C38 Using Surface Volta Potential Measurements to Visualize Fingerprints on Metals

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After attending this presentation, attendees will understand how Volta potential measurements are made, leading to the visualization of latent fingerprints on metals. The advantages of this new method will be discussed together with the strategies to further improve the clarity of the fingerprints using Vacuum Metal Deposition (VMD).

This presentation will impact the forensic science community by revealing how a non-contact vibrating capacitor technique can visualize fingerprints on metals without the use of any chemicals, without damaging DNA evidence and with no surface contact.

The fingerprint pattern left on a metal surface often causes corrosion of the underlying metal due to the salt (sodium chloride) content of sweat. The presence of salt on the surface causes the Volta potential to be lowered at fingerprint ridge marks in comparison to the background metal potential. The scanning probe machine is used to measure Volta potential of the metal surface to a comfortable resolution of 500 dots per inch to reveal the latent fingerprint.

The clarity of the fingerprint depends mainly on the corrosive interaction of the fingerprint with the metal. Metals such as iron or brass often give clear images of continuous ridge detail whereas stainless steels or pure zinc are more challenging surfaces due to their higher resistance to corrosion. The image clarity is also affected by the quality of the machine and settings used e.g. resolution, probe dimensions, and scanning height.

The potential contrast between the fingerprint and the background metal can be increased by using the Vacuum Metal Deposition (VMD) technique to apply either silver or gold/zinc coatings that preferentially deposit on the metal. If the fingerprinted metal is noble e.g., copper then the gold/zinc coating is used but if the fingerprinted metal is reactive e.g. zinc then a silver coating is applied.

The typical exhibit that is analyzed is relatively small and flat e.g. a 5cm x 5cm plate or is a piece cut out from a larger exhibit. The machine is equipped with a stage moved by x, y, z and rotational motors allowing moderately non-planar surfaces to be scanned. Cartridge cases of various calibers can conveniently be accommodated and imaged for fingerprint patterns by first establishing a topographic profile for the exhibit followed by volta-potential mapping where a constant probe-to sample spacing is maintained. Examples will be presented of partial print recovery on spent cartridge casings both from laboratory studies and ongoing criminal investigations by United Kingdom police forces.

In summary, this presentation shows how the Scanning Kelvin Probe works and gives examples of fingerprint images obtained on various metal surfaces. The presentation goes on to discuss the use of Vacuum Metal Deposition to further enhance the images.

References:

1. Williams, G. and N. McMurray (2007). "Latent fingermark visualization using a scanning Kelvin probe." Forensic Science International 167(2-3): 102-109.
2. Williams, G., H. N. McMurray, et al. (2001). "Latent fingerprint detection using a scanning Kelvin microprobe." Journal of Forensic Sciences 46(5): 1085-1092.

Fingerprints, Metals, Corrosion

 ** Presenting Author*