Extending the Capabilities of SERS in Studies of Cells

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Surface-enhanced Raman scattering (SERS) enables us to obtain spectra from molecules that are in the close proximity of gold or silver nanostructures, at high sensitivity and with nanoscopic lateral resolution. This has been exploited to monitor cellular biomolecules, or to obtain spectral signatures of molecules that are brought into cells or other complex biological systems. Since the signals that can be obtained in SERS strongly depend on the interaction of a molecule with the nanostructures, SERS is particularly useful to monitor nano-bio interactions.

The strong dependence of the optical properties of the nanostructures on the interactions in/with a biomatrix has implications for the development of SERS as a tool for single cell probing. As we will show here, the high sensitivity with regard to the plasmonic properties of the metal nanoparticles *inside* the biological system must be considered, and the efficiency of the SERS probes must be evaluated. It can be assessed by combining information about the SERS characteristics with spatially resolved nanoaggregate quantification, and with studies of the nanoaggregate morphologies.[1] We will show such results for a variety of different plasmonic structures and for composite materials with a plasmonic component. Furthermore, we will discuss how the SERS data can be used for sample identification and classification in spite of the high fluctuations of SERS signals and preparation specifics in some biosamples. [2].

In addition to mere detection of molecules, SERS can monitor the molecular interactions at the surface of the metal nanostructures. We have recently seen that two-photon excited SERS, surface-enhanced hyper Raman scattering (SEHRS) is particularly sensitive to the interaction of molecules with the surface of silver nanoparticles.[3] This can be used to construct new SERS probes for studies of cells.

References

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