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Using Synchrotron Sourced Microscopy to Explore Fingerprint Chemistry

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The successful detection of latent fingerprints is crucial to forensic investigations, however detection methods can be hindered by variation in response or lack of robustness. Despite ongoing research into fingerprint development, many remain undetected(1). A fundamental understanding of fingerprint chemistry can provide explanations for the effectiveness or lack thereof for current detection methods and drive development of improved techniques.

We have combined synchrotron sourced Fourier Transform Infrared (FTIR) and X-ray Fluorescence Microscopy (XFM) to reveal the spatial distribution of the molecular and elemental components within latent fingerprints. FTIR showed that fingerprints have a complex heterogeneous distribution of organic material, our research focussing primarily on visualising the lipid and amino acid distribution at the sub-micron scale (2). Recent time-course studies have imaged the rate which freshly deposited fingerprints dry, with the results reinforcing the chemical heterogeneity of latent fingerprints and demonstrate how differences in composition appear to influence drying rates and redistribution of lipid material during drying.

We used XFM to explore the inorganic components within fingerprint residue. The distribution of trace metals including endogenous trace metals (Fe, Cu, Zn), diffusible ions (Cl⁻, K⁺, Ca²⁺), and exogenous metals (Ni, Ti) have been imaged across multiple donors (see Figure 1) (3). Further experiments have explored the effects of the external environment on these metals post deposition, and the transfer of exogenous metals prior to deposition.

With these techniques, we have begun to have a better understanding of the chemical complexity and transfer processes associated with latent fingerprints, thus providing the essential fundamental underpinning for the development of improved detection methods.

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