# *SERS for studies of cells: From basic concepts to practical tools*

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The area of surface-enhanced Raman scattering for studies of biological systems, mainly cells and tissues has emerged rapidly. At the same time, the omnipresence of nanomaterials in our everyday life has been pushing research in the fields of biotechnology and nanotoxicity. The possibility to employ Raman scattering as a method to study both the biological system as well as the nanomaterials opens exciting new avenues for nanotoxicity research, surface science, and cell biology.

In SERS, the increased lateral resolution is very useful for imaging, and in many cases adds to the selectivity of the Raman micro-/spectroscopic experiment. We utilize Raman scattering and SERS for the analysis of cellular samples of animal and plant origin which are several tens to hundreds of microns in size. There, nanoparticles of gold and silver are used as plasmonic nanostructures to generate the enhanced local optical fields in which SERS takes place. However, as we have recently shown experimentally using gold nanospheres of different sizes yet identical surface properties, the electromagnetic SERS enhancement depends on nanosphere size, but the enhancement factor can vary also with analyte concentration (1). This has serious implications for the application of nanoparticle solutions as SERS substrates in quantitative analytical tasks and also for live cell experiments. In such experiments, metal nanoparticles are transferred into the cell, and depending on their size and surface properties, can be directed to different cellular compartments. In order to find out about the interaction of the nanoparticles with the cellular ultrastructure, their morphology and possible agglomeration behaviour, we have studied cultured cells after particle transfer by SERS, synchrotron X-ray tomography and transmission electron microscopy. We observe a dependence of the nanoparticle interaction on the material and possibly the surface (2). The experiments provide for the first time an opportunity to study on one hand the composition, structure and stability of the corona of the nanoparticles, and particle structure, agglomeration and morphology on the other hand, both in the context of the cellular ultrastructure.

References

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