## 04-06: Nano-FTIR spectroscopy of in situ and extracted silica phytoliths

Victor Manuel R. Zancajo[1,2,3], Max Eisele[4], Rivka Elbaum[3], Janina Kneipp[1,2]

[1]*Chemistry Department and School of Analytical Sciences Adlershof (SALSA), Humboldt-Universität zu Berlin, Brook-Taylor-Strasse 2, 12489 Berlin, Germany*
[2]*BAM Federal Institute for Materials Research and Testing, Richard-Willstätter-Straße 11, 12489 Berlin, Germany*
[3]*R. H. Smith Institute of Plant Sciences and Genetics in Agriculture, The Hebrew University of Jerusalem, Rehovot 7610001, Israel*
[4]*neaspec GmbH, Eglfinger Weg 2, 85540 Munich-Haar, Germany*

We present the application of nano-FTIR spectroscopy to study plant silicification. FTIR based on IR fingerprint absorption spectroscopy is a widely used technique for chemical materials identification and characterization. It has been widely used to study cell wall constituents like proteins, aromatic phenols, cellulose and to characterize biosilica. Therefore, FTIR can provide important information on how silica affects the plant structure and development, reveal the differences in cell wall composition between the silicified and non-silicified cells and provide structural information of the deposited silica. Despite the capabilities of IR spectroscopy, the spatial resolution is limited to several micrometres by the diffraction of the long IR wavelengths, however, the diffraction limit can be circumvented by scattering-type near-field optical microscopy (s-SNOM). Fourier transform infrared nano spectroscopy (Nano-FTIR) based on s-SNOM, can be regarded as an extended atomic force microscope (AFM) that returns an infrared image together with topography and mechanical phase images [1]. It provides wavelength-independent nanoscale resolution far beyond the classical diffraction limit [2]. Its resolution is approximately equal to the radius a of the probing tip (~20 nm) and it allows to acquire simultaneous amplitude and phase images to obtain information on refractive and absorptive properties of the sample [3]. As will be demonstrated for the silica structures in our project, it is possible to correlate chemical and mechanical information combining the mechanical phase and IR spectra of the phytolith structures and to obtain information on structure and composition on the surrounding plant tissue.

**References**

[1] HUTH, F., et al., 2012: Nano-FTIR Absorption Spectroscopy of Molecular Fingerprints at 20 nm Spatial Resolution. Nano Letters, **12**, 3973-3978.

[2] GOVYADINOV, A. A., AMENABAR, I., HUTH, F., CARNEY, P. S., and R. HILLENBRAND, 2013: Quantitative Measurement of Local Infrared Absorption and Dielectric Function with Tip-Enhanced Near-Field Microscopy. The Journal of Physical Chemistry Letters, **4**, 1526-1531.

[3] KEILMANN, F., and R. HILLENBRAND, 2004: Near-field microscopy by elastic light scattering from a tip. Philosophical Transactions. Series A, Mathematical, Physical, and Engineering Sciences, **362**, 787-805.