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Comparison of Scanning Kelvin Probe with SEM/EPMA Techniques for Fingermark Recovery from Metallic Surfaces

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Highlights

- The Scanning Kelvin probe provides a fermi energy map revealing latent fingermarks
- Scanning Kelvin probe could pre-identify fingermark areas for targeted DNA recovery
- SEM/EPMA data was compared to Scanning Kelvin Probe images of fingermarks
- An increase in sodium, chlorine and oxygen coincided with a change in CPD
- Scanning Kelvin probe worked best on non-enhanced surfaces without VMD

Abstract:
Most traditional techniques to recover latent fingermarks from metallic surfaces do not consider the metal surface properties and instead focus on the fingermark chemistry. The scanning Kelvin probe (SKP) technique is a non-contact, non-destructive method, used under ambient conditions, which can be utilised to recover latent prints from metallic surfaces and does not require any enhancement techniques or prevent subsequent forensic analysis. Where a fingermark ridge contacted the metal, the contact potential difference (CPD) contrast between the background surface and the fingermark contact area was 10 - 50 mV. Measurements were performed on the untreated Brass, Nickel-coated Brass and Copper metal surfaces and compared to traditional forensic enhancement techniques such as vacuum metal deposition (VMD) using Au-Zn and Au-Ag. Using VMD, the CPD change ranged from 0 - 150 mV between the dissimilar metal surfaces affected by the fingermark. In general, SKP worked best without additional enhancement techniques.
Scanning Electron Microscope (SEM) scans were used to identify the fingermark contact areas through a Sodium, Chlorine and Oxygen electron probe micro-analyzer (EPMA). The fingermark was observed in the backscattered electron image as the carbon deposits scattered the electrons less than the surrounding metal surface. The fingermark is shown clearly in a Cathodoluminescence scan on the Copper sample as it blocks the photon emission at band gap (2.17 eV) from the underlying Copper Oxide (Cu_2O) surface. For the first time, SEM, EPMA and Cathodoluminescence techniques were compared to SKP data.
Visible and latent fingermarks were tested with latent, eccrinous fingermarks more easily imaged by SKP. Results obtained were very encouraging and suggest that the scanning Kelvin probe technique, which does not need vacuum, could have a place as a first stage analysis tool in serious crime investigation.

Keywords: Scanning Kelvin Probe, Fingermarks, Forensic Science, Metal Surfaces, Contact Potential Difference, SEM