PÔSTER - RESUMO - MATERIAIS E BIOMATERIAIS

DEVELOPMENT OF METALLIC NANOPARTICLES FOR APPLICATION IN BIOMARKER STUDIES

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The intensive use of pesticides in agricultural environments has raised increasing concern regarding their potential impacts on biological systems, particularly due to their ability to induce oxidative stress and sublethal biochemical alterations in aquatic organisms. In this context, the detection of molecular biomarkers associated with oxidative imbalance is of great relevance for environmental monitoring and ecotoxicological studies. Among these biomarkers, glutathione (GSH) plays a central role in cellular redox homeostasis and is widely recognized as a sensitive indicator of oxidative stress. However, the reliable spectroscopic detection of GSH requires the development of stable and well-characterized plasmonic substrates. This undergraduate research project presents a preliminary study focused on the synthesis and optical characterization of gold nanoparticles (AuNPs) as a foundational step toward future surface-enhanced Raman scattering (SERS) applications aimed at GSH detection. At the present stage, the work is dedicated exclusively to the preparation, stabilization, and Ultraviolet–visible (UV–Vis) characterization of

AuNPs, establishing the necessary experimental conditions before Raman and SERS measurements. Gold nanoparticles were synthesized through the chemical reduction of chloroauric acid using sodium citrate as both reducing and stabilizing agent. The synthesis protocol was optimized to promote the formation of colloidal nanoparticles with reproducible optical properties and minimal aggregation, which are essential characteristics for plasmonic enhancement. UV–Vis spectroscopy was employed as the primary characterization technique to monitor the localized surface plasmon resonance (LSPR) band, allowing evaluation of nanoparticle formation, dispersion, and colloidal stability. As an initial proof of concept, Rhodamine 6G (R6G) was selected as a model probe molecule. The choice of R6G is justified by its well-known optical properties, strong interaction with metallic surfaces, and intense and characteristic spectral features, which make it a widely accepted reference compound in plasmonic and SERS-related studies. UV–Vis interaction tests were carried out by adding R6G to the AuNP colloidal solutions in order to investigate possible plasmon–molecule interactions. Changes in the LSPR band position and intensity were analyzed as indirect indicators of molecular adsorption and local refractive index variations at the nanoparticle surface. The use of R6G at this stage allows the validation of the optical response and stability of the AuNP system under controlled conditions, minimizing uncertainties associated with more complex biological molecules. Once the plasmonic behavior of the system is well established using the model probe, the experimental strategy will be extended to glutathione (GSH). Due to its thiol group, GSH exhibits a strong affinity for gold surfaces, making it a relevant target molecule for nanoparticle-based sensing platforms. Future steps of the project will involve studying the interaction between AuNPs and GSH, followed by Raman and SERS measurements to evaluate detection sensitivity and molecular specificity. In summary, this preliminary study establishes an experimental foundation for the development of AuNP-based plasmonic substrates, combining synthesis optimization and UV–Vis characterization with model probe validation. The proposed progression from Rhodamine 6G to glutathione detection ensures methodological and scientific coherence, paving the way for future applications in oxidative stress assessment and ecotoxicological monitoring. Additionally, this work contributes to the academic training of the undergraduate student, fostering skills in nanomaterial synthesis, optical characterization, and experimental planning.

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