RamanFest November 09-10 2023 Paris FRANCE

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Novel biocompatible nanoprobes for multimodal optical imaging via SERRS and fluorescence effects

Context and Objective: Anisotropic gold systems as nanoflowers (AuNF) are the object of intensive studies, due the unique plasmonic properties they provide that can be used in various fields, including biomedical applications. The ability of AuNFs to interact with near-IR light makes them attractive as optical imaging agents, since biological tissues are more transparent to the light in the near-IR region. In the present study, we aimed to develop AuNF-based aqueous colloids able to provide aggregation-free surface-enhanced resonance Raman scattering (SERRS) effect in NIR, due to both the tip effect on their petals and "hot spots" in the junctions between the petals (Fig1), but also fluorescent in the NIR region.
Methods: We have recently developed a new protocol of synthesis of the AuNF (1) which surpasses practically all the limits of the protocols published before: it is fast, single-step and uses only a small number of known reagents. In addition, our protocol allows to control the characteristics of AuNF such as the size and the position of their LSPR band, between 600 and 900 nm (Fig 1). To improve their stability in various media, in the present study, we coated our AuNF with various biocompatible materials. The physico-chemical characterization of the hybrid nanosystems was carried out using TEM (transmission electron microscope), DLS (dynamic light scattering) and UV-visible spectroscopy.
Results and Conclusions: We studied the effects of the coatings on the intensity and shape of SERS spectra of a fluorescent chromophore Blue Nile (NB) emitting in the near infrared. The colloidal substrates based on our AuNFs coated with biocompatible shells have shown their potential to provide the SERS effect without aggregation and to allow ultra-sensitive analysis of small chromophores. Their detection in cells has been demonstrated, using several optical imaging modalities, namely SERRS and fluorescence in NIR. In addition, our results show that these new substrates are able to deliver a molecular cargo to cancer cells. Thus, they appear promising as versatile agents, for multimodal optical imaging and also for drug delivery.

References

[1] Pacaud M., Hervé-Aubert K., Soucé M., Makki A.A., Bonnier F., Fahmi A., Feofanov A., Chourpa I. One-step synthesis of gold nanoflowers of tunable size and absorption wavelength in the red & deep red range for SERS spectroscopy. Spectrochim. Acta A: Mol. Biomol. Spectrosc. 2020, 225: 117502.

Figures

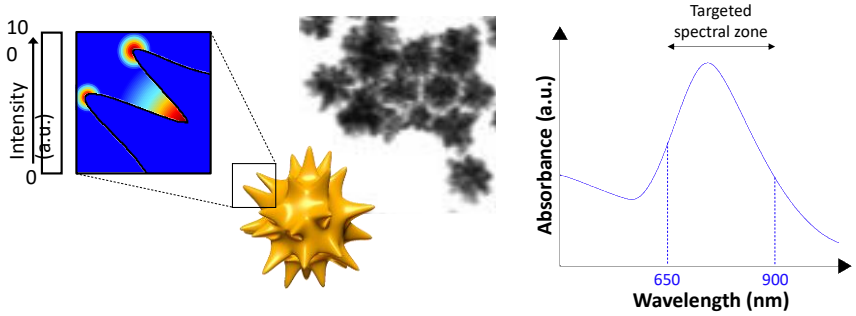

Figure 1: Left: schematic presentation of the tip effect and of the hot spot formation on a plasmonic nanoflower. Middle top: TEM image of AuNFs (diam. ca 100 nm). Right : spectral zone of the tunable plasmonic resonance of AuNF.