"Nanoplatforms based on plasmonic nanoparticles for multitherapy in the treatment of cancer"

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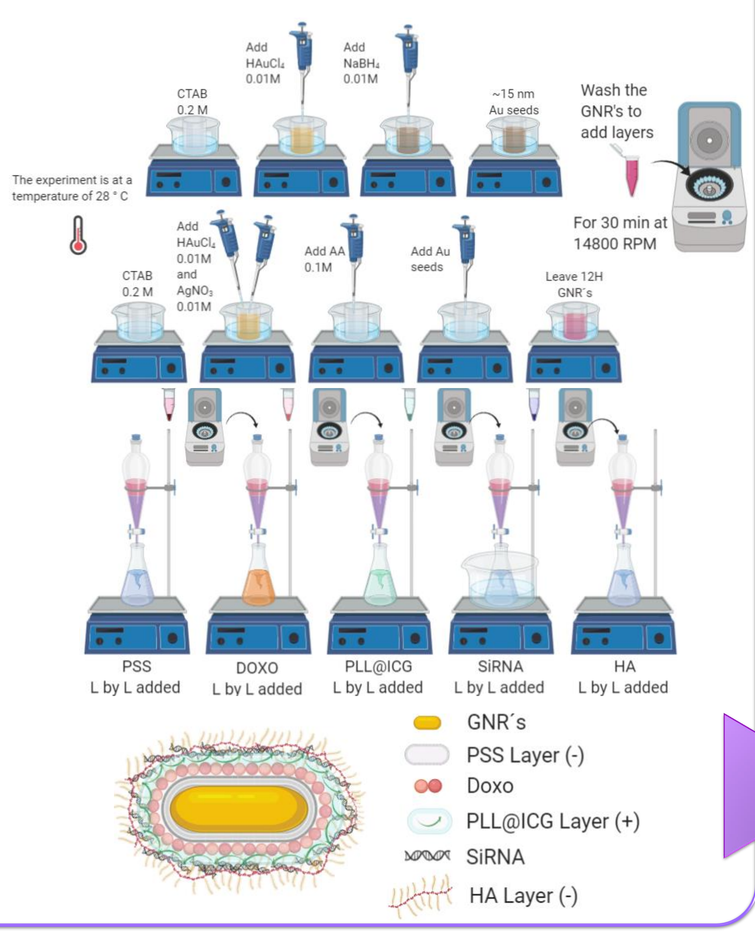
I. INTRODUCTION

In most of the cases, the diagnostic and therapy stages are carried out independently and this lead to delays in the application of the treatments and, therefore, an important risk to the patients´ health. To overcome these incoveniences, in the few last years theranostic has reached an important role to join in a unique nanoplatform therapeutic treatment, action and monitoring of the response to simultaneous therapy.

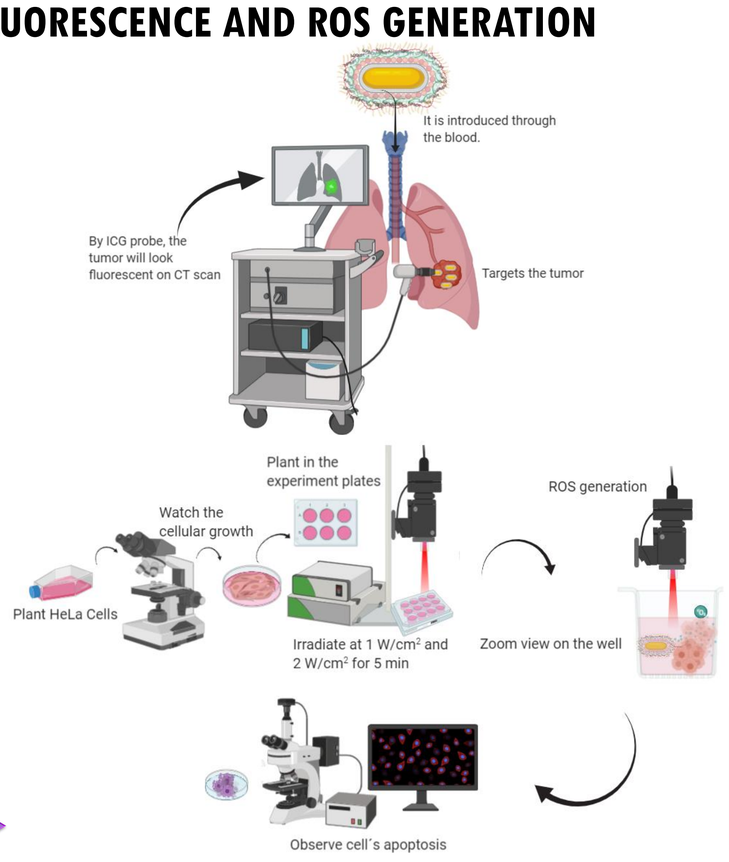
Thus, we designed a hybrid nanosystems based on gold nanoparticles capable of simultaneously combining their potential as a photodynamic therapeutic agent (PDT), plasmonic photothermal therapy (PPTT) and/or chemotherapy to kill malignant cells [1-11].

II. METODOLOGY

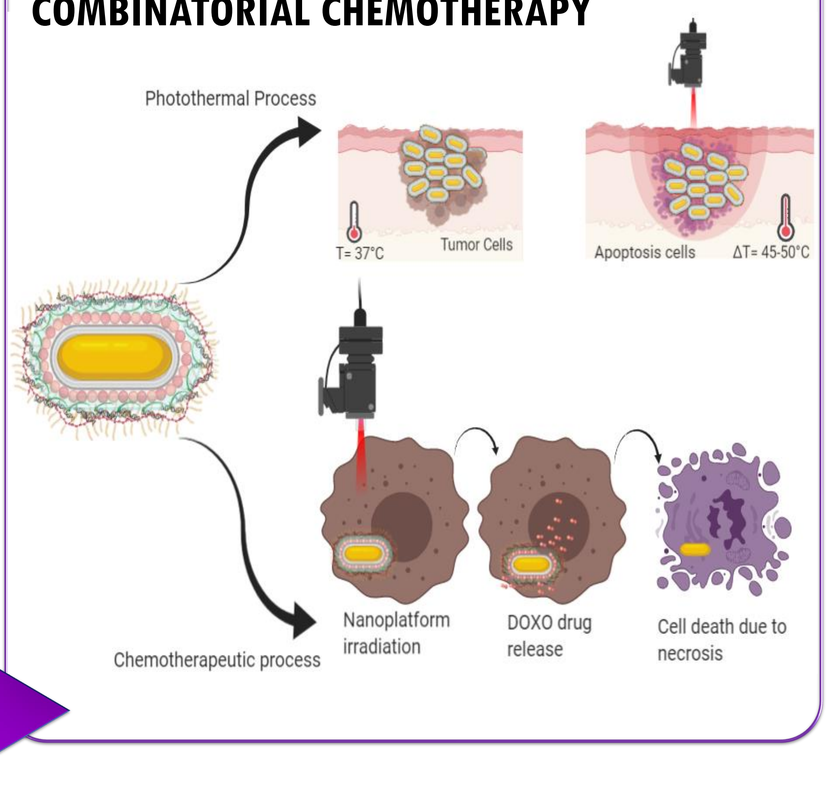
OBTAINING GNRs NANOPLATFORM



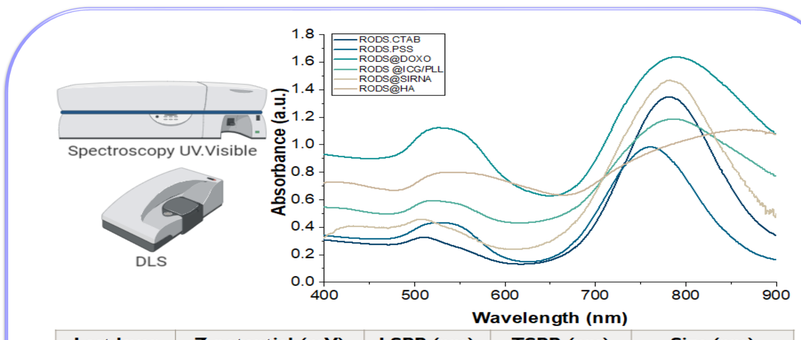
FLUORESCENCE AND ROS GENERATION



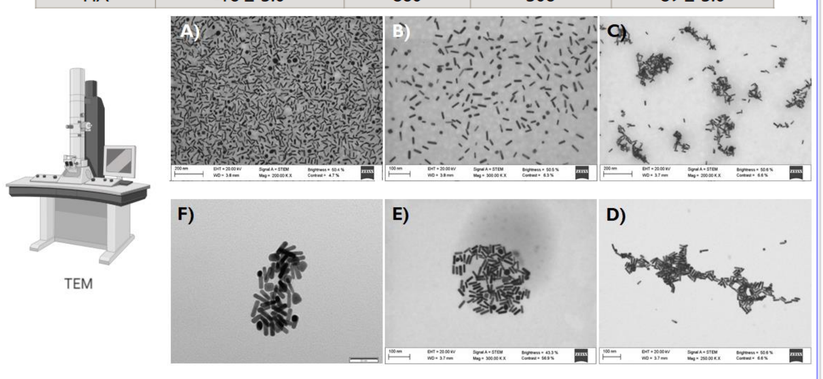
PHOTOTHERMIC PROCESS AND COMBINATORIAL CHEMOTHERAPY



III. RESULTS

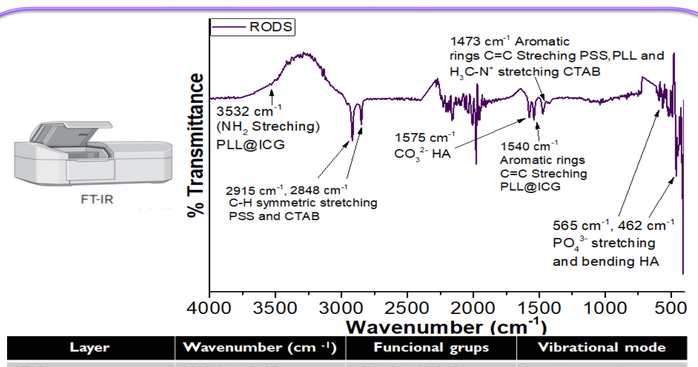


Last layer	Z-potential (mV)	LSPR (nm)	TSPR (nm)	Size (nm)
CTAB	+48 ± 3.0	782	509	25 ± 4.0
PSS	-36 ± 5.0	760	531	28 ± 3.0
DOXO	-28 ± 3.0	789	534	36 ± 6.0
ICG@PLL	+39 ± 4.0	785	520	42 ± 5.0
SiRNA	+23 ± 3.0	781	540	68 ± 6.0
HA	-16 ± 5.0	860	506	89 ± 5.0

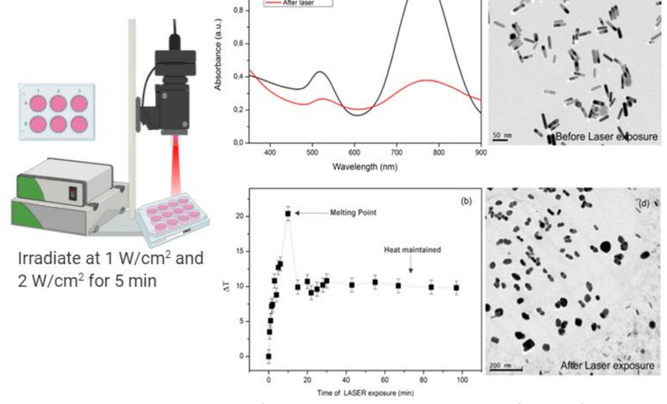


- The physicochemical properties of the nanoplatform are observed by UV-Visible. The transverse and longitudinal plasmon bands of the GNRs continue in each layer.
- The plasmons bands continue in the biological windows. We can also observe that the size of the nanoplatform is between 89 and 97 nm.
- The morphology of the GNRs can be observed by SEM. We can verify that the morphology of the GNRs continues to be maintained after each layer.

CHARACTERIZATION OF THE NANOPLATFORM: MORPHOLOGY, UV-VIS, ζ-POTENTIAL AND PARTICLE SIZE

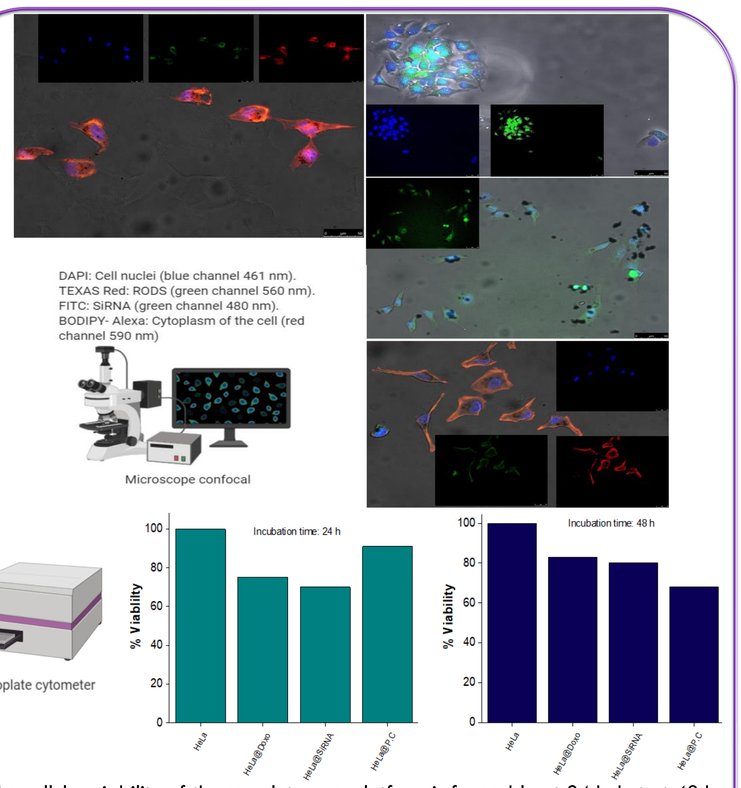


Layer	Wavenumber (cm -1)	Funcional grups	Vibrational mode
CTAB	2923, 1464, 1495	$-CH_3$, CH_4, H_3C-N^+	Streching symmetric
PSS	2917, 2850, 1540	$-CH_3$, benzene ring, C=C	Streching symmetric
ICG@PLL	3532, 1540, 1475	NH_2, C=C, aromatic rings	Steching
HA	1575, 565, 462	CO_3^{2-}, PO_4^{3-}	Streching, bending



- In the FT-IR spectrum we can verify by the vibrational modes of each functional group, the layers added by the layer by layer method.
- The irradiation at 1 and 2 W / cm2 shows that after irradiation with the laser of a wavelength of 808 nm, with an exposure time of 30 min, the morphology of the GNRs changes, which allows us to ensure the drug release. The increase in temperature confirms the presence of localized heat therapy.

CHARACTERIZATION OF THE LAYER BY LAYER PROCESSS BY FTIR AND PPTT AND CHEMOTHERAPY



- The cellular viability of the complete nanoplatform is favorable at 24 h, but at 48 h we notice that the cell starts to die.
- This indicates that we must improve the interaction between the nanoplatform and the cell.
- In pictures A and B we can observe the reflection that the gold presents from the confocal microscope. This allows us to observe that there is an adequate internalization of the applied concentration (1x1011 rods / mL).
- Also, in pictures C and D, we observe the presence of the complete nanoplatform where it is observed to be located at the cytoplasm of the cell.

IN VITRO STUDIES: BIOCOMPATIBILITY NANOPLATFORMS-HELA CELLS

IV. CONCLUSIONS

- The GNRs were characterized with a suitable longitudinal and transversal plasmon band within the biological window after the layer by layer coating process.
- The applied layers were added by steric impediment, which allows the observation of the charge changes from anionic to cationic.
- After the layer by layer coating processes, the final size of the nanoplatform remains at the nanometer range.
- From FTIR-spectrum vibrational modes, each polyelectrolyte layer were identified.
- GNRs Irradiation tests proved the nanoplatforms photothermal therapy.
- The internalization of the GNRs in HeLa cells verify the biocompatibility of the nanoplatform.

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