DEVELOPMENT OF NANOCOMPOSITE MATERIALS FOR THE RECOVERY OF CESIUM AND URANIUM

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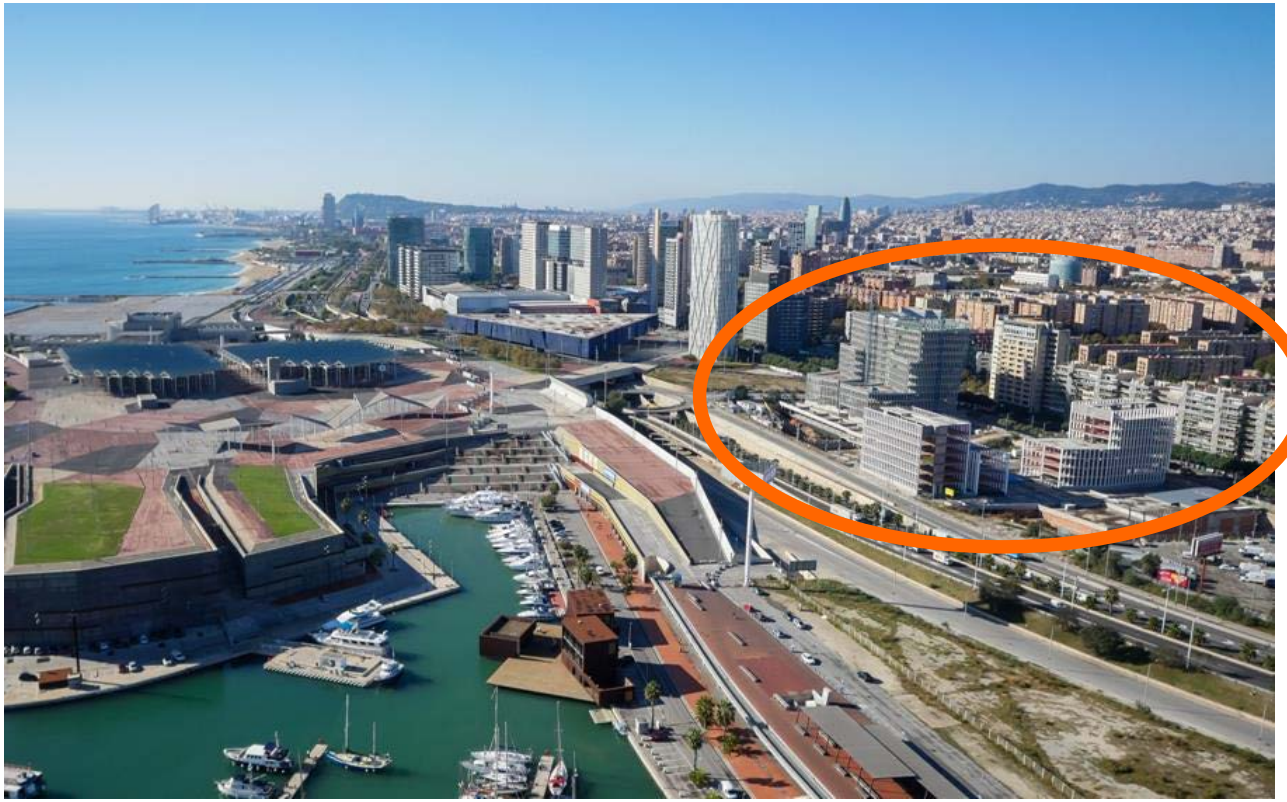

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OBJECTIVES

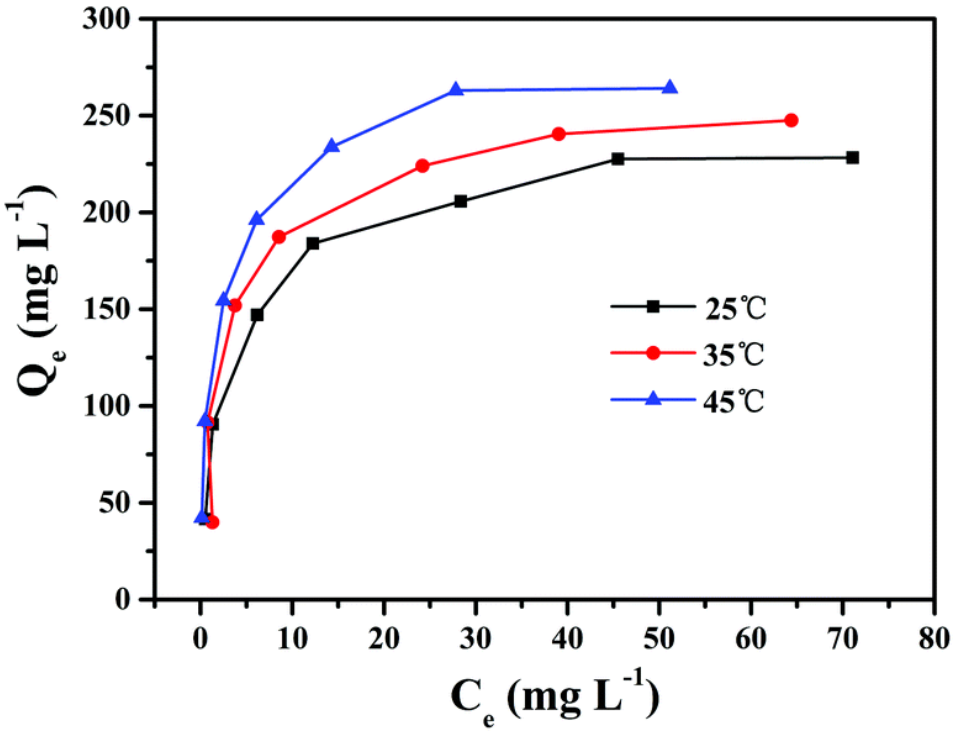
1) Development of two nanostructured hybrid nanocomposite:

- Cellulose TriAcetate (CTA) + Prussian Blue (PB)
- CTA + graphite

2) Characterization of these nanocomposites

3) Recovery capacity of Cesium and Uranium

RECOVERY OF URANIUM BY GRAPHITE/ACTIVATED CARBON



RECOVERY OF CESIUM BY PRUSSIAN BLUE

Prussian Blue (PB): Iron(III) hexacyanoferrate(II)

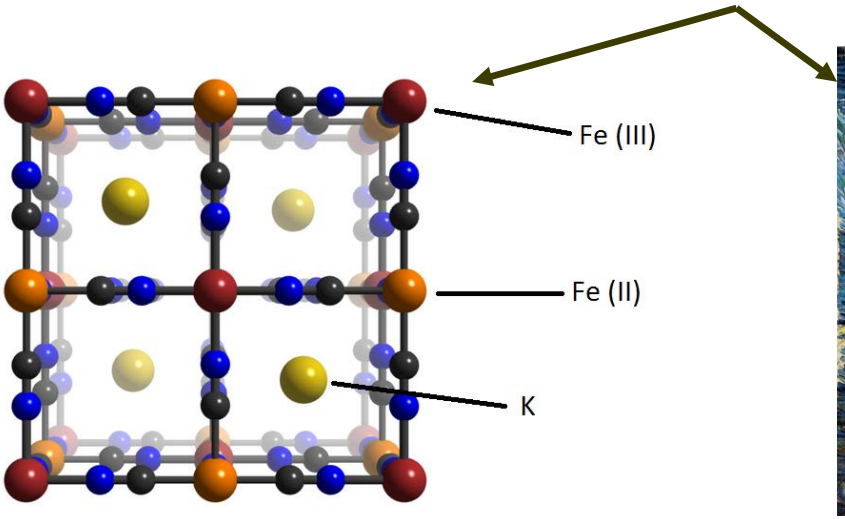
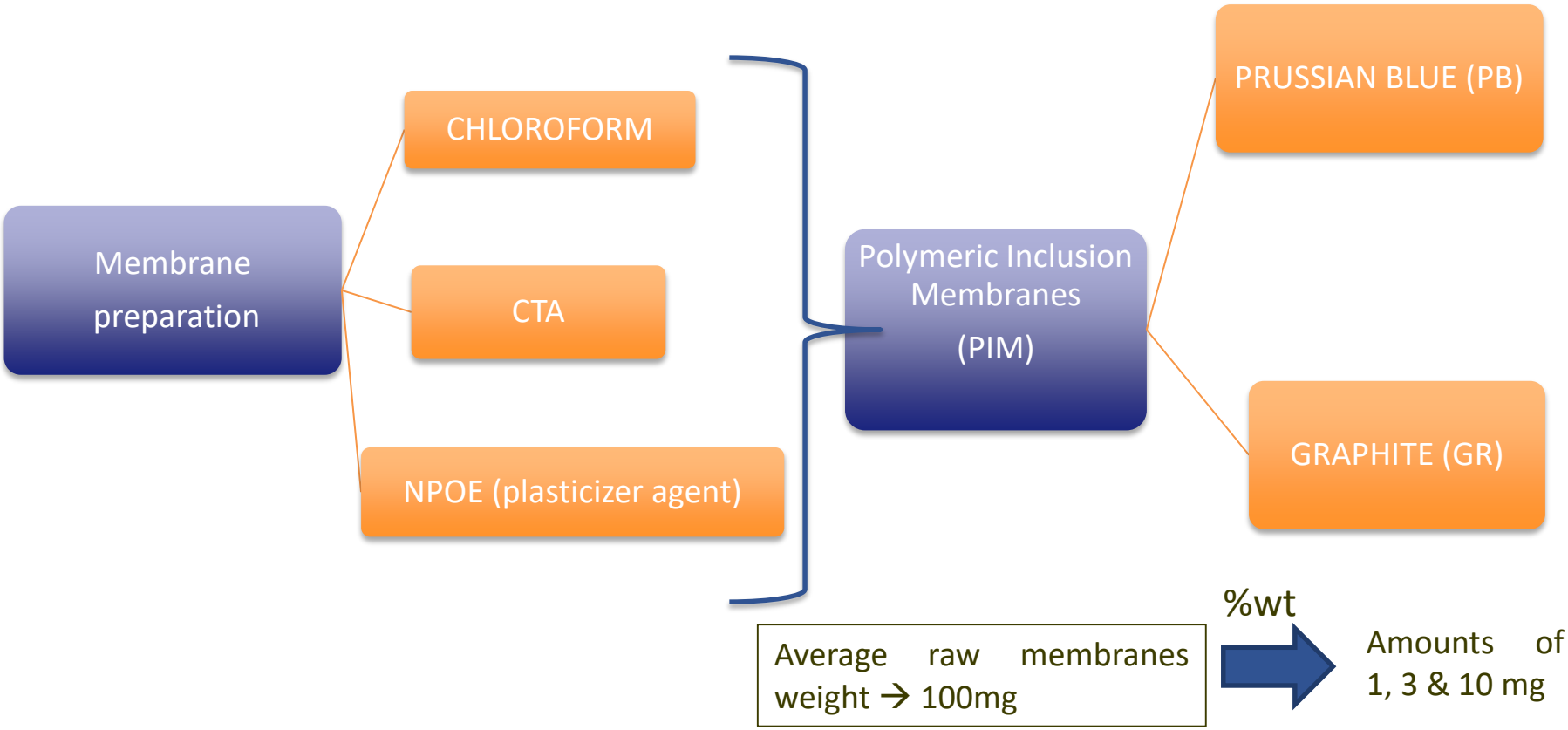


Figura 1: Chemical structure of PB. https://chemicalstructure.net

Figure 2: Starry night (Vincent Van Gogh)

EXPERIMENTAL PROCEDURE



PIM SYNTHESIS

25 mL solution from,
1 g CTA
100 mL Chloroform

+

0,5mL
2-Nitrophenyl octyl ether
(NPOE)

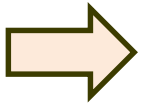
+

25 mL
Chloroformo

=

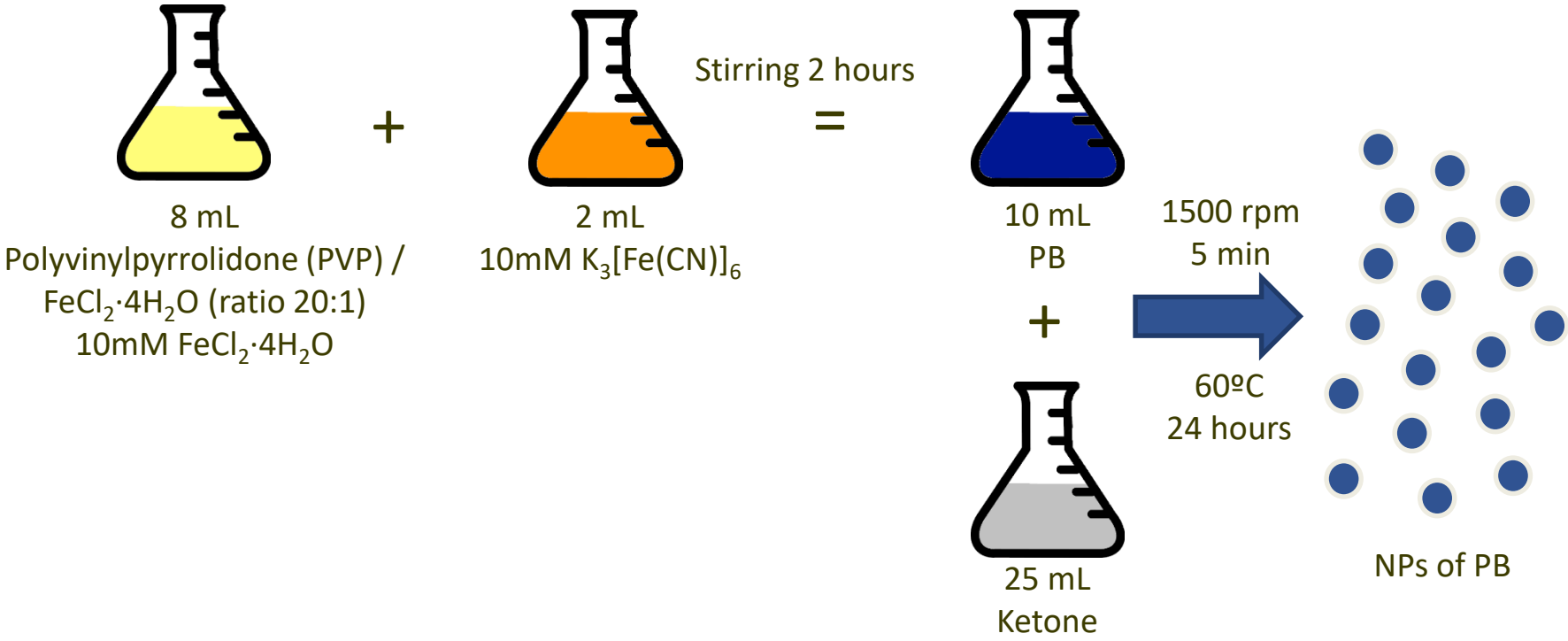
50 mL
PIM Solution

The optimal amount of the membrane solution was 6 mL.



6 mL on a plate

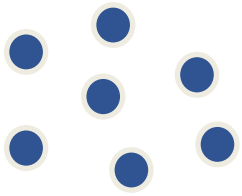
PRUSSIAN BLUE SYNTHESIS



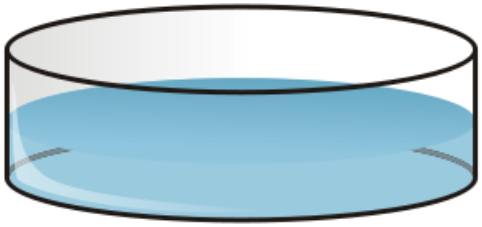
MODIFIED MEMBRANE SYNTHESIS

PIM Solution

+



NPs of PB



CTA membrane doped with NPs of PB

PIM Solution

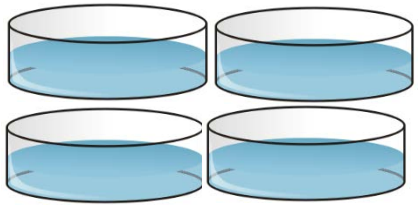
+

Comercial nanolayers of graphite

CTA membrane doped with nanolayers of graphite

SORPTION TESTS

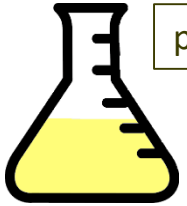
+



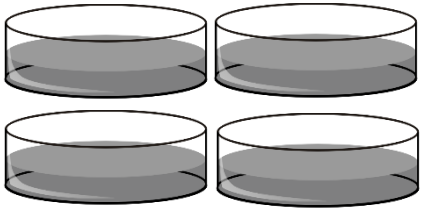
[Cs] = 10^{-5}M

PB MEMBRANES

pH = 7



+

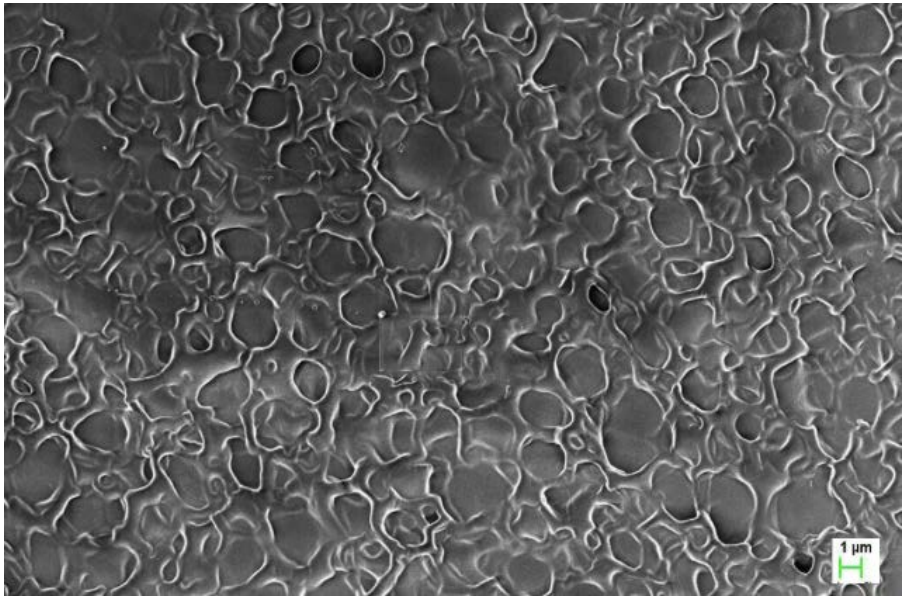


[U] = 10^{-6}M

GRAPHITE MEMBRANES

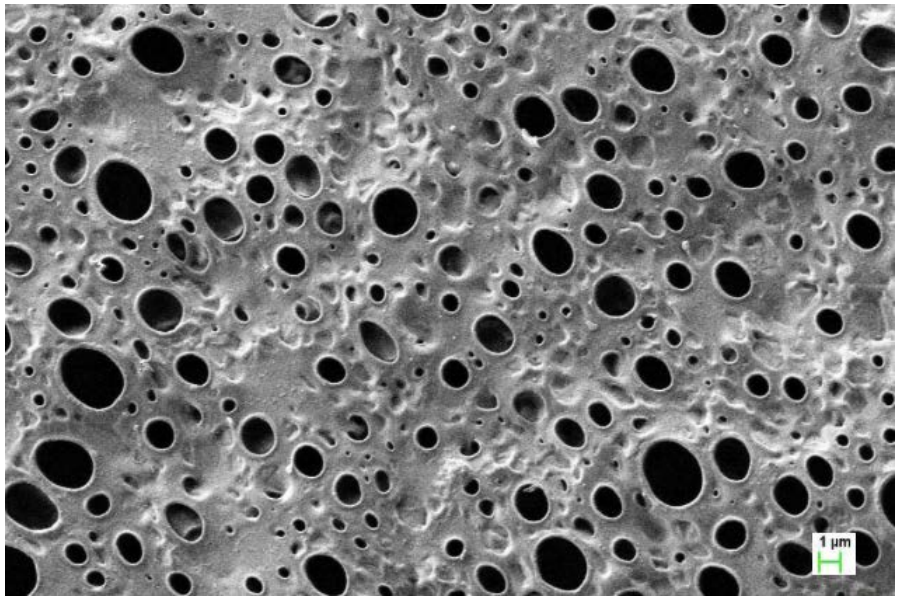
Stirring 24 hours

SEM RAW MEMBRANE CONTROL



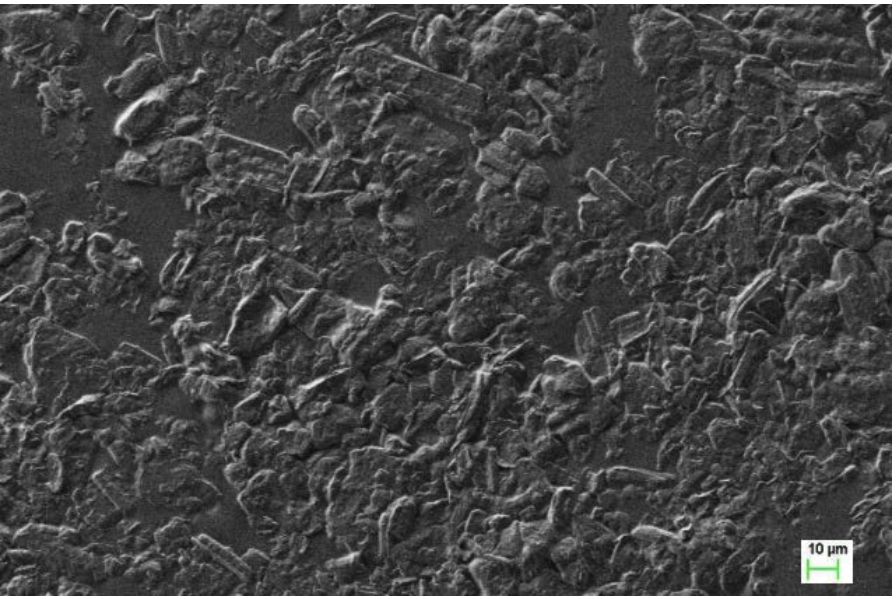
Well defined porous

SEM PB MEMBRANE



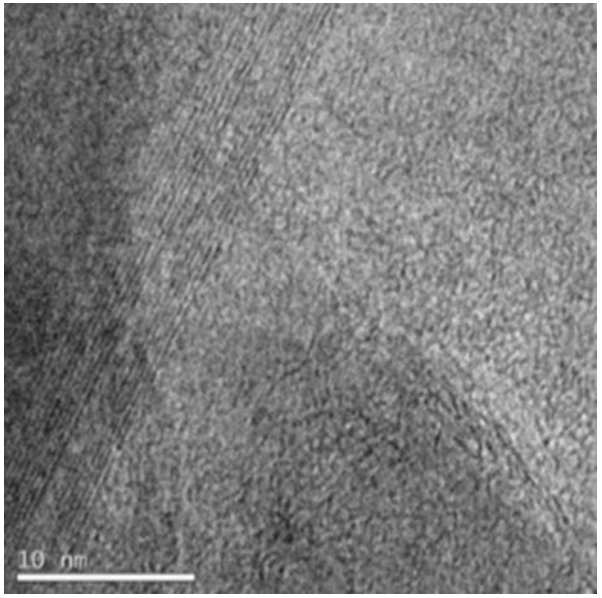
- Doped membranes clearly show porous on the surface.
- This is due to use of ketone during the synthesis

SEM GRAPHITE MEMBRANE



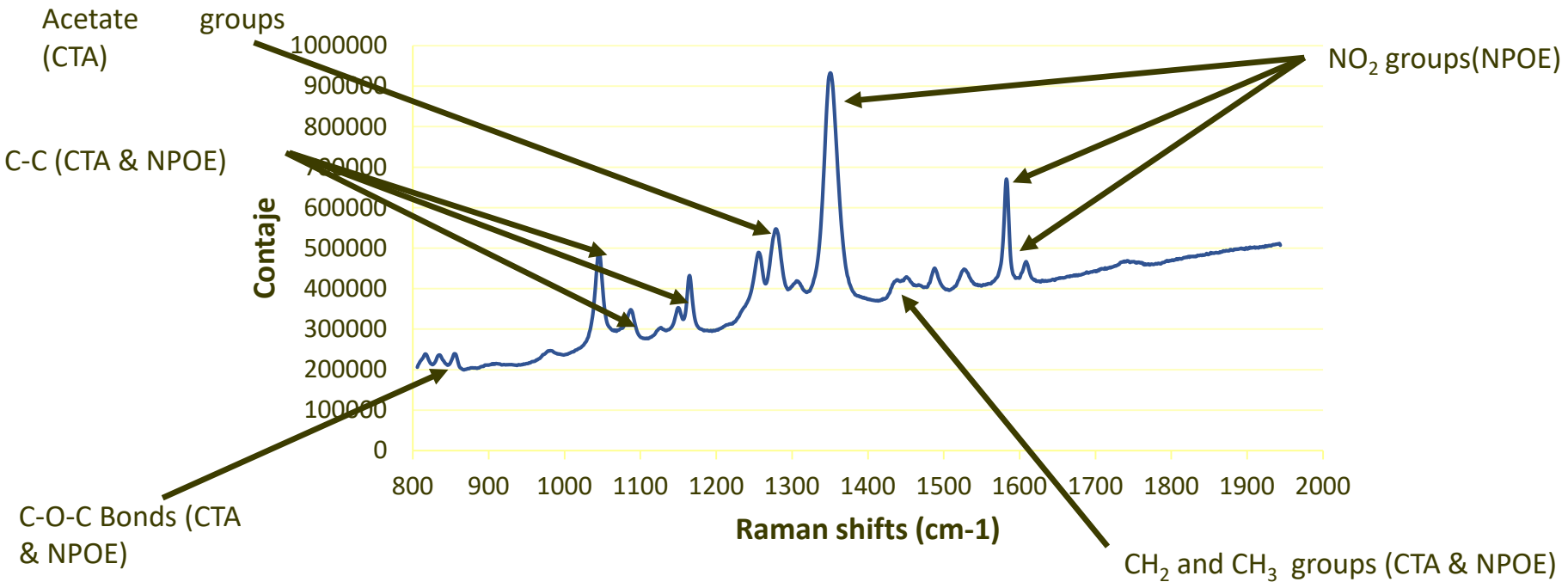
- Doped membranes are well covered by nanolayers of graphite.

TEM GRAPHITE MEMBRANE

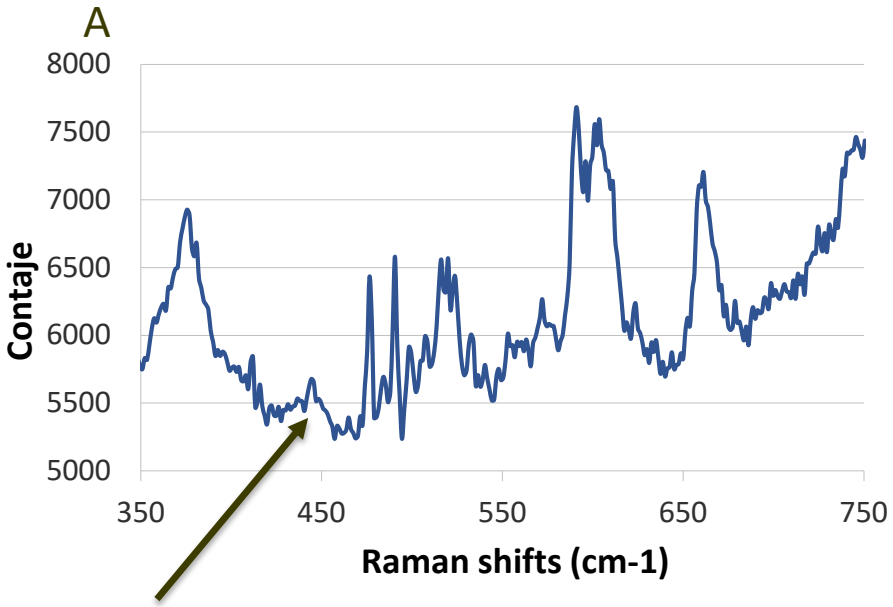


- It is possible to see the profile of the atomic planes forming the skeleton of the atoms.
- Interatomic space is **0.3335 nm**

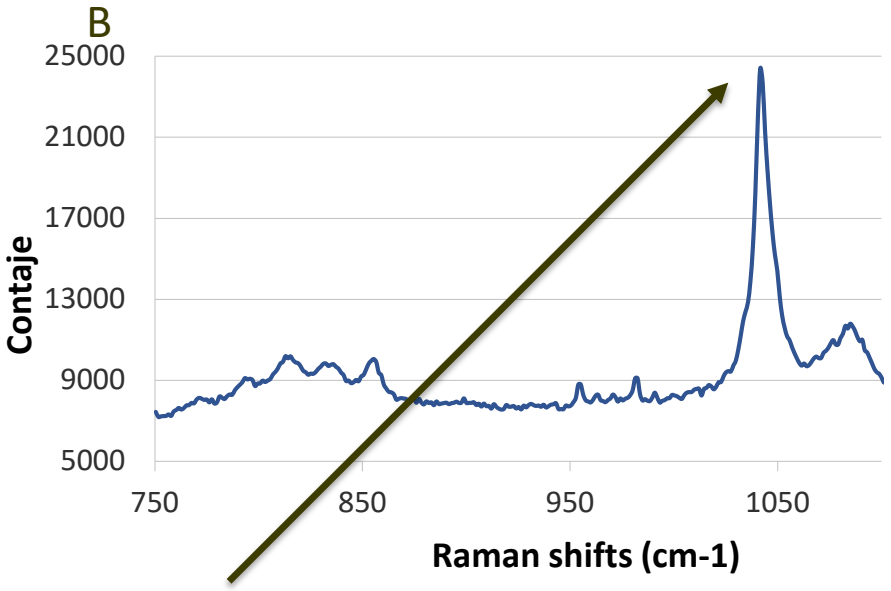
RAMAN RAW MEMBRANE CONTROL



RAMAN GRAPHITE MEMBRANE AFTER URANIUM SORPTION



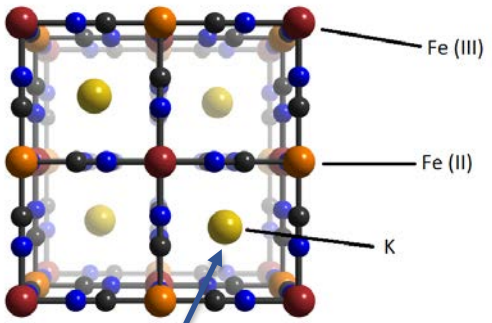
Symmetry of the U-O double bond



Vibrations of the crystal lattice

Cs SORPTION ON PB MEMBRANES

EXPERIMENTS	[Cs] (µg/L)	RECOVERY (%)
Initial Cesium	1072	-
Raw Membrane control	1046	2
Membrane PB1	810	24
Membrane PB3	188	82
Membrane PB10	120	89



IONIC EXCHANGE MECHANISM OF Cs

U SORPTION ON GRAPHITE MEMBRANES

Experiments	[U] (µg/L)	Recovery (%)
Initial uranyl	120	-
Raw Membrane control	65	46
Membrane GR1	43	64
Membrane GR3	32	73
Membrane GR10	27	78

Physical sorption
+
Redox Reaction

CONCLUSIONS

Two nanostructured hybrid nanocomposite materials were prepared using cellulose triacetate membranes as support matrix. Polymeric Inclusion Membranes (PIM) were prepared mixing cellulose triacetate (CTA), chloroform and 2-Nitrophenyl octyl ether (NPOE).

Some Membranes were modified with Prussian blue (PB) nanoparticles (NPs) protected by polyvinylpyrrolidone (PVP) and Other Membranes were modified with Graphite.

The nanocomposites were characterised by Scanning Electronic Microscopy (SEM), Transmission Electronic Microscopy (TEM) and Raman spectroscopy to obtain detailed information about the morphology, chemical funcional groups and composition of the Samples

For the system graphite-U, the raw membrane showed a recovery of 46%, the maximum was found to be 78% of recovery when a 10% w/w of graphite was used

For the PB-Cs, the raw membrane did not present a significant! capacity to adsorb Cs, in contrast to the 89% sorption of Cs for nanocomposite with 10% w/w of PB.

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THANK YOU FOR YOUR ATTENTION