Functionalized gold nanoparticles in colorimetric and chemoresistive sensors: synthesis, sensing mechanism and interface properties

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Nanomaterials are one of the most studied materials due to their unique optical, magnetic, and electrical properties. These properties have attracted the attention of users in various applications such as catalysts, sensors, optoelectronic devices, and in biomedicine [1]. Due to their simple preparation, high surface area, and physiochemical malleability, metal nanoparticles (MNPs) are one of the most promising nanotechnology-based materials for designing new types of sensors [2]. In this work, we focus on gold nanoparticles (AuNPs), characterized by their ability to display surface plasmon resonance (LSPR). The LSPR of AuNPs lies within the visible and near-infrared (NIR) region, thus rendering them suitable as transducers in sensors. Herein, we present applications of AuNPs functionalized with monoand bi-functional hydrophilic/hydrophobic thiols in colorimetric and chemoresistive sensors [3,4]. Surface ligand molecules allowed to disperse NPs in both polar/nonpolar solvents, making them a versatile tool that can be adapted to the aqueous environment as well as to hydrophobic ones. The synthesized AuNPs were fully characterized, before and after the recognition process, by both physicochemical (UV–vis, FTIR, 1H-NMR, DLS and, z-potential) and morphostructural techniques (AFM, FESEM, HRTEM). The results obtained for both sensors demonstrated an increase in the mean particle size upon contact with Hg0vap and melamine as contaminants. AuNPs-3MPS shown the ability to recognize melamine in aqueous solution due to electrostatic interactions between charged AuNPs surface and melamine. Tuning the distance between NPs, i.e., isolated or interconnected AuNPs, allowed to obtain an irreversible/reversible response towards Hg0vap.

References

[1] Wang, L. et al. Adv. Funct. Mater. 2020, 30,2005400.
[2] Singh, H. et al. Environ. Sci. Nano 2021, 8, 863–889.
[3] Fratoddi, I. et al. ACS Appl. Nano Mater. 2021, 4, 2930?2940.
[4] Cerra, S. et al. Colloids Surf. B 2021, 203, 11172.