# ÓMICAS

# A Colorimetric Sensor for Detection of Aluminum (III) using Gold Nanoparticles

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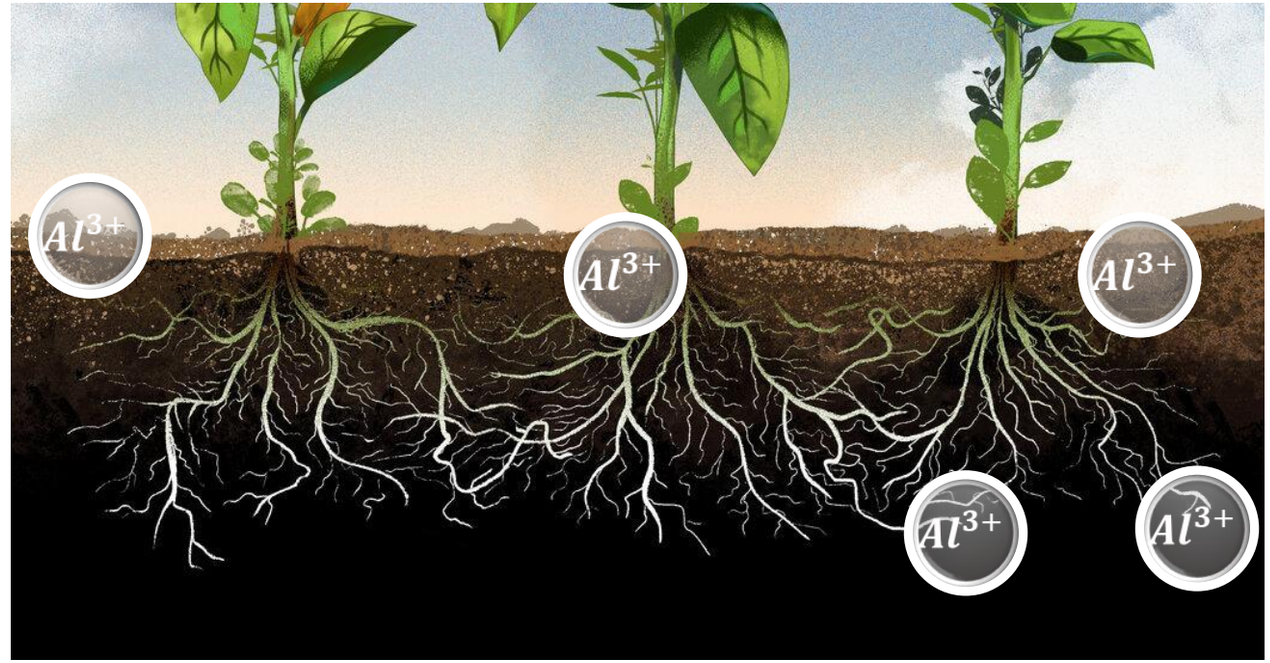
# Outline

1. Introduction
2. Experimental section
3. Sensitive colorimetric assay using AuNPs
4. Conclusions
5. Acknowledgment

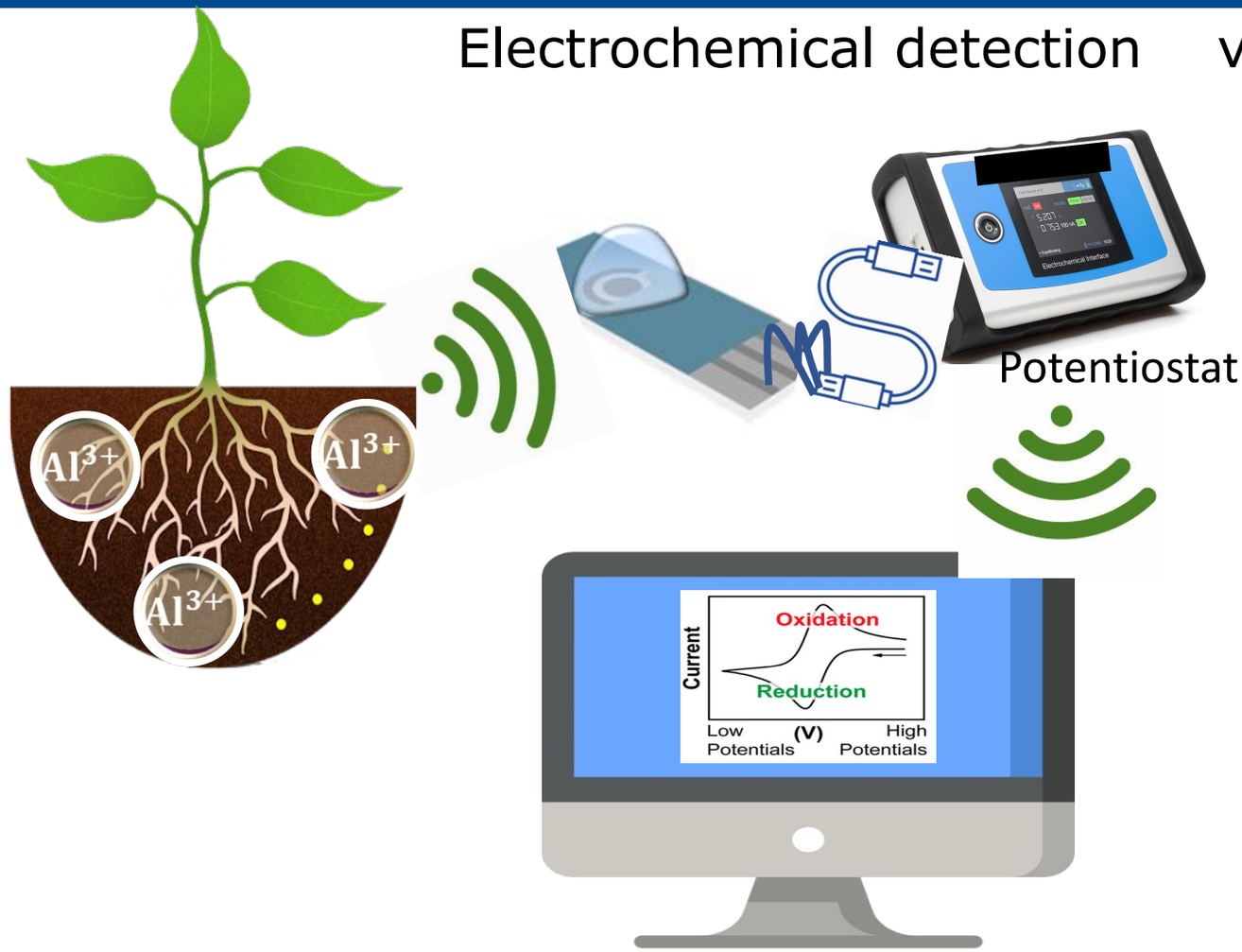
# Introduction: Aluminum toxicity in plants

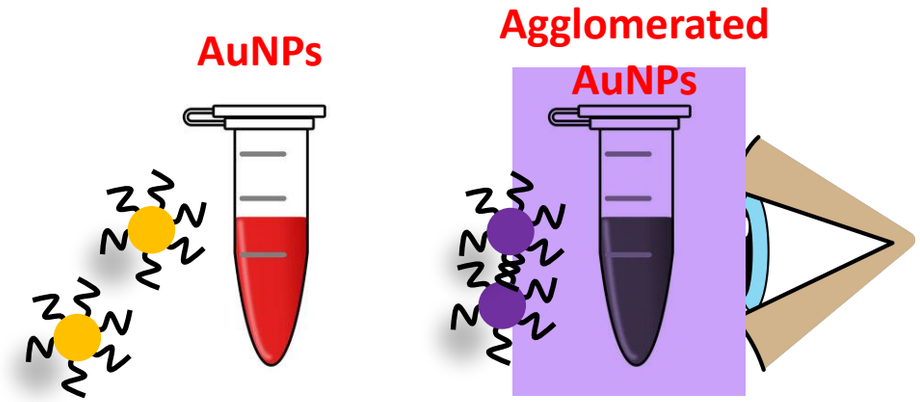
- Root growth inhibition
- Inhibition of the absorption of water and nutrients
- Lipid peroxidation
- Modification of the cytoskeleton
- Inhibition of cell division.




Colombia is a country of low fertility. This is due to the fact that 85% of the territory has acidic soils, 57% with high aluminum content and 98% with phosphorus deficiency. *Instituto Geográfico Agustín Codazzi (IGAC)*

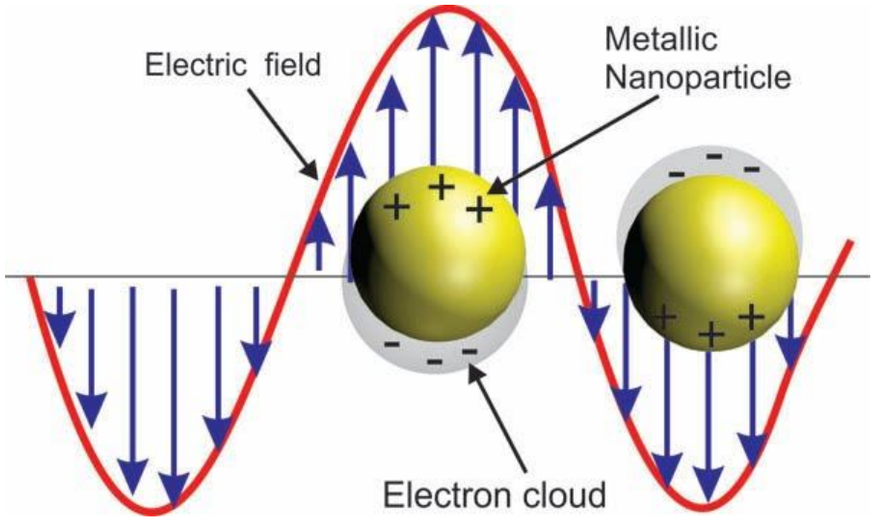
## Electrochemical detection vs Colorimetric sensor

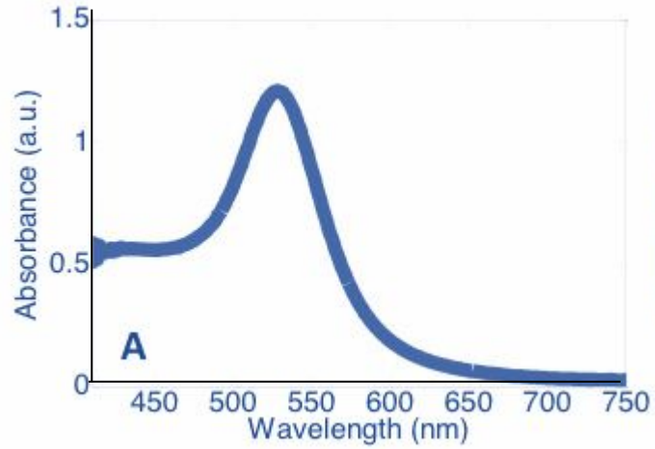


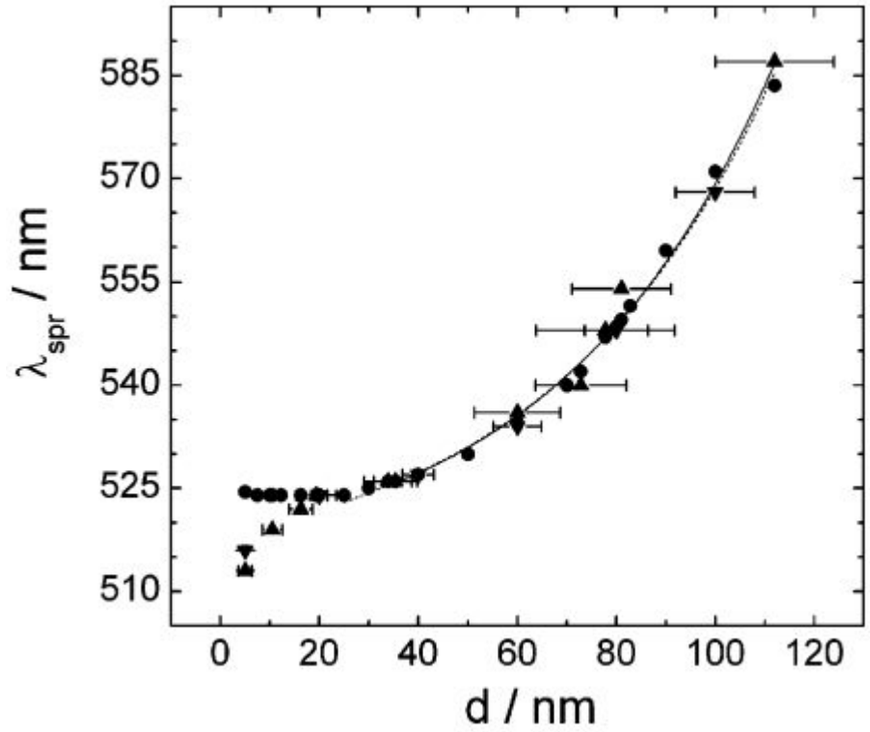




Naked – Eye detection of Al(III)

# Introduction: Surface Plasmon Resonance (SPR) effect of AuNPs



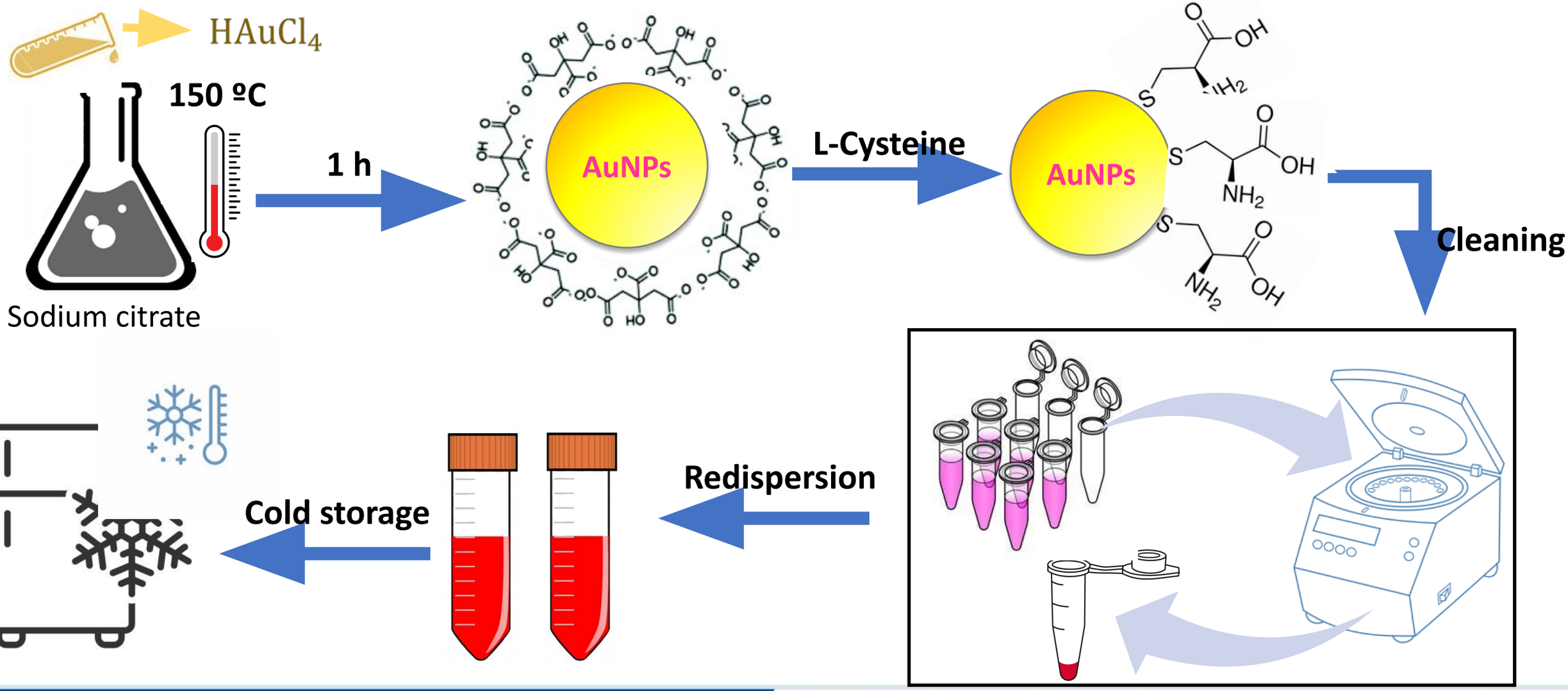




$$d = \frac{\ln\left(\frac{\lambda_{spr} - \lambda_0}{L_1}\right)}{L_2}$$

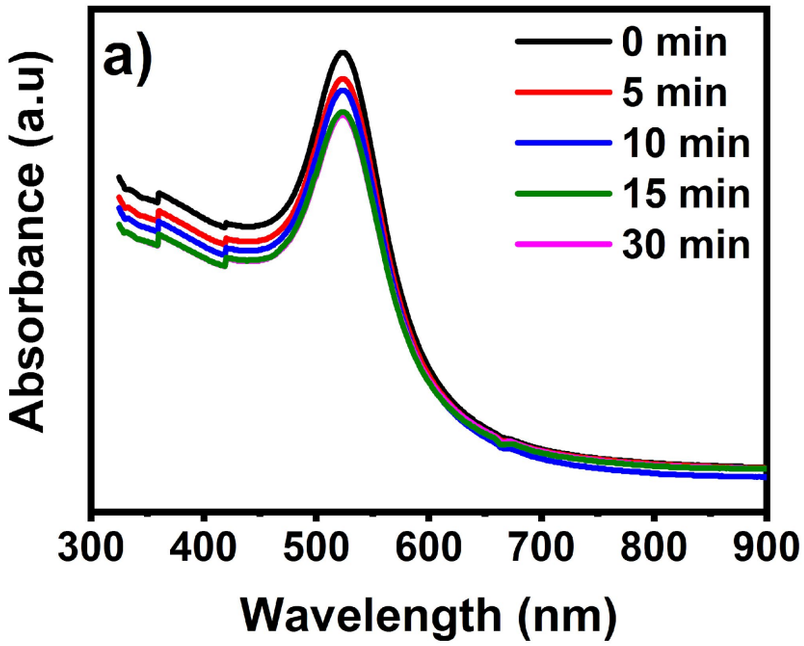
Focusing nanoplasmonics. *J. Nano Sc. Tech*, 3(2015)10-17

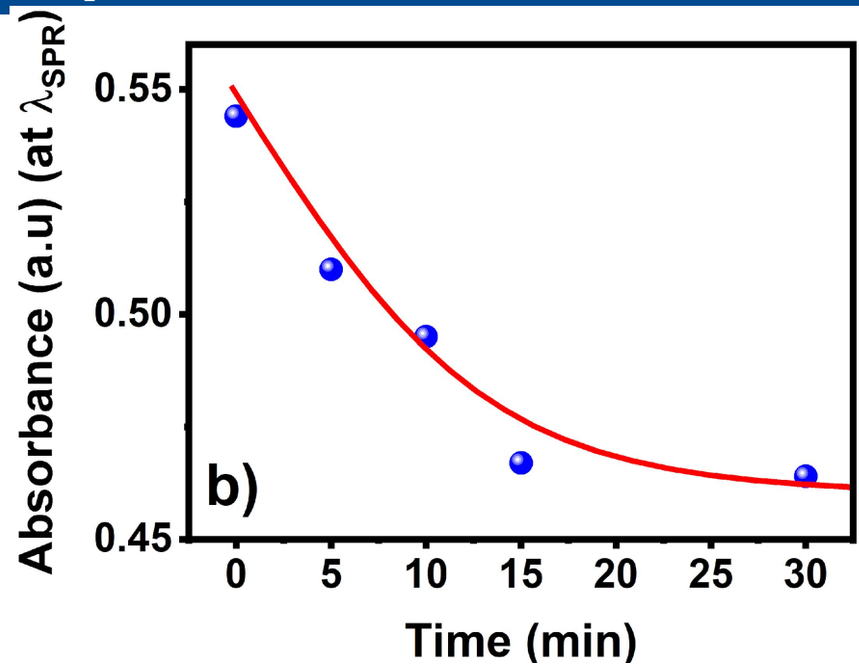
Analytical Chemistry, Vol. 79, No. 11, June 1, 2007

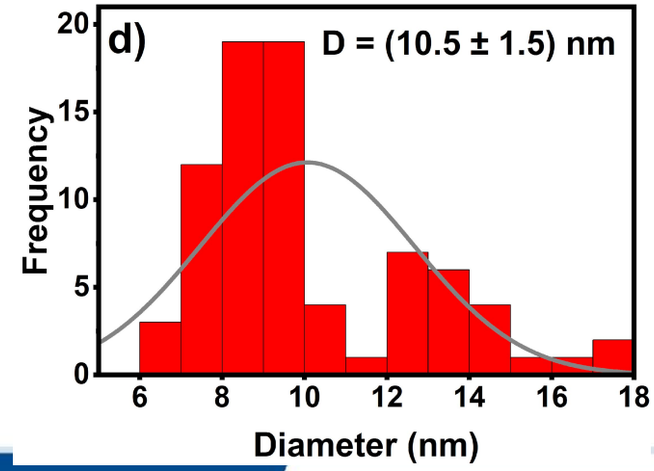
# Experimental: synthesis of L-Cysteine-AuNPs

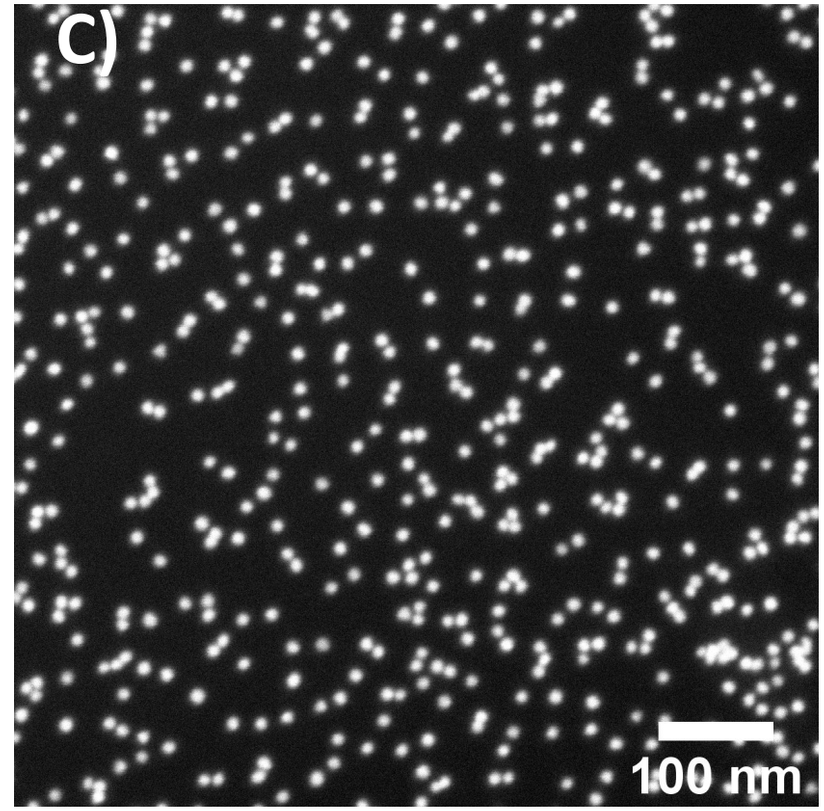


# Experimental: AuNPs Characterization



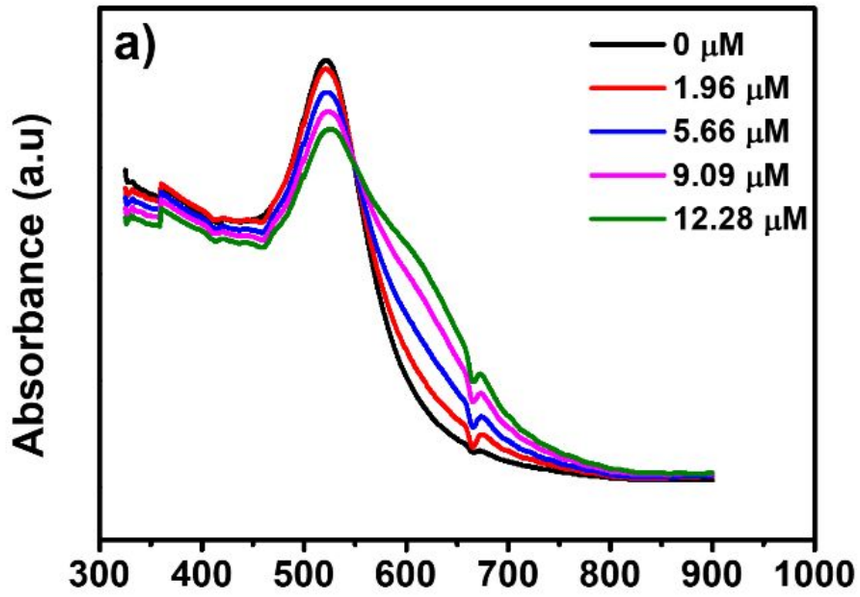



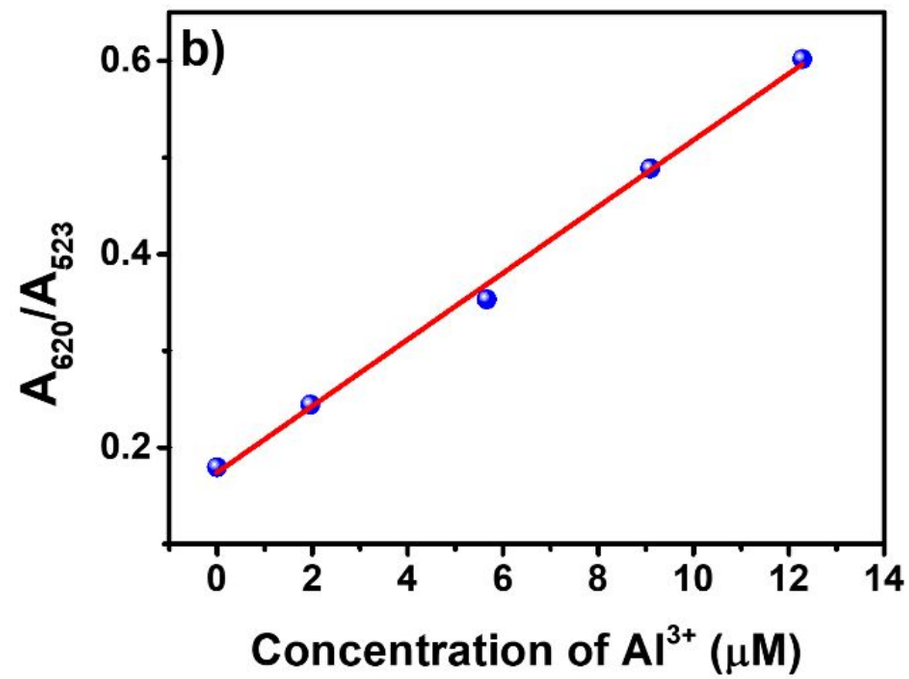



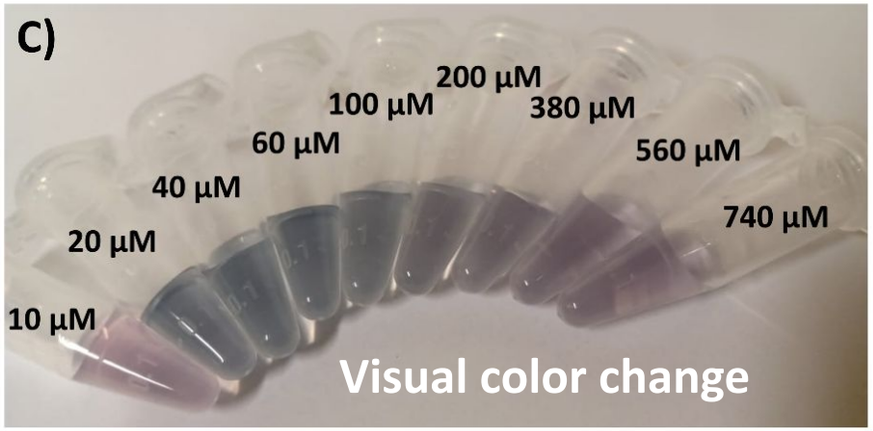

(a) UV–vis spectra of as-synthetized L-Cysteine AuNPs; (b) Absorbance at $\lambda_{SPR}$ vs functionalized time; (c) SEM image of 10 nm L-Cysteine functionalized AuNPs; (d) size distribution

# Experimental: Colorimetric sensor

L-Cysteine functionalized AuNPs



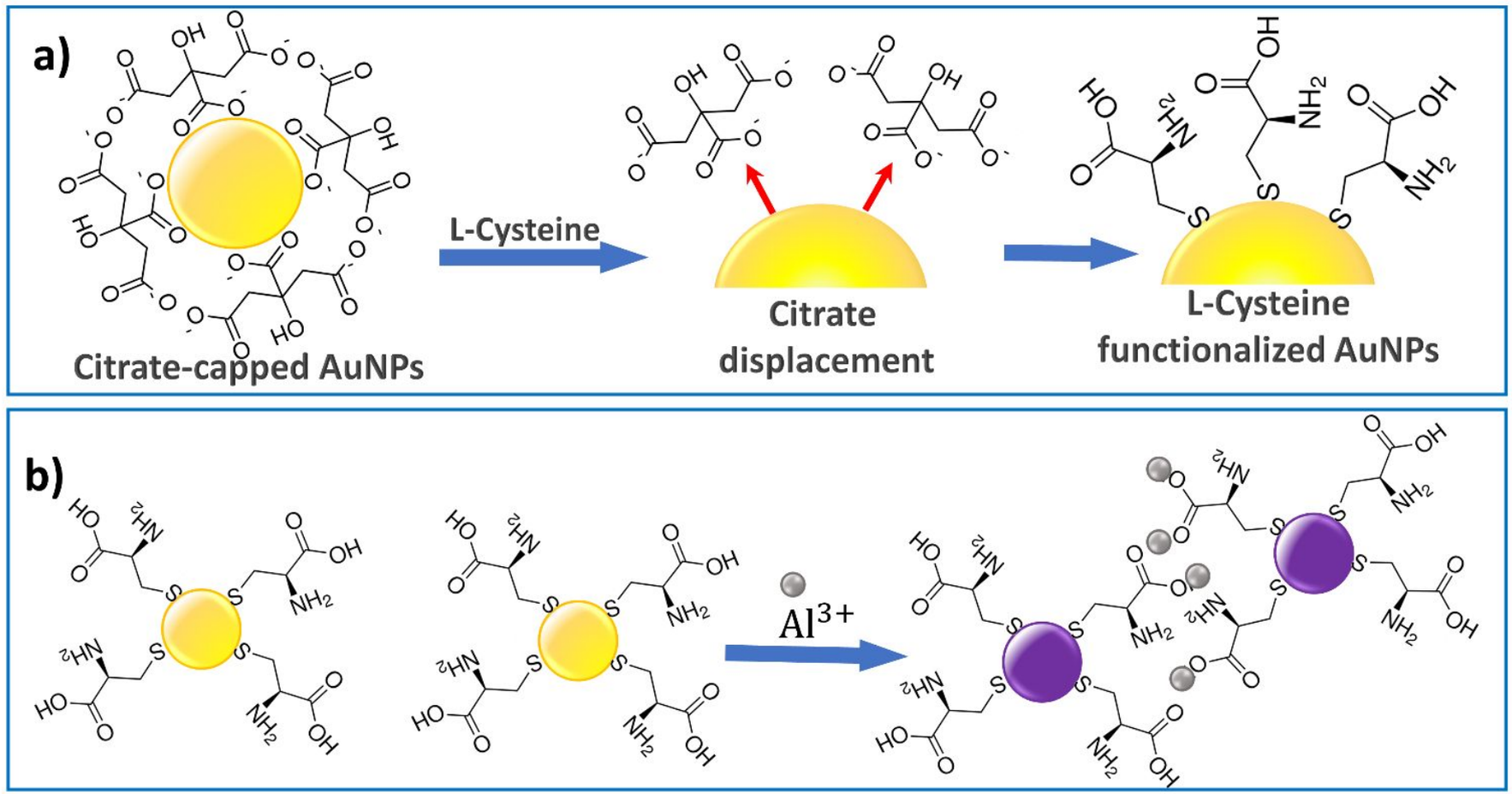




The limit of detection (LOD) was found to be 25 nM, which is much lower than the level (37.5 µM) of irrigation water defined by the Food and Agriculture Organization (FAO).

(a) Surface plasmon resonance absorption change of L-cysteine functionalized AuNPs in the presence of different concentrations of $Al^{3+}$. (b) Absorbance ratio ($A_{620}$ nm/$A_{523}$ nm) of of L-Cysteine functionalized AuNPs in the presence of metal ions.

# Experimental: Mechanism of detection




When the solution containing $Al^{3+}$ ions is added to the nanoparticle solution, an agglomeration process of the nanoparticles occurs due to binding with chelating ligands, yielding a substantial red-to-purple color change

Schematic representation of (a) synthesis and functionalization of AuNps and (b) the NPs agglomeration as a mechanism of detection of $Al^{3+}$

# Conclusions

In this work, a simple, fast and sensitive colorimetric sensor for determination of $Al^{3+}$ ions has been developed. The presence of $Al^{3+}$ can be monitored by the colorimetric response of the L-Cysteine functionalized AuNPs. It was evidenced that $Al^{3+}$ induced agglomeration of AuNPs, resulting in a color change from red to purple and a corresponding SPR absorption shift from 512 nm to 620 nm.

The detection limit (LOD) for $Al^{3+}$ was found to be 25 nM, which is much lower than the level (37.5 µM) of irrigation water defined by the Food and Agriculture Organization (FAO).


# Gracias

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## Aliados

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## Apoyan

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