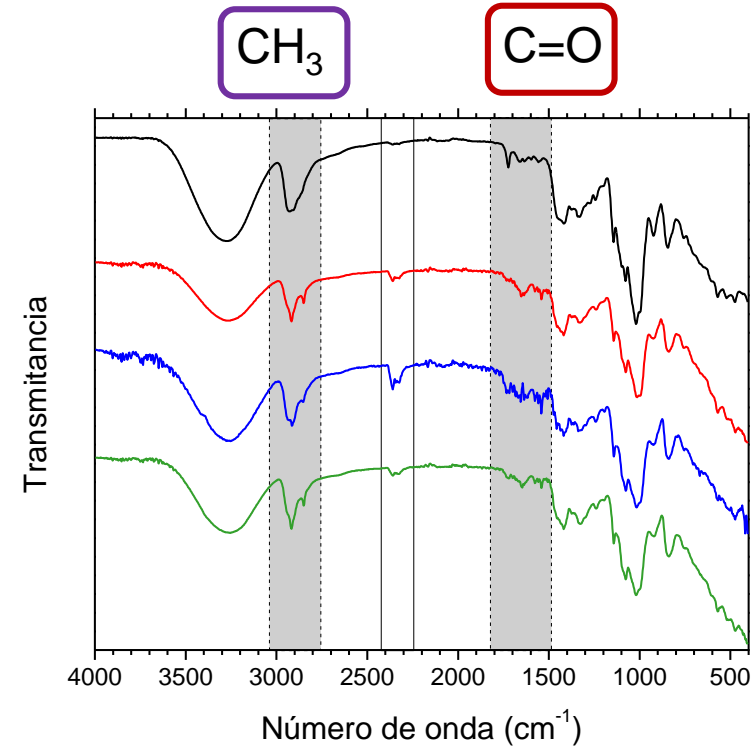
# Yuca (PLA)



## Agua destilada pH 4.7

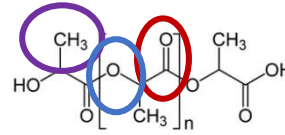


## Agua de mar

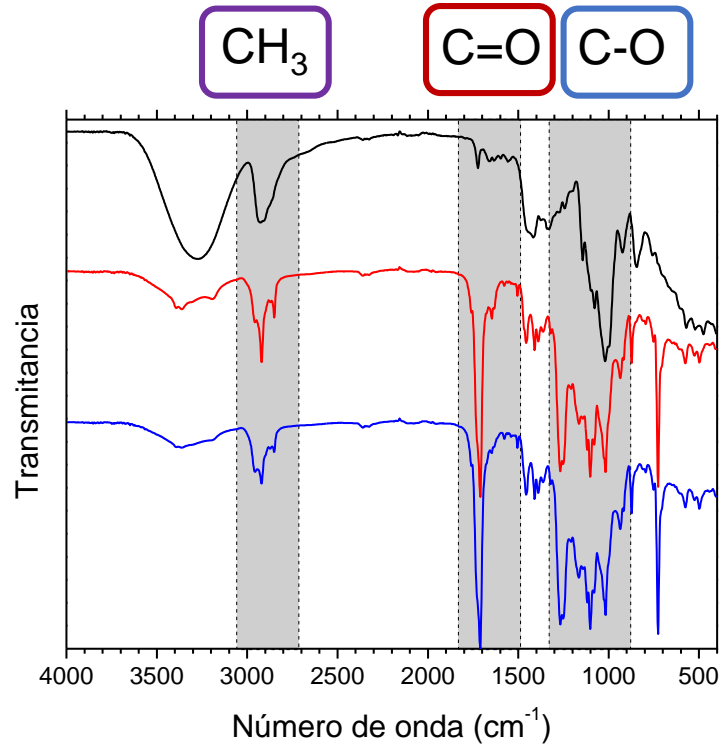


— Patrón — 3 días — 8 días — 15 días

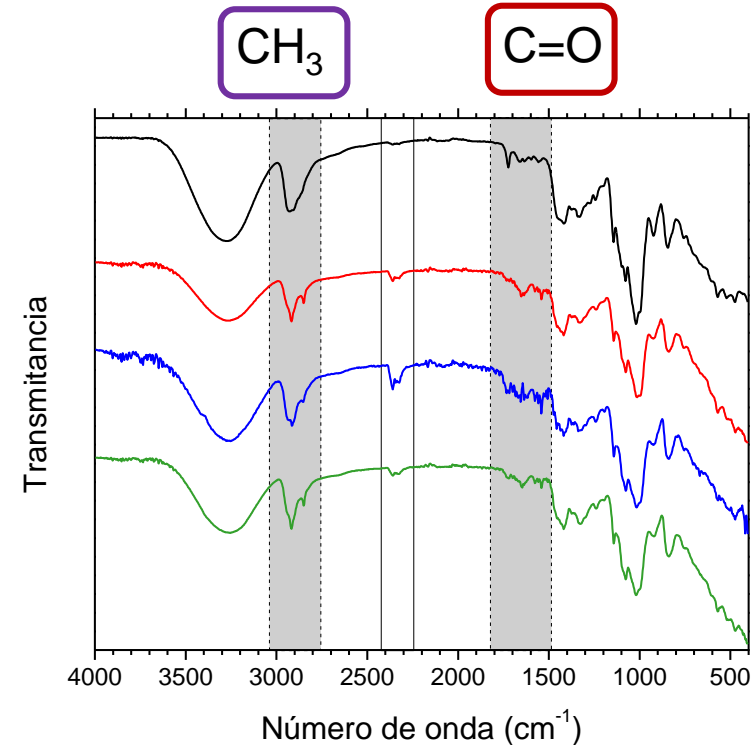
# Yuca (PLA)



## Agua de mar 40°C

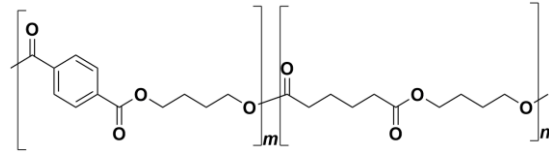


## Agua de mar



— Patrón — 3 días — 8 días — 15 días

PBAT

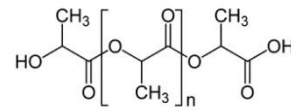


MEDIO



pH ácido

Yuca (PLA)



T<sup>a</sup> y sales

# EQUIPOS

## LABORATORIO

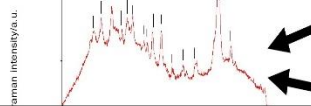
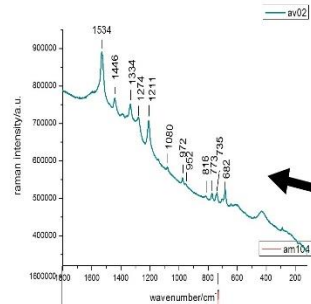


## PORTÁTIL

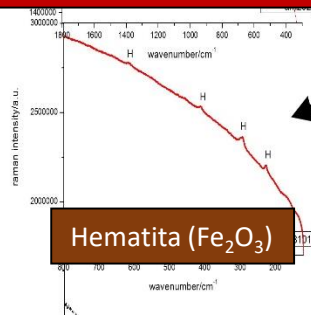


# LABORATORIO

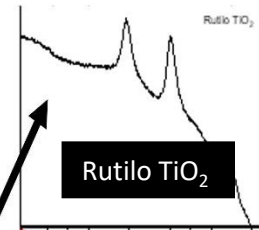
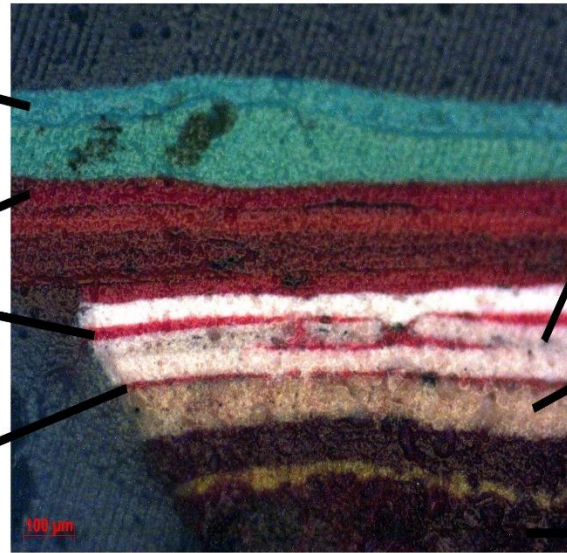
## Ftalocianina de Cu



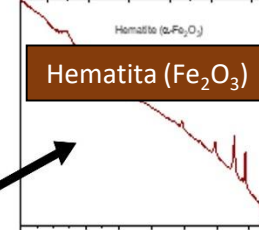
Pigmento orgánico tipo "azo"



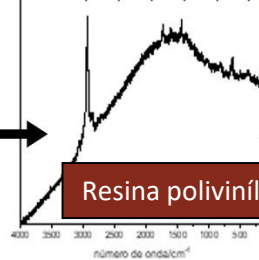
Hematita (Fe<sub>2</sub>O<sub>3</sub>)



Rutilo TiO<sub>2</sub>



Hematita (Fe<sub>2</sub>O<sub>3</sub>)



Resina polivinílica



a

b

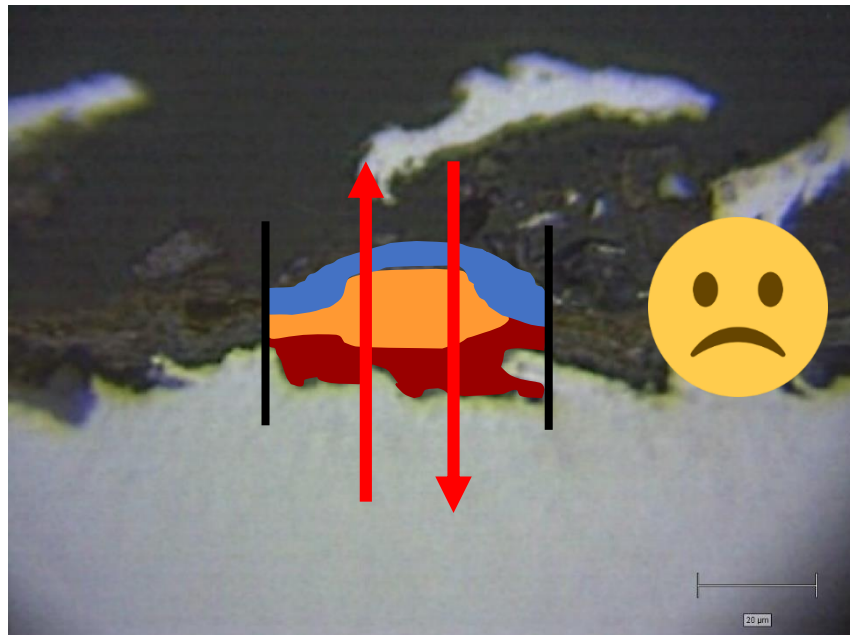


a)



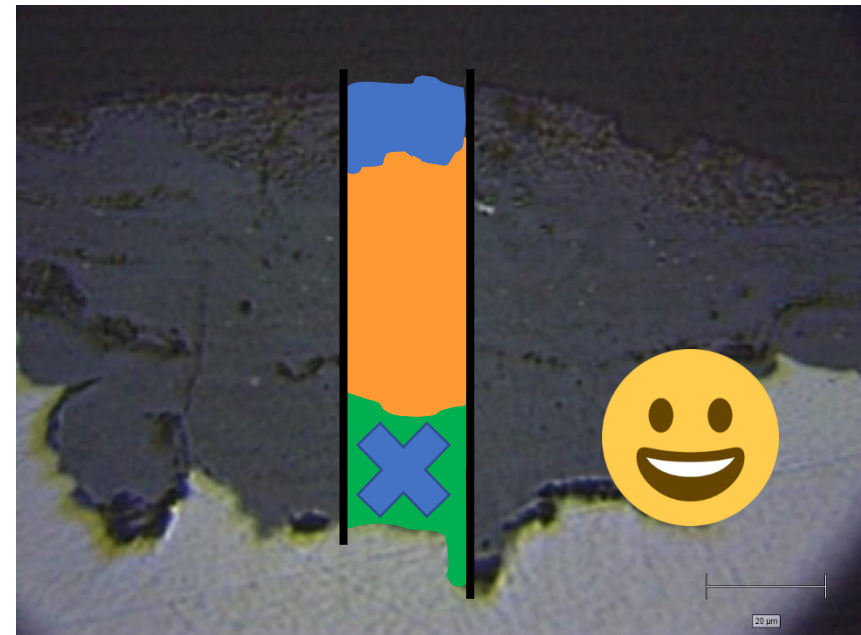
# LABORATORIO

## FERRIHIDRITA



Reactivo catódico

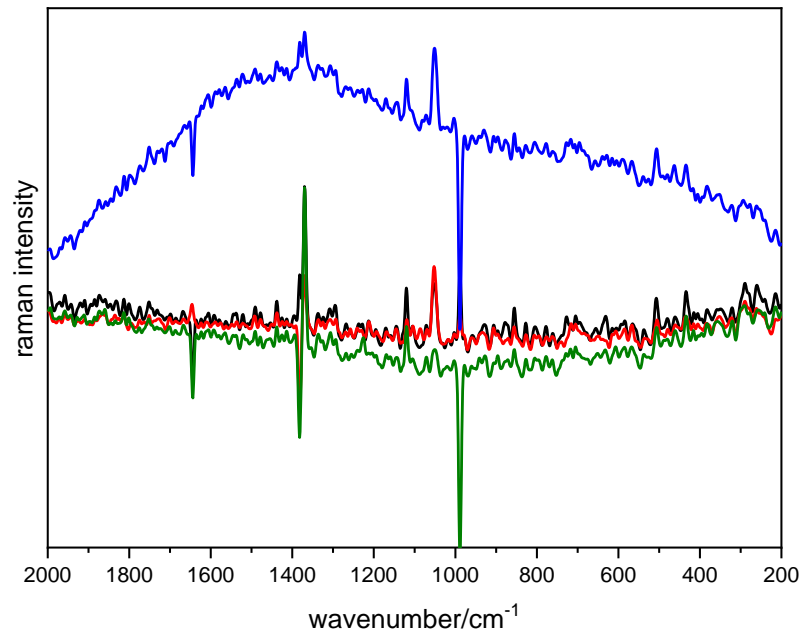
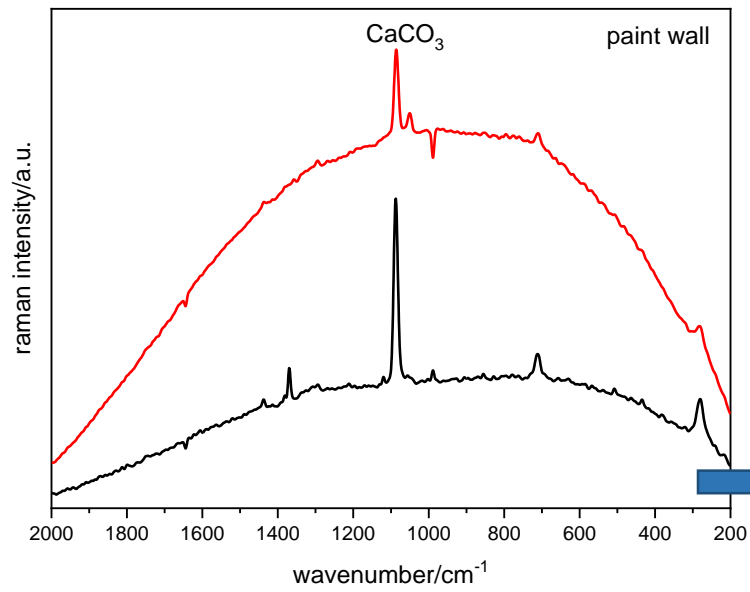
## GOETITA



Termodinámicamente estable

# PORTÁTIL

ESTUDIO EN EDIFICACIONES



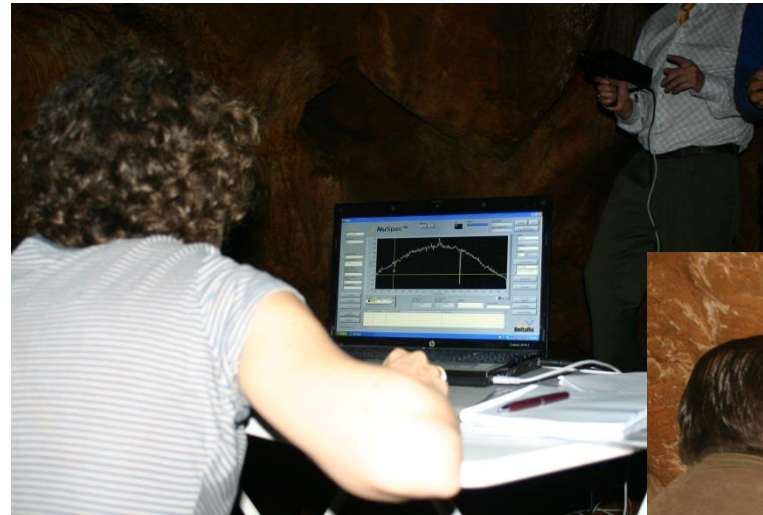
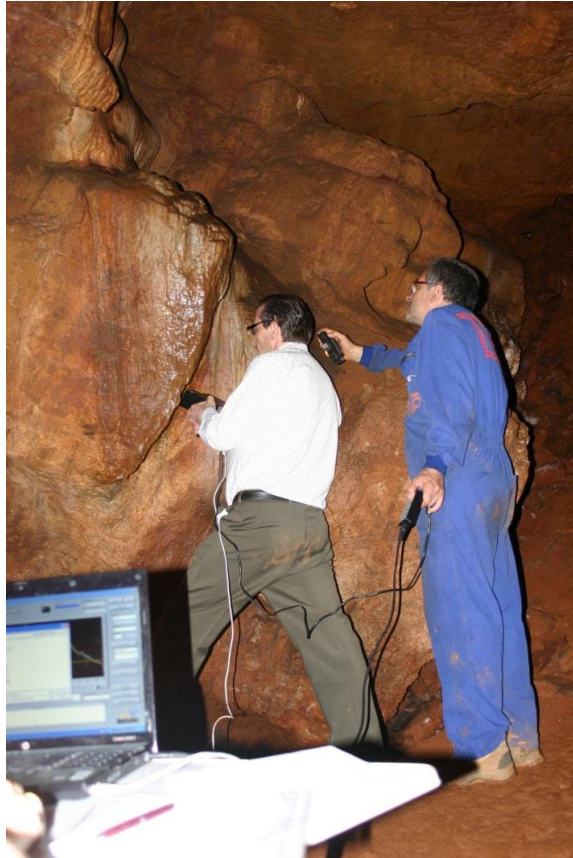
# PORTÁTIL

## ESTUDIO DE PINTURAS RUPESTRES CUEVAS DE MALTRAVIESO CÁCERES



# PORTÁTIL

## ESTUDIO DE PINTURAS RUPESTRES CUEVAS DE MALTRAVIESO CÁCERES



PORTÁTIL

ESTUDIO DE PINTURAS RUPESTRES  
CUEVAS DE MALTRAVIESO CÁCERES

Positivo

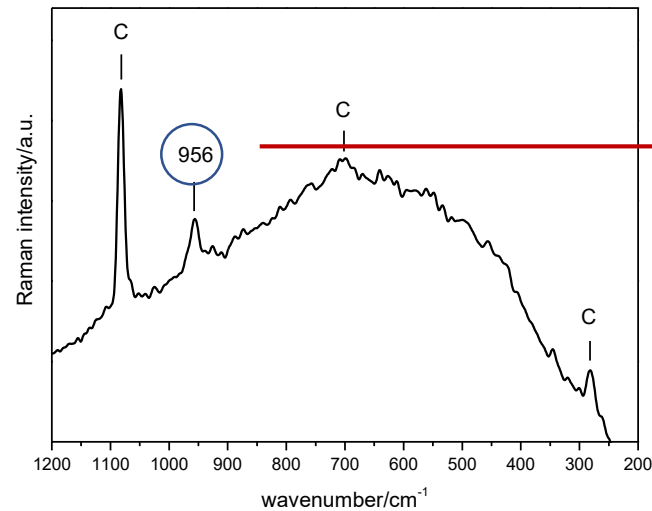
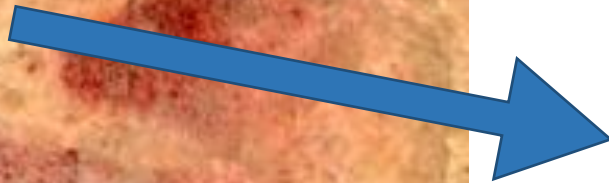


Negativo



# PORTÁTIL

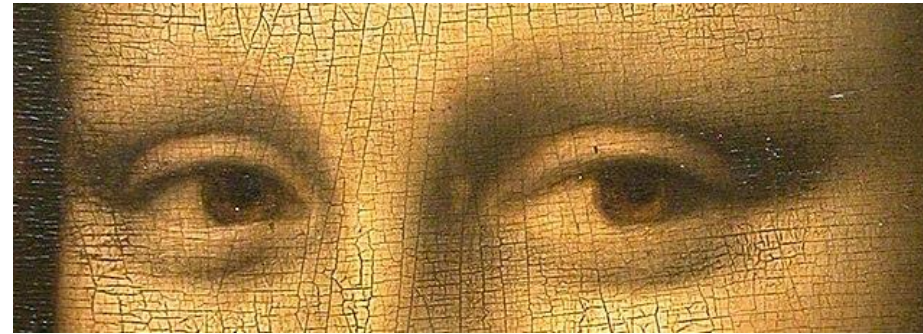
## ESTUDIO DE PINTURAS RUPESTRES CUEVAS DE MALTRAVIESO CÁCERES



$v_1 \text{ PO}_4^{3-}$  in  $\text{Ca}_3(\text{PO}_4)_2$

TÉCNICA MIXTA

# Técnicas espectroscópicas aplicadas al estudio de materiales



**Sagrario Martínez Ramírez**  
**Ana Crespo Ibáñez**

Departamento de Espectroscopía Nuclear, Vibracional y de Medios Desordenados

Instituto de Estructura de la Materia (CSIC)

Madrid

[sagrario.martinez@csic.es](mailto:sagrario.martinez@csic.es)

[a.crespo.i@csic.es](mailto:a.crespo.i@csic.es)