A141 Analyzing Lateral Diffusion of Fingerprint Constituents as a Function of Time Since Deposition

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After attending this presentation, attendees will be aware of how imaging mass spectrometry could be used as a technique to monitor the diffusion of fingerprint constituents as a function of time since deposition. Through the ability to image several different components, the potential for this technique to be able to determine an approximate age of a fingerprint will also be presented.

This presentation will impact the forensic science community by introducing a unique and innovative application of imaging mass spectrometry, more specifically, how imaging mass spectrometry can be used to better understand fingerprints, concentrating on chemical changes in a fingerprint.

Though the imaging of fingerprints has been reported previously using mass spectrometry techniques, the use of the technique as a potential way to monitor the age of fingerprints has not been discussed. Through initial studies, it has been shown that the relative location of certain components in a fingerprint change as the fingerprints age. The general trend appears to be that a number of constituents appear to diffuse out of the ridges of the fingerprints and into the valleys. Furthermore, there appears to be a threshold time after which these compounds have completely diffused and the ridges and valleys of the fingerprint cannot be differentiated using chemical imaging. However, even though the chemical image is indistinguishable, ridges are still optically visible.

The technique which is used to obtain the images is a Secondary Ion Mass Spectrometer (SIMS). The SIMS technique is a high vacuum technique in which a primary ion species—in this case either bismuth or fullerene ions—is accelerated toward a sample and, upon interaction, causes the ejection of secondary ions, which are characteristic of the sample. SIMS is a soft ionization technique, and readily produces the molecular ion of nearly all chemical species. Furthermore, this technique has already been shown to readily detect a number of different sebaceous and eccrine components of a fingerprint. SIMS also provides several benefits over other types of imaging mass spectrometers, such as ambient pressure ionization mass spectrometry, the most important of which is the ability to provide chemical images with spatial resolution of 1µm or better. This is a level of spatial resolution which is difficult to obtain using techniques such as DESI-MS. This high-resolution technique also allows for the simultaneous imaging of all chemical signals present in a fingerprint, which enables monitoring and comparison of a number of different fingerprint components simultaneously.

Initial studies have shown a number of fingerprint constituents diffuse from fingerprint ridges over varying time scales. These changes have been noted to occur over several months, which may provide a way to tell differences in fingerprints over longer times cales than just days to weeks. While changes in the long time scale have been identified, experiments are also being completed to discover changes which provide a way to date on a shorter time scale. Finally, the effects of sample substrate and environmental exposure conditions will be analyzed. An evaluation on the practicality of the technique will also be presented.

Fingerprints, SIMS, Chemical Imaging

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