Synthesis of Janus Magneto-Plasmonic nanoparticles. Multimodal imaging and SERS detection

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Multicomponent nanoparticles have attracted strong interest in the last years due to the unique combination of properties present at the nanoscale that make them suitable for a high set of applications. Among them, Janus nanoparticles, characterized by two different surface regions, can be of great interest to produce a specific interaction with interfaces, biomolecules, membranes etc.
Here, we report the synthesis of Janus nanoparticles composed of Au-Fe_3O_4 nanostar-nanosphere (also called nano-octopueses) through two consecutive seed-mediated-growth steps. Electron tomography combining HAADF-STEM and EDX was performed to evaluate the Janus character of the nanoparticles (figure a-e). The nanoparticles showed superparamagnetic properties and a high plasmonic absorption at the near-IR (figure f).The extraordinary versatility of these nanoparticles has been tested in analytical sensing using Surface-enhanced Raman spectroscopy (SERS), and multimodal imaging. The resulting experiments showed the high Raman enhancement of these nanoparticles thanks to the Au nanostar part of the Janus nanoparticles that can be further amplified with the use of magnetic concentration, allowing nanomolar detection in very small sample volumes. Furthermore, with the use of combined gold and iron oxide in a Janus configuration we demonstrate how these magnetoplasmonic nanoparticles act as superior contrast agents in a high variety of imaging techniques, including cell imaging in dark and bright field, multiplexed SERS mapping and 3D tomography in magnetic resonance imaging (MRI) and computed tomograpy (CT) among others.

References

[1] J. Reguera D.J. Aberasturi, N. Winckelmans, J. Langer, S. Bals, L.M. Liz-Marzán, *Farad. Discuss. 191 (2016) 47-59*

Figures

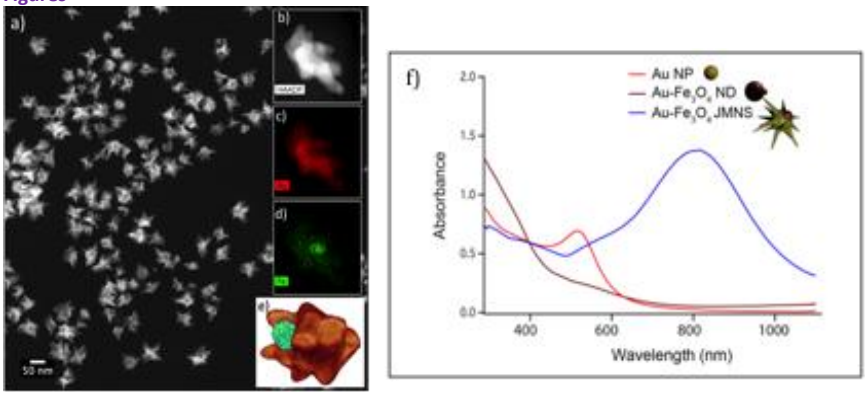

Figure 1: a-e) HAADF-STEM, EDX mapping and combined electron tomography. f) UV-VIS of the Janus nanostars and the initial seeds used in the synthesis.