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Nano-scale Secondary Ion Mass Spectrometry (NanoSIMS)

High-resolution chemical imaging allows the visualization and quantification of the chemical composition of cells and thus offers unique research opportunities in the Life Sciences. Analytical nanometer-scale secondary ion mass spectrometry (NanoSIMS) imaging is perfectly suited to measure and visualize the distribution of virtually any elements and their stable isotopes of interest in biological material. The CAMECA NanoSIMS 50L which is available since 2010 at the Large-Instrument Facility for Advanced Isotope Research offers a spatial resolution for element/isotopemapping downto 50 nm and thus even allows highly sensitive analyses at the sub-cellular level. Our NanoSIMS instrument is the only one in Austria and we support research groups in the faculty, university and many other national and international institutions in their chemical imaging efforts. Current applications of our NanoSIMS focus on microbial ecology and cancer research, respectively. In microbial ecology we combine NanoSIMS with stable isotope probing (e.g. 2H/1H, 13C/12C, 15N/14N, 18O/16O, 34S/32S), high-throughput elemental analysis - isotope ratio mass spectrometry (EA-IRMS), Raman micro-spectroscopy and single cell identification techniques such as fluorescence in situ hybridization (FISH) for obtaining yet inaccessible information about the phylogenetic identity and functional role of microorganisms in their environment. Utilizing this approach, previously unrecognized physiological properties of bacteria and archaea thriving in soils,microbialmats, activated sludge, deep groundwater samples andwithin symbiotic relationships inmarine ecosystems aswell as the mammalian gut could be deciphered.

Biography

In collaboration with colleagues from the Department of Inorganic Chemistry and the Vienna Research Platform for Translational Cancer Therapy Research, the technique's capability of multi-elemental, isotope selective topochemical analysis has been exploited for studying the sub-cellular uptake and distribution of isotopically labeled metal-based anticancer drugs within two- and three-dimensionally cultured malignant and non-malignant cells as well as within normal and tumor tissues. In this context, combining NanoSIMS with fluorescence microscopy and quantitative laser ablation inductively coupled mass spectrometry (LA-ICP-MS) for millimeter-scale chemical mapping and transmission electron microscopy (TEM) for single cell ultrastructure characterization has proven successful.

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