

Mass Spectrometric Characterization of Biological Surfaces

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We have used time-of-flight secondary ion mass spectrometry (TOF-SIMS) and laser postionization secondary neutral mass spectrometry (Laser-SNMS) to analyze various biological surfaces. Both techniques use a focused energetic primary ion beam for bombarding a solid sample, and a mass spectrometer for analysis. But unlike SIMS, which analyzes only the sputtered secondary ions, Laser-SNMS uses laser beams to either resonantly or non-resonantly ionize the majority of sputtered neutral particles.

In our presentation, we will compare and discuss the salient characteristics of the TOF-SIMS and Laser-SNMS techniques and will show applications in the following fields: (a) imaging and quantifying target-specific drug delivery systems as well as intrinsic elements and molecules in single cells with subcellular resolution *in vitro*, i.e. in cell cultures, and *in vivo*, i.e. in tissues, (b) investigation of the immobilization process of PNA and the influence of length and type of spacer molecules on the efficiency of hybridizing DNA to PNA biosensor chips and of its use for DNA diagnostics with unlabeled DNA, (c) detection of proteins in cells, and (d) investigation of yield behavior and fragmentation patterns using different primary ions (Ar^+ , Xe^+ , SF_5^+ , Au^+ , An_n^+) for increasing efficiency and sensitivity in cell and DNA diagnostics. Furthermore, we will discuss current instrumental developments, particularly in regard to 3D molecular imaging with nanometer-scale resolution.

It can be said in conclusion that TOF-SIMS and Laser-SNMS are well suited for imaging and quantifying trace element and molecule concentrations in biological materials with very high efficiency and nanometer-scale resolution. In particular, TOF-SIMS has the potential for providing a new rapid method for unlabeled DNA diagnostics, and its high detection efficiency makes this technique especially useful for directly analyzing genomic DNA.