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COMPARING TOF-SIMS WITH LASER DESORPTION/ PHOTOIONIZATION FOR SURFACE ANALYSIS

Jennifer L. Trevor,[1,2] Luke Hanley,[1,2] Michael J. Pellin,[1] and Keith R. Lykke[1]

[1]Materials Science and Chemistry Divisions, Argonne National Laboratory, Argonne, IL 60439
[2]University of Illinois at Chicago, Chicago, IL 60607

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Comparing TOF-SIMS with Laser Desorption/Photoionization for Surface Analysis*

Jennifer L. Trevor,[1,2] Luke Hanley,[2] Michael J. Pellin,[1] and Keith R. Lykke[1]
[1]Materials Science and Chemistry Divisions, Argonne National Laboratory, Argonne, IL 60439
[2]University of Illinois at Chicago, Chicago, IL 00607

TOF-SIMS has become the standard mass spectrometric tool for the molecular analysis of polymeric, organic, and biological surfaces.[1] However, variations in desorption yields, ionization efficiencies, and ion-induced damage of adsorbates still present significant difficulties in the analysis of TOF-SIMS data. Laser desorption combined with photoionization may provide a significant improvement over TOF-SIMS, but little data has been collected comparing the relative efficacy of these processes. When such comparisons have been done, they usually have not been supported by independent surface analysis.

An instrument exists that has the capability of utilizing both methods of analysis and the potential for imaging of these surfaces. The Chicago-Argonne resonance ionization spectrometer for microanalysis (CHARISMA) is a reflectron time-of-flight mass spectrometer (TOF) that is configured for secondary ion and neutral mass spectrometry using either ion beam bombardment or laser ablation for sample desorption.[2] A Schwarzschild all-reflecting microscope that enables in situ laser microanalysis with a lateral resolution below 1 μm has been incorporated into the instrument, which allows for easy sample viewing and imaging. The instrument has a mass resolution of $m/\Delta m > 2000$.

We have studied biotin and biotin conjugated self-assembled monolayers (SAMs) adsorbed onto gold as a model system to compare TOF-SIMS with laser desorption/photoionization as a method for biological surface analysis. Surface coverages were monitored independently by high-resolution spectroscopy for chemical analysis (ESCA). Projection lithography[3] with a Schwarzschild microscope and UV radiation was performed on a masked biotin-SAM. The sample was then rinsed with water and etched in an aqua regia solution ($HCL:HNO_3:H_2O$) to expose the underlying Cr adhesion layer and form a positive photopattern. The photopattern was then analyzed by both SIMS and laser SNMS to validate the utility of both techniques for this system. N_2 laser desorption was used in combination with 193 nm laser photoionization to probe the photopattern. Although the microscope resolution is diffraction wavelength limited, for this photopattern we used a grid with bar lengths on the order of 10 μm magnified to ensure that the correct region of the pattern was sampled with the laser. A signature mass fragment for biotin was seen in both SIMS and SNMS. This is an important result for laser SNMS, because it validates the utility of the technique for biological surface analysis.

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[1] Analytical Chemistry **65**, 622A-629A (1993)
[2] Rev. Sci. Instrum. **66**, 3168-3176 (1995)
[3] Langmuir, in press

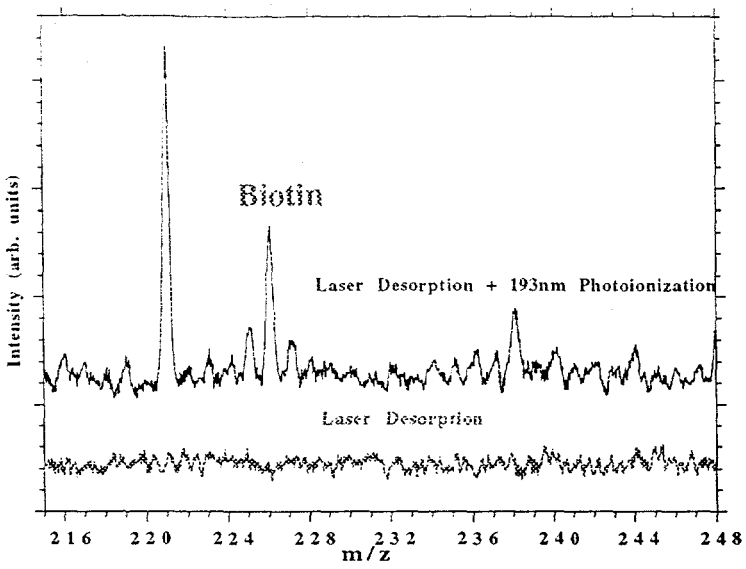

Fig1. Laser desorption with 193nm photoionization from photopattern of Biotin- SAM.

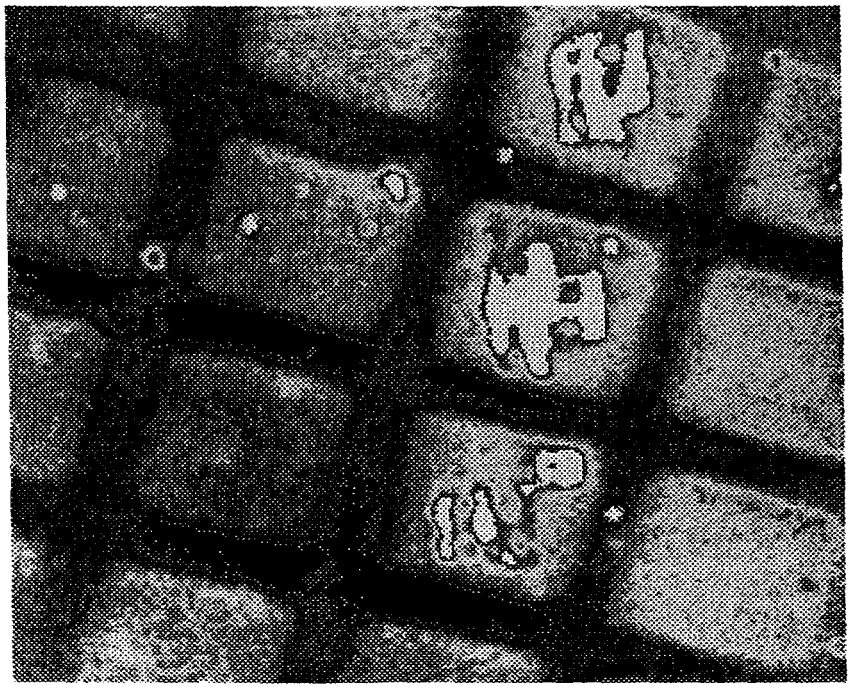

Fig 2. Image of Biotin-SAM photopattern. White lines are from laser ablation.