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Mass Spectrometry of Surfaces Using Ion Beams: Molecular Mapping of (Bio)Polymers

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Surface Mass Spectrometry using Time-of-Flight Secondary Ion Mass Spectrometry (ToF-SIMS) has matured into a flexible analyzing tool suited for routine and daily analysis of polymer surfaces. This is mainly due to its high sensitivity (fmol range), its high surface sensitivity (uppermost monolayer) and the fact that both, inorganic and organic species can be identified at the same time, i.e. in the same experiment. Thus it is suited for screening and survey analysis with no need for any pre-information.

Whereas the lateral resolution during the onset of the technique in the beginning of the 80s of the last century was in the order of a few mm only, nowadays ToF-SIMS has progressed onto an imaging technique with an ultimate lateral resolution below 100 nm. Routinely, fields of view ranging from (10 x 10) μm^2 to (9 x 9) cm^2 are addressed with modern instrumentation.

With the advent of so called cluster ions for primary excitation and sample erosion it has also become possible to go in depth, i.e. to elucidate the molecular structure of a sample as a function of depth in a sputter experiment. The depth resolution is in the order of a few nm, allowing a detailed probing of the surface near layers.

Combining imaging with depth profiling furthermore addresses the 3-dimensional inorganic and organic structure of a surface of interest. Typical analysis volumes for this mode are 100 (X) x 100 (Y) x 10 (Z) μm^3. An example for 3D analysis of organic materials is presented in Figure 1.

Based on a description of the physical background and the used instrumentation the talk will mainly focus on examples for the application of the technique to the characterization of polymer and biopolymer surfaces. Here, particularly the analysis of polymer additives (identification, localization; diffusion/segregation) is addressed.

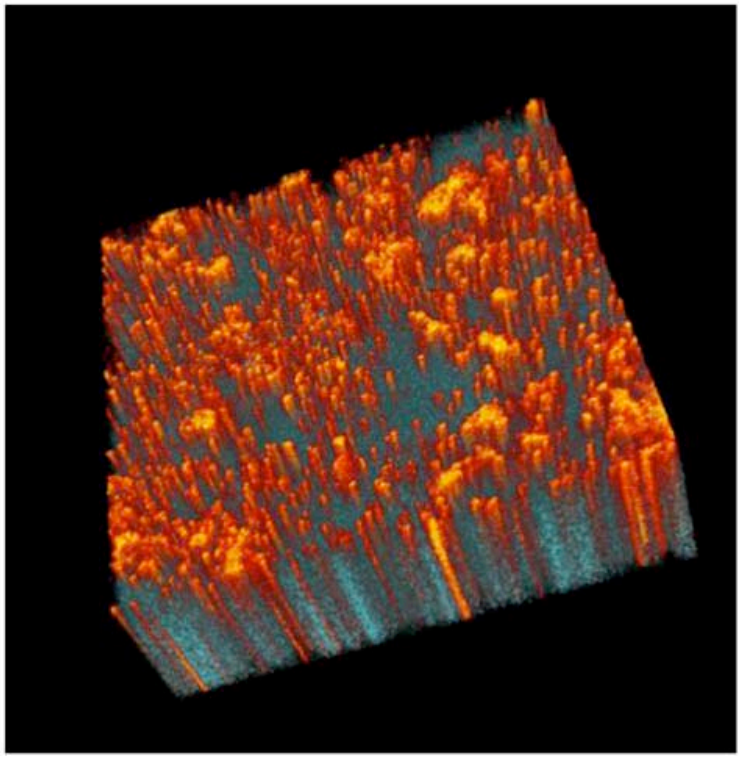

Figure 1: 3D ToF-SIMS analysis of the segregation of an organic flame retardant in polyamide; field of view:30 x30x1 μm^3

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