SERS spectroscopy towards quantitative molecular sensing of drugs

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The quick and cost-effective quantitative detection of drugs in biological fluids (*e.g.*, blood, plasma, urine) is an active research area. The use of spectroscopic methods based on light scattering and plasmonics (*e.g.*, SERS) emerged as a promising and complementary approach to High-Performance Liquid Chromatography (HPLC). Compared to HPLC, SERS can provide molecular-level information with reduced sample preparation and consistently lower times and costs. In particular, this research meets the need of medical doctors (MDs) to rapidly analyse the quantity of drugs in the bloodstream (within minutes), a practice referred to as therapeutic drug monitoring (TDM). TDM allows assessing the patient compliance to the drug with the possibility to personalize the therapy. The availability of a drug sensing SERS device would enable MDs to treat patients more effectively, with a drastically reduced blood volume required for the analysis (≈50 µl). Recent results are discussed on the use of nanostructured gold substrates to quantitatively detect apomorphine (APO), a drug against Parkinson's and Alzheimer's diseases, and carbamazepine (CBZ), an antiepileptic drug.
One of the challenges for molecular quantification by SERS is the signal reproducibility. The use of noble metal substrates produced by pulsed laser deposition (PLD) [1-5], thanks to their controlled nanostructure, allowed improving the situation compared to the use of colloids obtained by chemical routes (*e.g.,* Lee-Meisel colloids). By tuning the process parameters PLD allows exploring the plasmonic properties of different surface morphologies and their SERS behavior. Besides the production of good SERS substrates, the interpretation of the observed SERS signals is important to develop reliable sensors (Fig. 1a-b). This is particularly evident in the presence of chemisorption processes that modify the SERS signal with respect to the normal Raman counterpart (Fig. 1c). The selection of the appropriate molecular model and theoretical approach can significantly foster the interpretation of otherwise puzzling experimental results. The case of CBZ is examined in detail.

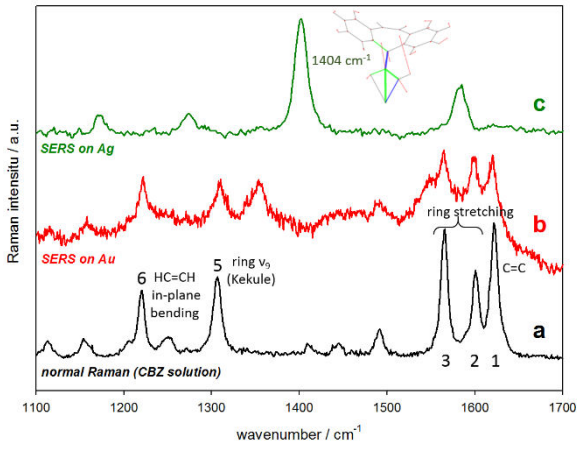

Fig. 1.

References

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