

# HETEROGENEITY INVESTIGATIONS BY MEANS OF RAMAN MICROSCOPY FOR SINGLE CELL IDENTIFICATION

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A fast analysis of microorganisms is necessary not only for medical applications but also for e.g. pharmaceutical production or food technology in order to identify potential harmful bacteria. Conventional identification methods require pure cultures from isolates which means different cultivation steps.

Vibrational spectroscopy offers a different approach to identify microorganisms. With Raman microscopy a spatial resolution of less than 1  $\mu\text{m}$  can be achieved. Therefore it is possible to measure single bacteria cells. Using Micro-Raman mapping experiments it has been shown that the bacterium shows spatial homogeneity. [1] This can be explained by the fact that bacteria normally exhibit no compartments.

In contrary bacterial spores and yeast cells show a high spatial dependency of the observed Raman spectra. [2]

In Fig. 1 four micro-Raman spectra

measured at different positions inside a yeast cell (spectra a-c) are shown. The chemical compounds vary depending of the measuring position. Spectrum a can be assigned to a protein spectrum whereas spectrum b shows the typical Raman signals of a lipid. Using Raman mapping this spatial difference can be displayed.

Therefore one spectrum of a single vegetative bacterial cell is sufficient to identify the strain. For heterogeneous samples such as single spores or yeast cells a mean spectrum from up to ten different positions is required in order to describe the complete cell.

Using micro-Raman spectra of single bacterial cells and mean spectra of yeast cells it is possible to create a database and identify microorganisms on a species or even strain level.

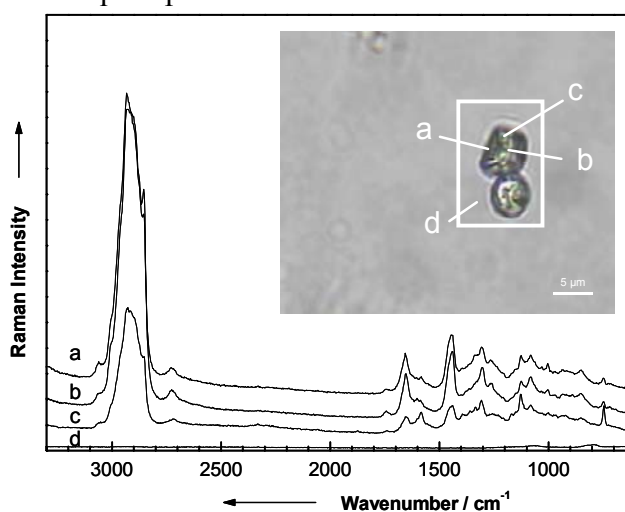


Figure 1: Micro-Raman spectra on different positions on a yeast cell (locations marked on the microphotograph).

[1] P. Rösch; M. Harz; K.-D. Peschke; O. Ronneberger; H. Burkhardt; H.-W. Motzkus; M. Lankers; S. Hofer; H. Thiele; and J. Popp, "Chemotaxonomic identification of single bacteria by micro-Raman spectroscopy: Application to clean room relevant biological contaminations", *Appl. Environ. Microbiol.* in print (2005).

[2] P. Rösch; M. Harz; M. Schmitt; and J. Popp, "Raman spectroscopic identification of single yeast cells", *J. Raman Spectrosc.* in print (2005).