Characterization of lipids in living cells and model systems by SERS

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Monitoring lipid metabolism in cells is of utmost importance for understanding lipid-related pathologies. Several methods are used for detection of lipids in living cells, e.g., fluorescence-based methods, however, in this case, extensive labeling is required. Thus, label-free, non-invasive methods for detection of lipids in living cells and specific organelles, e.g., endosomes, are urgently needed. Furthermore, biotechnological and therapeutic approaches require an understanding of the interaction of lipid membranes with nanostructures.

Here, we present surface-enhanced Raman scattering (SERS) as an approach for a direct, label-free characterization of the composition and structure of lipids in the cellular environment [1] as well as in vesicle models [2]. SERS gives unprecedented structural information in the nm-scaled vicinity of gold nanoparticles. Therefore, SERS spectra were obtained from macrophage cells that harbour large amount of lipids, in the used cellular model due to the infection by the *Leishmania* parasite [1]. Furthermore, interactions of lipids in model vesicles composed in a similar fashion as cell membranes were characterized using a combination of SERS and cryogenic electron microscopy (cryo-EM) [2]. The SERS spectra obtained from both, cells and vesicles, demonstrate that SERS is a sensitive tool for probing interactions and composition of lipids in living cells and in the future can enable new insights into lipid-related diseases.

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[1] Živanovic et al. Anal. Chem. 90 (2018) 8154-8161.
[2] Živanovic et al. J. Phys. Chem. Lett. 9 (2018) 6767-6772.