# *Surface-Enhanced Raman Scattering (SERS) as a label-free readout principle for microorganisms on microarray*

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The ever growing concerns of germs in drinking water have occupied researchers for years, trying to develop a fast and feasible high-throughput detection principle. Until now, several methods (e.g heterotrophic plate count and cross flow- and membrane filtration followed by a cultivation) have been used in the field of water analytics, though they are often time consuming and require an additional enrichment-step.[1]

Microarrays are implied in modern biochemistry of various immuno-complexes, such as biomolecules including DNA/RNA and oligonucleotides, proteins, peptides, carbohydrates, toxins and microorganisms for simultaneous detection. Existing methods require labelling molecules which produce the detected signal, possibly inducing false negative and false positive results.[2] Vibrational spectroscopy has proven to be promising for biomolecular detections as it is non-destructive, fast and sensitive.[3] Identification of compounds is possible by their specific fingerprint spectra. Raman microscopy (RM) can be carried out in aqueous solutions, as water is a weak Raman scatterer. The major constituent of microorganisms is water, hence RM is feasible to analyse their structural information in situ. Additionally, a spatial resolution in µm-range as well as high selectivity can be obtained. Nevertheless, RM is limited in its sensitivity and most biomolecules cannot be analysed due to a low Raman cross section. Surface-enhanced Raman scattering (SERS) on the other hand is a method, where metal particles enable signal enhancements up to $10^{14}$ compared to normal Raman due to chemical and electromagnetic enhancements. One can detect analytes down to a single molecule level.[4]

We have developed a label-free readout principle for microorgansims in aqueous environment using SERS. A microarray has been combined with a Raman setup which enables us to analyse several analytes both qualitative and quantitative non-destructive. Silver colloids (D = 23-26 nm), which are produced according to a modified procedure of Leopold and Lendl[5], are used as SERS substrates and give enhancement factors up to $10^5$. Due to the directed formation of Ag particle agglomerates on the cell wall, we have accomplished to deliver strong SERS spectra with high resolution of both *L. pneumophila* and *S. typhimurium*. Our preliminary results imply for a good perspective of the adoption in the field of drinking water analytics. Integration in an automatic fluidic system is planned.

**References:**

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