

Ernestine GAILLARD

E. Gaillard,¹ L. Mahtout,¹ D. Onidas,¹ Y. Luo¹, N. Felidj,² and C. Mangeney¹

¹LCBPT, UMR 8601, Université Paris Cité, 45 rue des Saints-Pères, 75006 Paris, France

²ITODYS, UMR 7086, Université Paris Cité, 13 rue Jean-Antoine de Baïf, 75013 Paris, France

ernestine.gaillard@etu.u-paris.fr

Nanocomposite Hydrogels based on Functionalized Gold Nanotriangles as SERS Platforms for Biomarker Detection

Surface-Enhanced Raman Scattering (SERS) has emerged as a powerful analytical technique for the ultrasensitive detection of biomarkers, offering high molecular specificity and low detection limits[1]. The performance of SERS substrates strongly depends on both the plasmonic properties of metallic nanostructures and the control of their surface chemistry, which governs their stability and interactions with target analytes[1–4]. In this work, we develop a nanocomposite hydrogel-based SERS platform consisting of anisotropic gold nanotriangles immobilized within an agarose matrix (Figure 1). Gold nanotriangles were selected for their tunable localized surface plasmon resonance and their ability to generate intense electromagnetic hot spots[4–6]. To improve colloidal stability and tailor the surface towards molecular recognition, the nanoparticles were functionalized using aryldiazonium salts, providing robust and versatile organic surface layers[1,2,7]. The study focuses on the synthesis and characterization of the functionalized gold nanotriangles, their incorporation into agarose hydrogels, and the evaluation of the resulting nanocomposite as a SERS substrate. Particular attention is paid to the stability of the plasmonic nanoparticles during encapsulation and to the ability of the functionalized interface to promote the indirect detection of thiolated biomolecules through surface interactions. This approach aims to combine the optical performance of anisotropic plasmonic nanostructures with the mechanical and chemical advantages of hydrogels, paving the way toward robust, reproducible, and biocompatible SERS sensors for future biomedical and environmental sensing applications.

References

- [1] G.Q. Wallace, J.-F. Masson, *The Analyst* 145 (2020) 7162–7185.
- [2] D. Li, P. Nizard, D. Onidas, A. Lamouri, J. Pinson, S. Mahouche-Chergui, K. Aubertin, F. Gazeau, Y. Luo, C. Mangeney, *Nanoscale* 14 (2022) 1452–1458.
- [3] S. Mahouche-Chergui, S. Gam-Derouich, C. Mangeney, M.M. Chehimi, *Chem. Soc. Rev.* 40 (2011) 4143.
- [4] P. Talarska, M. Boruckowski, J. Żurawski, *Nanomaterials* 11 (2021) 2454.
- [5] J. Zhu, R.B. Lennox, *ACS Appl. Nano Mater.* 7 (2024) 23288–23294.
- [6] L. Scarabelli, L.M. Liz-Marzán, *ACS Nano* 15 (2021) 18600–18607.
- [7] Y. Luo, Y. Xiao, D. Onidas, L. Iannazzo, M. Ethève-Quelquejeu, A. Lamouri, N. Féridj, S. Mahouche-Chergui, T. Brulé, N. Gagey-Eilstein, F. Gazeau, C. Mangeney, *Chem. Commun.* 56 (2020) 6822–6825.

Figures

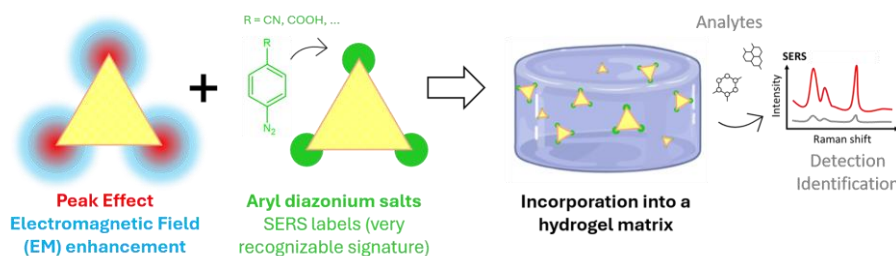


Figure 1: Representation of the indirect strategy for biomarker detection based on aryldiazonium functionalized gold nanotriangles incorporated into agarose hydrogels.