Extending the range of metal ions SERS detection using hybrid plasmonic/ZIF-8 particles

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Plasmonic devices exploiting surface-enhanced Raman spectroscopy (SERS) as the sensing technique have emerged as a class of promising optical tools for the ultrasensitive quantification of metal ions of environmental and biological interest [1]. A central bottleneck in this field is the availability of suitable surface receptors able to convert the selective binding with these vibrationless analytes into measurable SERS signals.
We tackled this issue by employing a hybrid substrate comprising a highly SERS-active plasmonic core and a ZIF-8 metal-organic framework (MOF) shell [2,3]. The ZIF-8 shell firmly captures aromatic receptors close to the plasmonic structure regardless of their intrinsic affinity for the metallic surface and without altering their properties as chromogenic reagents. Furthermore, it imparts molecular sieving abilities enabling the direct use of the SERS sensing platform in complex media. These virtues were demonstrated by using various classes of chromogenic receptors targeting diverse metal ions. Notably, we successfully applied this approach for the detection of Cu(II) in untreated urine samples for Wilson's disease diagnosis.
Overall, we believe this class of multifunctional hybrid substrate will serve as a powerful material for expanding the applicability of SERS spectroscopy in real-life environmental and biomedical metal ions analysis.

References

[1] Guerrini L., Alvarez-Puebla R.A., ACS Omega (2021); 6, 1054.
[2] Pazos-Perez N., Guerrini L., Talanta (2024); 266, 124941.
[3] Zorlu T., Puértolas B, Becerril-Castro I.B., Guerrini L., Giannini V., Correa-Duarte M.A., Alvarez-Puebla R.A., ACS Nanoscience Au (2023); 3, 222.

Figures

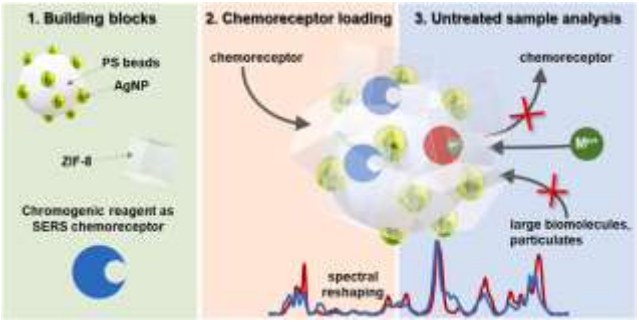

Figure 1. Main features of the hybrid plasmonic/MOF particles (PS@AgNPs@ZIF-8) and their application in metal ion detection in complex aqueous media.