Invited talk

Tip-enhanced Raman spectroscopy for nanoscale chemical and structural characterization of biomolecules and biointerfaces

Sébastien BONHOMMEAU

Institut des Sciences Moléculaires, Université de Bordeaux, Bordeaux, France

Tip-enhanced Raman spectroscopy (TERS) has emerged as a powerful technique for chemical and structural characterization with nanoscale (and even sub-nanoscale) spatial resolution. TERS combines the chemical specificity of Raman spectroscopy and the high spatial lateral resolution of scanning probe microscopies (such as AFM). Several TERS configurations have been proposed for the description of biomolecules and biomaterials, either in bottom-, top- or side-illumination geometries. They allowed TERS signatures of nucleic acids, proteins/peptides, lipid membranes, viruses and cells to be unraveled.[1]

Here, we present scientific and technical achievements in TERS, and especially those realized at the University of Bordeaux for the characterization of biosurfaces and biointerfaces. Benefits of TERS in total internal reflection (TIR) compared with other experimental configuration will be underlined[2,3] and important elements regarding the fabrication of adequate TERS probes for nanoscale chemical imaging will be discussed.[4] TIR-TERS takes advantage of recent developments of surface-enhanced Raman spectroscopy (SERS) in TIR, to describe oriented biomolecules or protein assemblies on metal substrates.[2] SERS studies are indeed considered as good references for the interpretation of TERS data. Our recent works in TIR-SERS and TIR-TERS will be described through the investigation of several examples (cytochrome C monolayer, amyloid fibrils and lipid membranes).[2,3,5] In addition to TERS measurements in air, which are the most frequent, our activity for the development of TERS in liquid medium will be finally described. The achievement of TERS imaging in aqueous environment is the next major challenge for applications in biology.

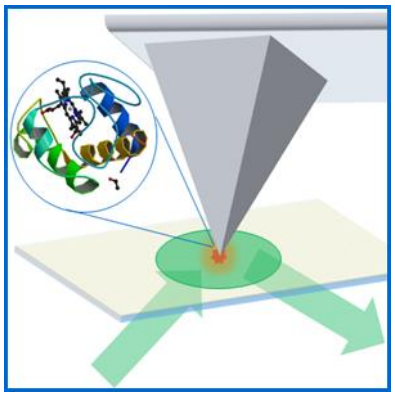

Figure 1. Schematic representation of TIR-TERS configuration for the study of cytochrome c.[2]

References

[1] Bonhommeau, S.; Cooney, G.S.; Huang, Y. Nanoscale chemical characterization of biomolecules using tip-enhanced Raman spectroscopy. *Chem. Soc. Rev.* **2022**, 51, 2416-2430.

[2] Talaga, D.; Bremner, A.; Buffeteau, T.; Vallée, R.A.L.; Lecomte, S.; Bonhommeau**,** S. Total internal reflection tip-enhanced Raman spectroscopy of cytochrome C. *J. Phys. Chem. Lett.* **2020**, 11, 3835-3840.

[3] Talaga, D.; Cooney, G.S.; Ury-Thiery, V.; Fichou, Y.; Huang, Y.; Lecomte, S.; Bonhommeau, S. Total internal reflection tip-enhanced Raman spectroscopy of Tau fibrils. *J. Phys. Chem. B* **2022**, 126, 5024-5032.

[4] Huang, Y. ; Talaga, D.; Bonhommeau, S. et al., *in preparation*.

[5] Cooney, G.S.; Talaga, D.; Bonhommeau, S. et al., *in preparation*.