D26 Identifying Potential Molecular Chronometers in Fingerprints Using C60+ Secondary Ion Mass Spectrometry

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After attending this presentation, attendees will be familiar with some of the possible uses of Dynamic C60+ Secondary Ion Mass Spectrometry (SIMS) for the chemical analysis of fingerprints. The potential abilities of this technique to image a fingerprint and monitor the changes in composition with time will be emphasized.

This presentation will impact the forensic science community by providing an evaluation of a new technique to analyze fingerprints.

C60+ SIMS involves the bombardment of a focused ion beam on a sample to generate secondary ions characteristic of the chemical composition of the sample. The benefit of C60+ SIMS over the traditional techniques is that C60+ SIMS could provide spatially resolved analysis and also has the potential to probe the composition of a fingerprint as a function of depth. With respect to mass spectrometry techniques, the C60+ is a soft ionization technique, which allows for a less fragmented molecular profile of the sample. In addition, using this technique also does not completely destroy the fingerprint, making it possible for comparisons to be made after being analyzed by C60+ SIMS.

Fingerprint development and imaging is a well-established and well-researched area in forensic science; however, the ability to both image and chemically analyze a fingerprint has been less commonly studied. The research focuses on the changes in the composition of fingerprints with time when exposed to a variety of environmental conditions (i.e., heat, humidity, and ultraviolet radiation). By doing so, potential molecular chronometers can be identified in an attempt to determine a timeframe of deposition. This could be useful evidentiary information as it may allow investigators to place a suspect at a scene within a certain timeframe or, similarly, rule out the presence of a suspect during the time of a crime based on the timeframe. To better understand changes which occur due to environmental factors, a chemically relevant artificial fingerprint material was developed to mimic both the eccrine and sebaceous secretions found in a normal fingerprint. The artificial fingerprint material provides more consistent and repeatable results than using actual fingerprints.

In this study, synthetic fingerprint material was either drop coated or printed, using a high viscosity polymer printer, onto silicon disks which were analyzed using the SIMS technique. A control disk was studied simultaneously with all environmentally exposed disks to note any changes in sample due to the vacuum. Experimentally exposed disks were subjected to a variety of conditions and mass spectra of the disks were collected at various time points throughout the study. The spectra were then compared to determine what, if any, chemical changes occurred which could be used as molecular chronometers for measuring time since deposition. Once completed using the artificial fingerprint material, the studies were replicated with actual fingerprints to see if the same chronometers were found to produce similar results. The imaging capabilities of actual fingerprints using C60+ SIMS were also studied.

Fingerprints, C60+ SIMS, Chemical Analysis

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