Session 3 - Raman Spectroscopy / Imaging (Co-chairs: Baranska/Gierlinger)

03-01: Raman imaging of plant cells: where do we stand and where to go?

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Raman microscopy provides non-destructively the molecular fingerprint of plant cells in context with their microstructure. Chemical imagings as well as in-situ studies show the high potential to get a deeper understanding of structure-function relationships as well as biological processes and technical treatments [1]. Examples include insights into biomineralisation processes (e.g. Strontium and Barium in the freshwater algae *Micrasterias denticulate* [2]) and many studies on plant cell wall components (e.g. following lignin and phenolic extractive impregnation of plant tissues [1,3]).

Nevertheless, the application on secondary plant cell walls (e.g. wood, nuts) involves challenges in sample preparation as well as in optimizing experimental data acquisition and analysis. Although a VIS- laser with λ_{ex}=532 nm gives the best signal intensity and spatial resolution, care has to be taken when measuring aromatic plant cell components. Spectral modifications, especially an increase of fluorescence and a decrease of the ratio between the lignin assigned bands at 1600 and 1660 cm^{-1} (aromatic C=C and ethenyl C=C stretch) was observed in lignified tissues [4]. Surprisingly these experiments paved the way to remove the lignin completely and unravel the Raman signature of the carbohydrate polymers and proteins – without chemistry, only repeated laser irradiation. Carbohydrate bands are in the native lignified tissues very often hidden as especially conjugated aromatic structures show a strong signal enhancement with 532 nm laser excitation.

In hyperspectral image analysis more and more multivariate unmixing methods (e.g. vertex components analysis) have been explored to reveal the most pure components. This enabled to elucidate even tiny layers and structures based on different Raman spectra [1,5]. Nevertheless, for final spectra interpretation still some steps forward in Raman band assignments are necessary.

References

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