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Surface enhanced Raman spectroscopic (SERS) detection of antibiotics and metabolites in complex biological matrices

Raman spectroscopy is known as powerful analytical tool in biomedical application schemes. Its limitation due to the intrinsic weak Raman effect is overcome by applying powerful plasmonic nanostructures creating the surface enhanced Raman spectroscopy (SERS) technique. SERS became attractive to identify and estimate the trace concentration of biomolecules such as drugs and its metabolites even in complex matrices. [1, 2] To perform SERS investigations, we applied as sensing principle the direct approach, which allows all molecules to contribute to the overall SERS spectrum. The specificity is increased for those molecules with high affinity towards the metal surface.
The bacterium *S. multivorans* is known to form PCE reductive dehalogenase (PceA) within the membrane, which is the key enzyme in respiration of a major groundwater contaminant, perchloroethylene (PCE). PceA harbors B12 which was detected by means of SERS after coating the SERS-active surface with the bacterial membrane. [3]
Further on, the SERS technique was applied to estimate the antibiotic ciprofloxacin in pharmaceutical formulations. For formulations with high background signal, a dilution by 1:5000 was applied and the recorded SERS spectra were only dominated by the contribution of the target ciprofloxacin, which is associated with the strong affinity of this drug towards the metal sensing surface. [4]
Finally, we illustrated the SERS-based detection of pyrazinoic acid (POA), a metabolite of the tuberculosis-relevant prodrug pyrazinamide (PZA). To be specific for POA, gold nanoparticles equipped with a Prussian blue modification were applied, complexing the POA molecules via Fe (II) and allowing its sensitive detection. This scheme has a high potential in assessment of PZA resistance in *M. tuberculosis* bacteria, as only sensitive bacteria convert PZA into POA. [5]

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