A214 Visualizing Depleted Latent Fingerprints Using Columnar Thin Films

Stephanie F. Williams, BS, 210 Market St, Sunbury, PA 17801; Robert Shaler, PhD, 30 Spring St, Flemington, NJ 08822; and Drew Pulsifer, MS, and Akhlesh Lakhtakia, PhD, Penn State Univ, 212 ESM Bldg, University Park, PA 16802*

After attending this presentation, attendees will have gained knowledge of the use of the Conformal-Evaporated-Film-By-Rotation (CEFR) technique to deposit Columnar Thin Films (CTFs) on depleted latent fingerprints for development and visualization. This study aims to determine the sensitivity of the CEFR development technique by developing fingerprints which have been successively placed in order to reduce the amount of sebaceous material left behind (i.e., as a depletion series). Comparison to traditional methods is made by using depletion series of split fingerprints on several different forensically relevant surfaces. The selected forensically relevant substrates are those which previous research has shown that traditional development techniques work as well or better than the CEFR development technique.

This presentation will impact the forensic science community by adding another option for latent fingerprint development in situations where the fingerprint quality is low and traditional development techniques are not adequate.

Determining the sensitivity of this fairly new development technique may impact the forensic science community by adding another option for latent fingerprint development in situations where the fingerprint quality is low and traditional development techniques are not adequate.

By the CEFR technique, a CTF is deposited onto a latent fingerprint on a substrate that is affixed to a rotating platform in a vacuum chamber. In the vacuum chamber, a source material is evaporated by resistive heating to produce a collimated vapor flux. The vapor condenses on the rapidly rotating substrate, thereby creating a thin film that entombs the fingerprint. This thin film comprises columns with diameters on the nanometer length scale. The CTF produces an observable contrast between the fingerprint ridge detail and the underlying substrate, and thus allows the fingerprint to be visualized by its surface topology rather than by mechanical or chemical interactions.

A study was carried out to determine the sensitivity of the CEFR technique by using depletion series. For each series, sebaceous secretions were collected on a pre-cleaned finger and then fingerprints were deposited without renewal of the sebaceous material on the finger. The second, fourth, sixth, eighth, tenth, and twelfth fingerprints were each placed on a substrate of the same kind. Each substrate was prepared for split fingerprints, with one half of the fingerprint being developed by the CEFR technique and the other half by a traditional technique. The substrates used were black nylon, white nylon, black ABS plastic, white ABS plastic, brass, and stainless steel. Based on previous research, the evaporant materials utilized were chalcogenide glass and tris(8-hydroquinolinato)aluminum (Alq3). Traditional techniques utilized were: red fluorescent powder, black powder, black magnetic powder, cyanoacrylate fuming, and cyanoblue with cyanoacrylate fuming.

The depletion series were obtained by wrapping the fingertip in a clear thin plastic wrap to eliminate the interference of eccrine secretions being produced from the pores in the friction ridge skin. In a preliminary study, the eccrine secretions caused some fingerprints deposited later in the depletion series to have more material than earlier depleted fingerprints. This caused the depletion series to be ineffective and inconsistent between different trials. The inconsistency was eliminated when the plastic wrap was used.

Results obtained were qualitatively and quantitatively, examined. Qualitatively, photographs of the developed fingerprints were visually graded, and quantitatively the photographs were examined using the Universal Latent Workstation (ULW). The fingerprints examined with the ULW were graded using a custom algorithm which calculates the amount of definitive minutiae in each fingerprint as determined by the quality map produced with the ULW's extended feature set. Depletion series on brass, developed with a CTF, were qualitatively and quantitatively superior to those developed by traditional techniques, but depletion series on hard plastics gave mixed results.

Further research is still being conducted with depletion series on other substrates and with other evaporant materials. The CEFR technique will also be compared with vacuum metal deposition using the split print method in the future. The CEFR technique is also currently being evaluated for the development of partial bloody fingerprints and fingerprints on fired cartridge casings. Other fluorescent evaporant materials are also being compared to Alq3.

This work was supported by Grant No. 2010-DN-BX-K232 from the U.S. Department of Justice.

Depleted Fingerprint, Conformal-Evaporated, Columnar Thin Film

 ** Presenting Author*