Raman-investigation of microbial cell populations

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Individual cells within clonal microbial cultures exhibit marked phenotypic heterogeneity, which is manifested on a wide range of phenotypes, many of which are fundamental to organism's fitness and development. The control processes in microbial cells that regulate cell function can, at any moment in time, be differentially activated in different cells of genetically uniform populations and induce both, intra- and intercellular phenotypic heterogeneity. Subsequently, during microbial growth, several important cellular components may show significant changes in structure, quantity and localisation. Heterogeneity on the single-cell level is typically masked in conventional Raman studies of microbial populations, which rely on data averaged across thousands or millions of cells within the measurement volume. Confocal Raman microspectroscopy (CRM) is an evolving technique for the rapid, non-invasive chemical imaging of substance heterogeneity in microbial cell populations at the single cell level, in such a way that it enables the diffraction-limited investigation of both the spatial distribution of cell components and their chemical or structural nature.
Because of its paramount ecological and economical importance microbial PHB is subject of an increasing number of analytical studies. Its heterogeneous distribution within a population of different microbes was published recently[1]. Heterogeneity enables microbial cell populations to survive in respective environmental conditions and is therefore required for survival. Rapid responses to changes in the environment are achieved by coupling strong expression systems with feedback to up or down modulate expression after the initial stimulus. Underlying these phenomena the principle control processes that regulate cell function can be differentially activated in the cell of genetically uniform populations and induce both, intra-and intercellular heterogeneity. As an application example the results of a project will be shown which follows the PHB production in situ in the *Legionella bozemanii* strain L2165 in terms of content and distribution as a function of time or growth. The investigation is conducted by means of (confocal) Raman microspectroscopy (single cell approach) addressing the "all over heterogeneity effects" and FT-Raman spectroscopy for determining the total PHB content in the sample.

References:

[1] A. Hermelink, A. Brauer; P. Lasch, D. Naumann, *The Analyst* 134, 1149-1153 (2009).