



Optical detection based on gold nanocomposites for monitoring of pathogenic bacteria infection process

G. Landa^{1,2*}, L.G. Miranda^{1,2}, G. Mendoza^{1,2}, M. Arruebo^{1,2,3} and S. Irusta^{1,2,3}

¹Department of Chemical Engineering, Aragon Institute of Nanoscience, University of Zaragoza, Campus Rio Ebro, C/ Pedro Gómez S/N, 50018 Zaragoza, Spain
²Aragon Health Research Institute (ISS Aragon), 50009 Zaragoza, Spain
³Networking Research Center on Bioengineering, Biomaterials and Nanomedicine, CIBER-BBN, 28020 Madrid

Introduction

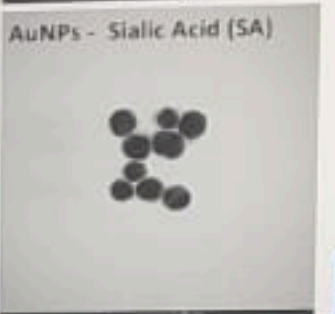
The increase of antibiotic resistant bacteria is a rising concern worldwide. Resistance to first-line drugs to treat infections caused by *Staphylococcus aureus*, a common cause of severe infections in health facilities and the community, is widespread. With the new generation of antibiotic becoming virtually ineffective, it is predicted that multi-resistant bacteria will cause more deaths than cancer by the middle of the century, causing 10 million deaths worldwide by 2050 [1].



SEM image: *Staphylococcus aureus*

AuNPs Synthesis

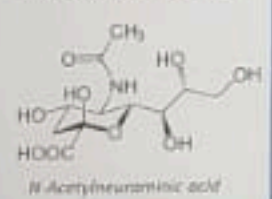
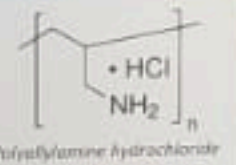
Both types of AuNPs were synthesized by Turkevich method and characterized by TEM image, UV-Vis spectroscopy.



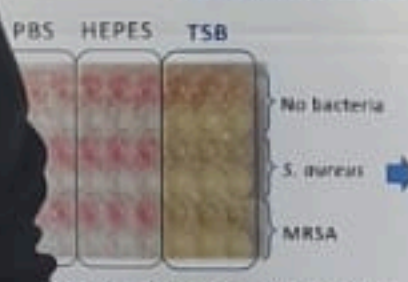
Objectives

Our aim was the development of a bacteria detection system based on the state of aggregation of gold nanoparticles (AuNPs). We proposed two strategies to achieve this:

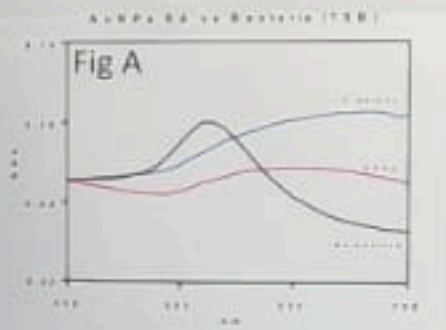
- Gold nanoparticles functionalized with a positive charge cationic polyelectrolyte (poly-allylamine hydrochloride, PAH) could aggregate when coating the negatively-charged bacterial wall.
- Pathogenic bacteria consume N-acetylneuraminic acid (Sialic Acid, SA). Gold nanoparticles stabilized by SA as a potential nutrient could aggregate once the bacteria have incorporated the SA.



AuNPs SA vs Bacteria



Colorimetric assay showing AuNPs in PBS, HEPES, and TSB buffers with and without bacteria. The color change from red to blue indicates aggregation of AuNPs.



SEM and EBSD imaging: *S. aureus* and AuNPs SA

Conclusions

In this project, a bacteria detection system based on gold nanoparticles functionalized with sialic acid has been developed. It has been confirmed that the state of aggregation of these nanoparticles can serve as a signal output, which can be monitored in order to study the proliferation of bacteria in complex media. Despite being a proof of concept the idea behind this system could serve as a promising and simple method for the detection and identification of pathogens in clinical samples.

