

Nanoscale SERS investigation of a polyphenol-based plasmonic nanovector for drug delivery applications

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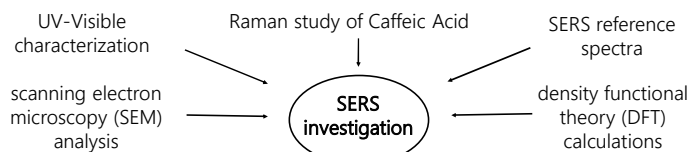
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Introduction

Polyphenols are reported with notably antioxidant and anti-inflammatory properties, which are at the basis of their several healthy effects. However, some of polyphenol intrinsic features, like poor solubility and low stability, often hinder their pharmaceutical applications [1]. Silver nanoparticles (AgNPs) are ideal nanovectors for polyphenol delivery, combining their well-known antibacterial properties with polyphenol beneficial action [2]. The localized character, the molecular specificity, and the high sensibility of Surface Enhanced Raman Scattering (SERS) make it a suitable technique for the investigation of polyphenol-AgNP based drug delivery system at the nanoscale level [3].

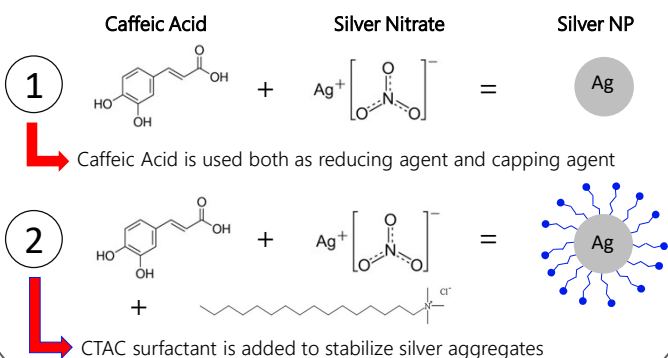
Strategy

We optimized a theoretical and experimental protocol for the SERS study of polyphenol synthesized AgNPs. We focused on AgNPs synthesized through Caffeic Acid both in presence and in absence of the CTAC surfactant [4].



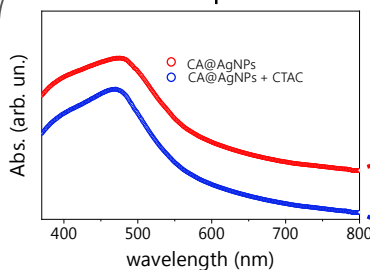
Synthesis

Polyphenol reductive power can be exploited to induce silver ion nucleation



Characterization

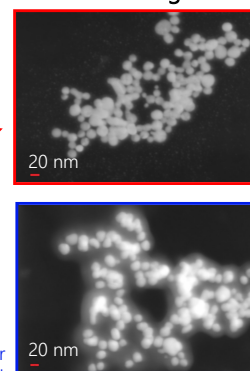
UV-Vis absorption



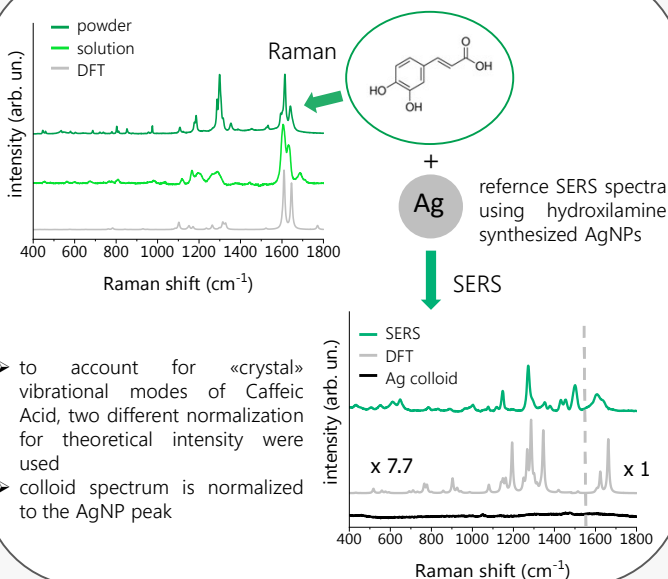
- plasmon resonance at ≈ 450 nm
- homogeneous distribution of Np: ≈ 20 nm diameter

presence of surfactant layer around AgNP was revealed

SEM images

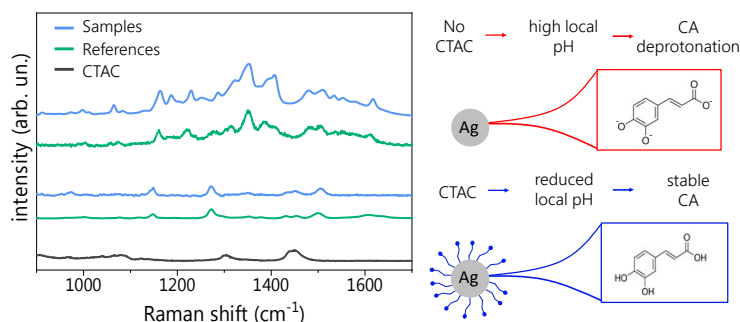


SERS reference & DFT spectra



SERS results

Sample SERS spectra were compared with reference SERS spectra at neutral and at strongly basic pH.



- SERS spectra of AgNPs stabilized with CTAC are well reproduced by SERS reference at neutral pH, while those from AgNPs synthesized without CTAC are well reproduced by SERS reference at high pH
- CTAC spectral features were not revealed in the SERS spectrum of surfactant stabilized AgNPs
- Drastic spectral changes between the two samples are assigned to chemical deprotonation of Caffeic Acid when the CTAC screen is absent

Perspectives

SERS spectroscopy can be used to monitor the interaction of Caffeic Acid with cellular components, thus allowing for a deep understanding of the biological behaviour of this polyphenol. In addition, Caffeic Acid can bind several biological molecules, proving the realization of a target specific SERS based nanosensor. These nanostructures have great potentialities for therapeutic and diagnostic applications, such as early cancer detection [5].

References

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