Functionalized gold nanorods as promising carrier for antiviral drugs

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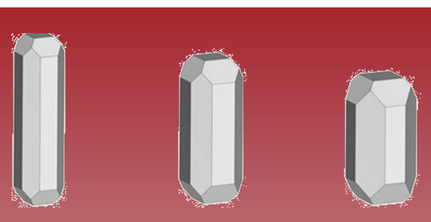
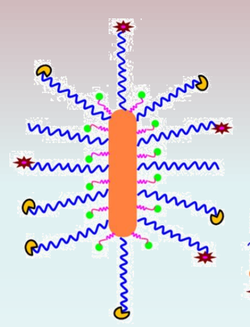
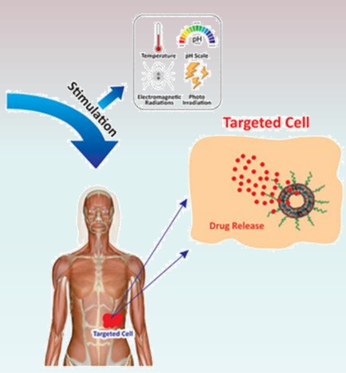


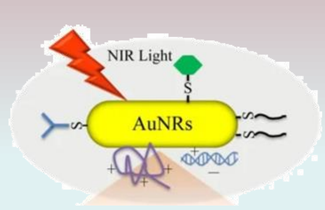
Gold nanorods (GNRs) are innovative diagnostic and therapeutic tools as they allow optimal and individual treatment of pathology, resulting in 'theranostics' [1,2] ,a concept based on the integration of diagnosis and therapy through the use of nanotechnology.

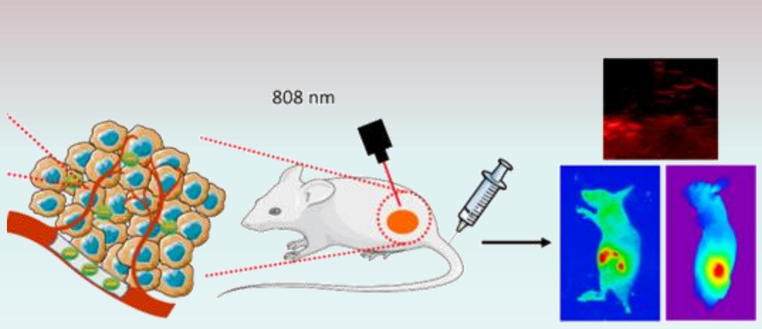
Their reduced size and aspect ratio (length/diameter) mean that these materials can be functionalized with different molecules; peptides and drugs can be bound to their surface, allowing a controlled transport and release of desired drugs [3].

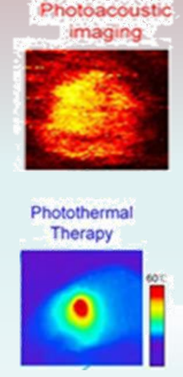
Their small size determines their ability to give rise to the surface plasmonic effect (LSPR) and consequently the possibility of studying them and tracking them in biological tissues using UV-VIS and NIR spectroscopic techniques (ultraviolet-visible and near-infrared spectroscopy) [4].
This is important for their use in imaging techniques and photothermal therapy.







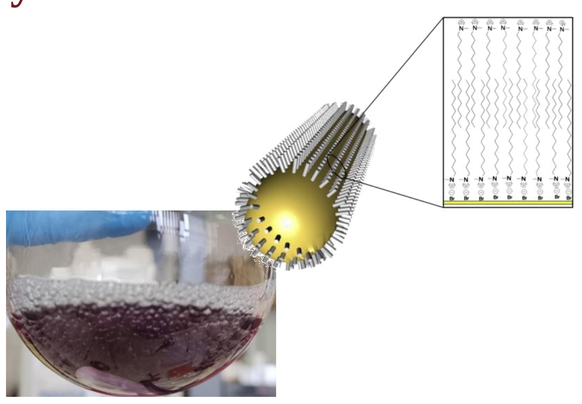


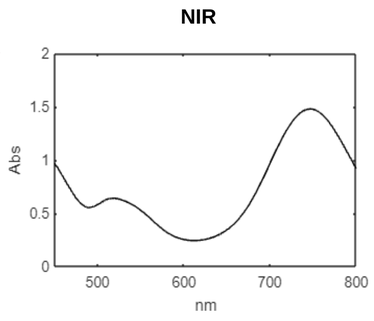


AIM: in this framework we report on a preliminary study in which funtionalized GNRs with different aspect ratios were synthesized and characterized by means of Uv-vis-NIR, FTIR and XPS spectroscopies and TEM.
Their biocompatibility was evaluated on VERO E6 cells by MTT test in view of future applications as antiviral drug delivery systems.

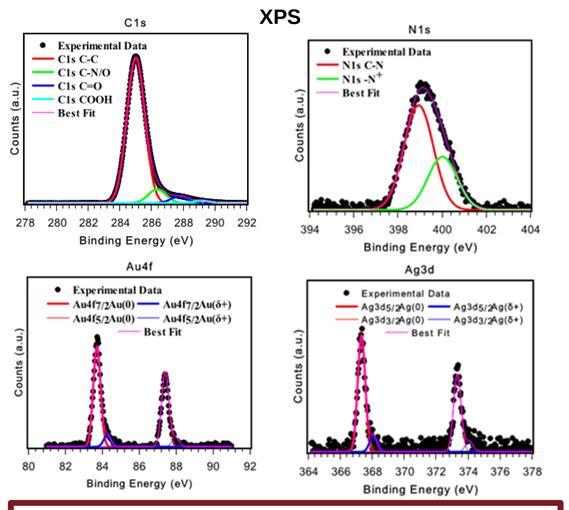
The synthesis was performed following the seed-mediated method [5] in which synthesis parameters were optimized in order to obtain monodispersed GNRs with different aspect ratios[2-4] using CTAB as surfactant and ascorbic acid as reducing agent. Characterization achieved by UV-VIS-NIR spectroscopy showed the typical longitudinal and transverse plasmon bands at 513 and 744 nm. Transmission (TEM) and scanning electron field emission (FESEM) microscopies confirmed the nanodimension (20x80 nm). In addition, X-ray photoelectron spectroscopy (XPS) and Energy Dispersive X-ray Spectroscopy (EDX) analyses were performed to estimate the composition and chemical stability. Moreover, the cytotoxic activity of the best sample of GNRs (the most reproducible, monodispersed and with high yield) was evaluated on VERO E6 cell line by MTT assay, using GNRs concentrations in the range 0.005 -1 μg/mL.

Synthesis and characterisation

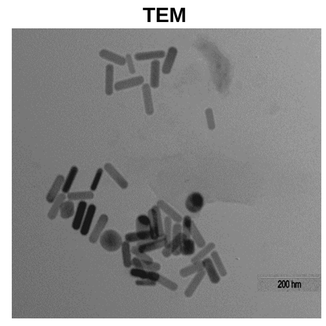


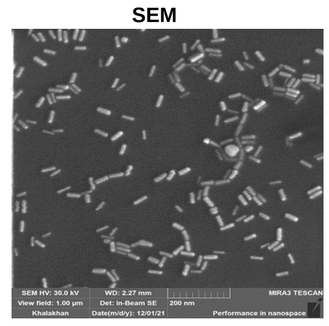


The NIR spectrum shows two plasmons (λ max 513 - 744 nm) characteristic of the longitudinal and transverse side.

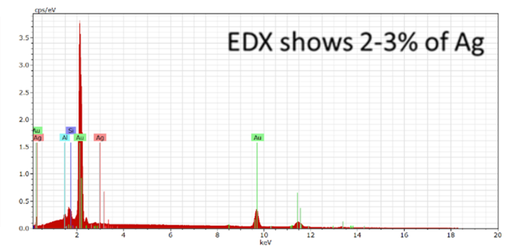


XPS studies confirm the assumed chemical composition.

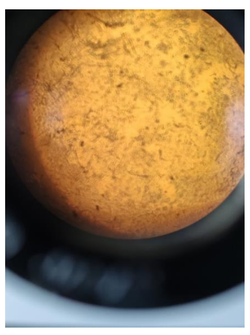




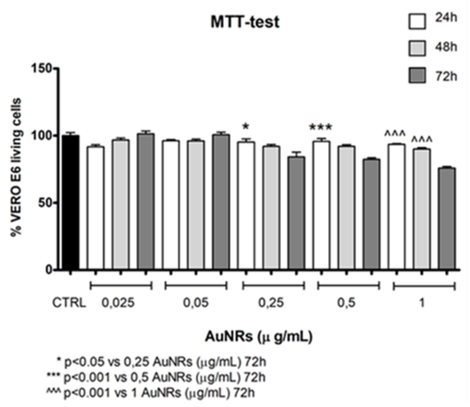
TEM and SEM analysis shows an aspect ratio of 3.8 and a moderate dispersion level.



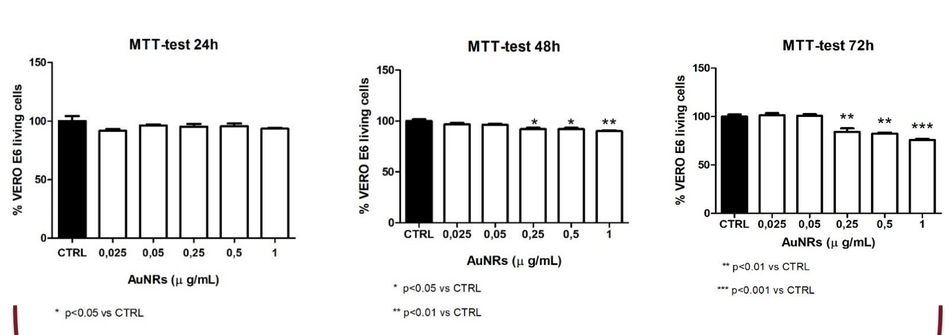
Biocompatibility studies



VERO E 6



The MTT test shows a reduction in viability at high concentrations (0.25; 0.5; 1 μg/mL).



The MTT test shows viability reduction at the longest treatment times (48 and 72 h) at the highest concentrations (0.25; 0.5; 1 μg/mL).
The reduction of cell viability is never more than 24%.

48h	
concentration (μg/ml)	reduction in viability (%)
0.25	-8
0.5	-8
1	-10

72h	
concentration (μg/ml)	reduction in viability (%)
0.25	-16
0.5	-18
1	-24

CONCLUSIONS

The results obtained showed that the synthesis parameters strongly influence the final aspect ratio of GNRs and their chemical physical behavior. Finally, GNRs prove to be promising hydrophilic nanocarriers for transporting drugs, due to their low cytotoxicity, opening up new possibilities for applications in both medicine and functional materials.

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[2] D. Maccora, V. Dini, C. Battocchio, I. Fratoddi, A. Cartoni, D. Rotili, M. Castagnola, R. Faccini, I.Bruno, T. Scotognella, A. Giordano, I. Venditti; Applied Sciences 2019, 9 (16) 3232
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[5] *B. Nikoobakht, M. A. El-Sayed, Chem. Mater. 2003, 15, 1957.*

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