Criminal profiling through MALDI MS based technologies

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As criminals become more forensically aware of their traceability, forensic scientists need to up their game with advancing implementable technology. Technology improvements should aim to enhance recoverability of the evidence and expand, strengthen and communicate retrievable intelligence.

Fingerprinting still remains one of the most powerful means of biometric identification. However it has been almost unchanged for hundred years; additionally the ridge pattern physical information may occasionally be insufficient to match a suspect with a record in the National database; such instances are exemplified by partial, distorted or smudged marks, fingertips' extensive scarring/abrasion or record absence of the suspect prints. *In all of these situations it is very desirable to have a technology able to provide additional intelligence from a fingermark exploiting its endogenous and exogenous molecular make-up*.

Pioneering work at Sheffield Hallam University, UK has demonstrated the capabilities of Matrix Assisted Laser Desorption Ionisation Mass Spectrometry Imaging (MALDI MSI) to yield both physical and chemical information by providing multiple images of the same fingermark, simultaneous with additional intelligence [1]. Physical information could complement the ridge pattern retrieved by CSI or even provide the only ridge pattern image for database comparison [1], as well as enabling separation of overlapping impressions [2]. The opportunity to detect chemical information (aminoacids, fatty acids, peptides, proteins, drugs, toiletry products, condom lubricants and blood as a few examples) could provide investigative leads on the suspect's lifestyle and activity prior to leaving the mark as well as being useful to prove/disproof the suspect's statements. In one of the earlier publications, for example, we demonstrate that it is possible to determine the sex of the donor through detection of peptides from their fingermark with high level of accuracy [3]. In a more recent publication, we report on the opportunity to reliably detect and map the presence of blood onto the identifying ridges of a fingermark, thus providing associative evidence between the events of the bloodshed and the biometric information [4]. Consumption of drugs and alcohol can also be proved [5, 6] and this is useful to inform on the suspect's state of mind while committing the crime. Here, the pioneering use and rapid developments of MALDI MS and MSI for the analysis of latent marks are presented together with insights into Police casework undertaken in collaboration with the West Yorkshire Police in UK.

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