Biomedical applications of advanced Raman spectroscopies

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Heterogeneity on the single-cell level is typically masked in conventional studies of microbial populations, which rely on data averaging across thousands or millions of cells in a sample. Confocal Raman Microspectroscopy (CRM) investigates cells at the diffraction limit and illustrates spatial heterogeneity of components within genetically homogeneous populations. The intra- and inter-cellular heterogeneity shown here has consequences for the method used, since the cell's individuality has to be carefully taken into account when spectroscopic information is used for identification or classification purposes[1-3].

However, the Raman scattering efficiency of CRM is comparably poor and does not allow investigations of biomolecules at very low concentration or single nanoparticles like viruses. Therefore different Raman-signal-enhancing techniques have been applied. In our surface-enhanced Raman scattering (SERS) experiments a special rough metal surface is brought in close proximity to a sample experiencing electromagnetic and chemical enhancement effects allowing the characterization of bacterial cells with highest sensitivity. In another approach, tip-enhanced Raman spectroscopy (TERS) combines SERS with atomic force microscopy (AFM). This technique provides detailed and highly sensitive chemical and spectral information on e.g. single virus particles at a spatial resolution below the optical diffraction limit[3].

The talk will give an overview of currently running projects in our laboratory at the Robert Koch Institute using different experimental setups of Raman spectroscopy.

References

[1] A. Hermelink, A. Brauer, P. Lasch, D. Naumann, *The Analyst* 134, 1149-1153 (2009).
[2] P. Lasch, A. Hermelink and D. Naumann, *The Analyst* 134, 1162-1170 (2009).
[3] D. Cialla, T. Deckert-Gaudig, C. Budich, M. Laue, R. Möller, D. Naumann, V. Deckert, J. Popp, *Journal of Raman Spectroscopy* 40, 240-243 (2008).