Magneto-plasmonic nanocomposites as selective and sensitive sensors for water remediation

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Environmental health is a major part of our lives; therefore, monitoring and addressing environmental pollution is essential. Surface-enhanced Raman scattering (SERS) is a highly sensitive analytical technique and a promising tool for detection of trace pollutants [1, 2] . As such, nanocomposites consisting of plasmonic and magnetic nanoparticles (NPs) are excellent candidates for water monitoring and remediation, offering the optical properties of plasmonic NPs (SERS) and facilitating target extraction from the environment using a magnetic field [2, 3] . Here, we present magnetic NPs decorated with Au NPs via chitosan and synthesized through a green route. To confirm SERS detection, highly charged porphyrins were chosen as model adsorbates. The nanocomposites were further functionalized with phenylboronic acid (PBA) to improve selectivity and tested for the SERS detection of other selected pollutants (e.g. amikacin). PBA has a unique ability to form reversible ester bonds with diol-containing molecules depending on the solution pH [4] . Therefore, such decorated magneto-plasmonic nanocomposites can be repeatedly used for the purposes of SERS detection and selective removal of pollutants from water.

Keywords:
Nanocomposites, magnetic nanoparticles, gold nanoparticles, SERS, phenylboronic acid.

References:

[1] Huang, Y.-H.; Wei, H.; Santiago, P. J.; Thrift, W. J.; Ragan, R.; Jiang, S. Sensing Antibiotics in Wastewater Using Surface-Enhanced Raman Scattering. *Environmental Science & Technology* **2023** , *57* (12), 4880-4891. DOI: 10.1021/acs.est.3c00027.
[2] Song, D.; Yang, R.; Long, F.; Zhu, A. Applications of magnetic nanoparticles in surface-enhanced Raman scattering (SERS) detection of environmental pollutants. *Journal of Environmental Sciences* **2019** , *80* , 14-34. DOI: 10.1016/j.jes.2018.07.004.
[3] Juang, R.-S.; Chen, W.-T.; Cheng, Y.-W.; Wang, K.-S.; Jeng, R.-J.; Zeng, Z.-L.; Liu, S.-H.; Liu, T.-Y. Fabrication of in situ magnetic capturing and Raman enhancing nanoplatelets for detection of bacteria and biomolecules. *Colloids and Surfaces A: Physicochemical and Engineering Aspects* **2022** , *648* , 129189. DOI: 10.1016/j.colsurfa.2022.129189.
[4] Vrbata, D.; Uchman, M. Preparation of lactic acid- and glucose-responsive poly(ε-caprolactone)-b-poly(ethylene oxide) block copolymer micelles using phenylboronic ester as a sensitive block linkage. *Nanoscale* **2018** , *10* (18), 8428-8442, 10.1039/C7NR09427B. DOI: 10.1039/C7NR09427B.

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