

Label-Free Chemical Imaging Analysis of Micropatterned Proteins and Cells Using TOF-SIMS

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Micropatterns of streptavidin and human epidermal carcinoma A431 cells were successfully imaged, as received and without any labeling, using for the first time a cluster Au_3^+ ion beam in time-of-flight secondary ion mass spectrometry (TOF-SIMS). Three different analysis ion beams (Ga^+ , Au^+ and Au_3^+) were tested to obtain label-free TOF-SIMS chemical images of micropatterns of streptavidin, which were subsequently used for generating cell patterns. The image of the total positive ions obtained by the Au_3^+ primary ion beam corresponded to the real image of micropatterns of streptavidin, whereas the total positive-ion images by Ga^+ or Au^+ primary ion beams did not. A principal component analysis of TOF-SIMS spectra was initially performed to identify characteristic secondary ions of streptavidin. Chemical images of each characteristic ion were reconstructed from the raw data and used in the 2nd PCA run, which resulted in a contrasted and corrected image of micropatterns of streptavidin by Ga^+ and Au^+ ion beams. The findings herein suggest that using cluster-ion analysis beams or multivariate data analysis for TOF-SIMS chemical imaging would be an effectual method for producing label-free chemical images of patterned biomolecules, including proteins and cells