EFFECT OF SIZE ON Au NANOPARTICLES IN BIOMEDICAL APPLICATIONS

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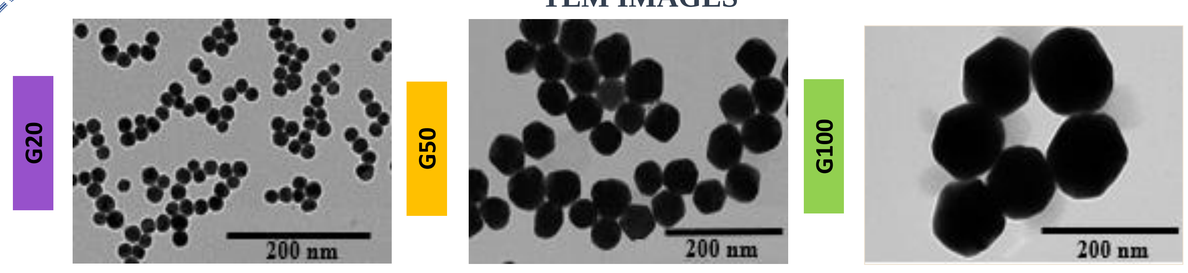
In this work, we study the effect of size on metallic gold nanoparticles (**Au NPs**) for biomedical applications. Au NPs of sizes 5, 20, 50 and 100 nm (G5, G20, G50 and G100, respectively) are structurally investigated by X-ray absorption spectroscopy (**XAS)** at the **Au L_3-edge in ALBA synchrotron**. Both X-ray absorption near edge structure (XANES) and extended X-ray absorption fine structure (EXAFS) signals are evaluated for different NP sizes, identifying the local modifications. In addition, the **photo-induced response** of the Au NPs is explored in several biological media from colloidal suspension, physiological solutions to tumor cells (water, PBS, DMEM and **tumor cells** MCF-7) identifying the **plasmonic coupling depending on the NP size**.

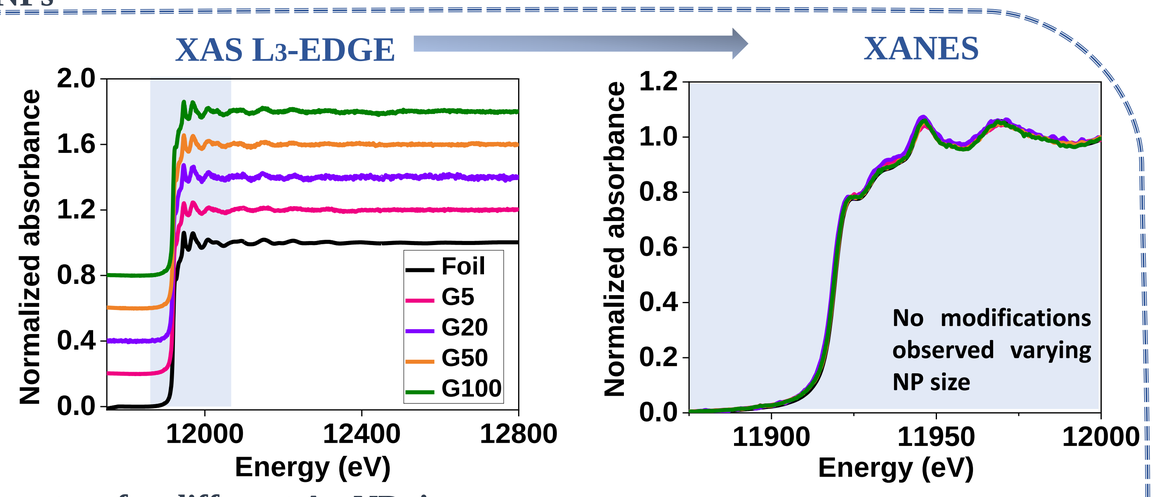
MORPHOLOGYCAL AND STRUCTURAL CHARACTERISTICS OF Au NPs

TEM IMAGES

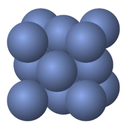


The **coordination number** (N) **increases** with **NP size**. A size effect is also identified in the first nearest-neighbor **shell** (R), with a **shorter value** for the **5 nm NPs**. The **Debye-Waller** factor is of **similar order** for all NP sizes, with values slightly higher for the NPs with smaller size.

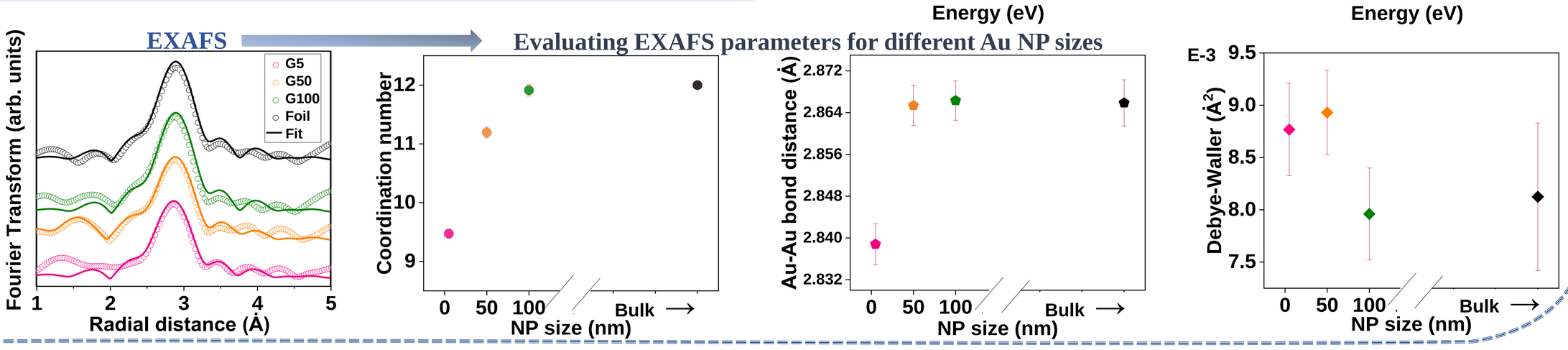
XAS L_3-EDGE → XANES



Au bulk structure fcc

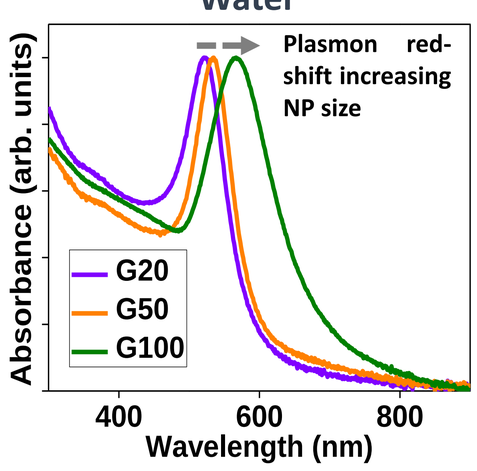


EXAFS → Evaluating EXAFS parameters for different Au NP sizes

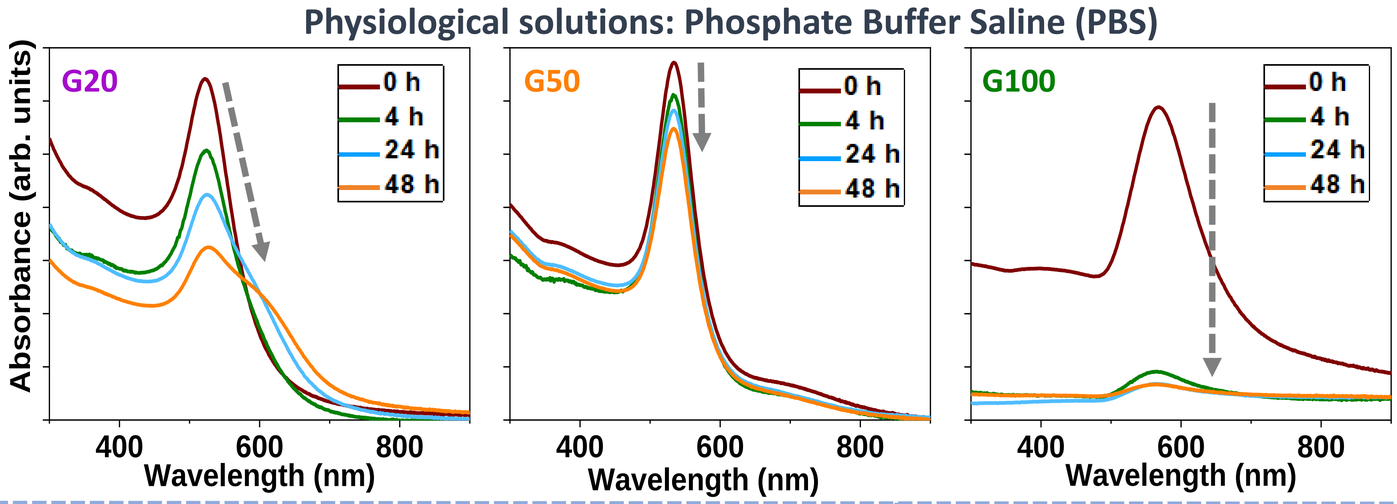


PLASMONIC AND PHOTO-INDUCED RESPONSE

Water



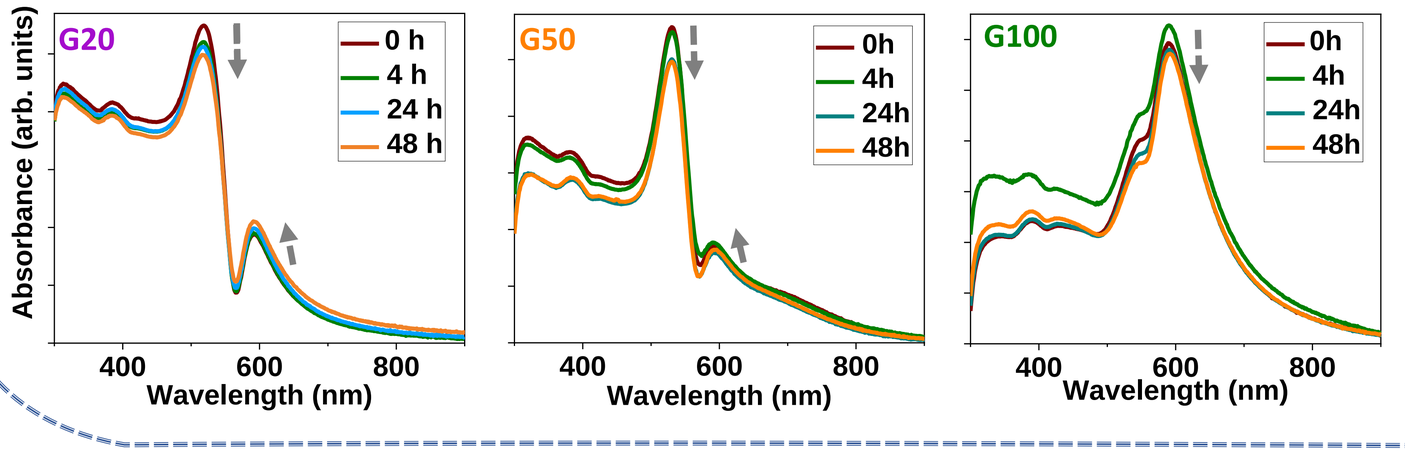
Physiological solutions: Phosphate Buffer Saline (PBS)



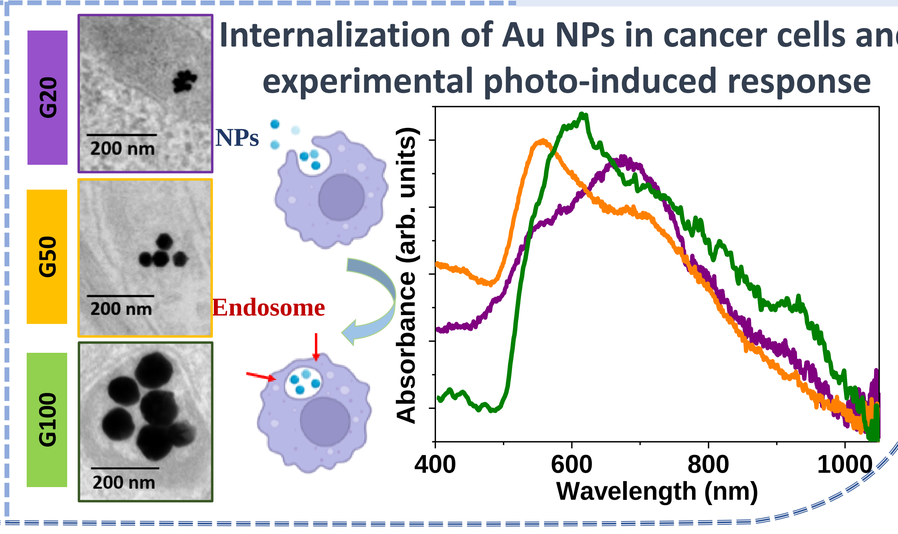
The **plasmonic response** of Au NPs **depends** on the surrounding **environment**. **Time dependence** is shown with arrows, identifying **plasmonic coupling** for some NP sizes. New resonances are also identified.

The **resonant extinction** can be **broadened and red-shifted** from the **visible range** (water) to the **NIR region** as a result of the interaction with **biological media**.

Physiological solutions: Dulbecco's Modified Eagle's Medium (DMEM)



Internalization of Au NPs in cancer cells and experimental photo-induced response



CONCLUSIONS

- By **XANES** measurements at the Au **L_3-edge, no modifications** have been observed varying the size of Au NPs.
- ***$k^2\chi$*(k) weighted EXAFS** fittings were carried out in k^2 weight in the range 2.7-10.5 $Å^{-1}$. The influence of the size of Au NPs has been determined via EXAFS structural parameters.
- The **photo-induced response** of Au NPs **depends on the media** in which they are immersed. **Time** dependence has been showed, identifying **plasmonic coupling** and **agglomeration** for some NPs sizes.
- **Au NPs** were **internalized** into MCF-7 cells and they are found **confined within cellular endosomes**. When **Au NPs are internalized into breast cancer cells**, the optical **response red-shifts**, **improving** their suitability for biomedical applications.

ACKNOWLEDGMENTS

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