Latent Fingermark Development on Fired Ammunition Casings using Vacuum Metal Deposition

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Introduction

Vacuum Metal Deposition (VMD) is a latent fingerprint development technique that allows for the visualization of fingermarks on a variety of surfaces[1]. VMD is useful because it can retrieve prints from old surfaces or surfaces that have experienced harsh conditions, such as fired ammunition[1]. The technology works by coating the evidence with a thin metal film under a high vacuum that results in a reversed developed latent print. Small amounts of metals such as gold, zinc, silver, sterling silver, copper, aluminum, and tin are evaporated and then deposited [2]. The sample can still be used for DNA evidence because the substrate within our fingerprint ridges is coated rather than the latent print itself, this is why it is called a reverse print [2].

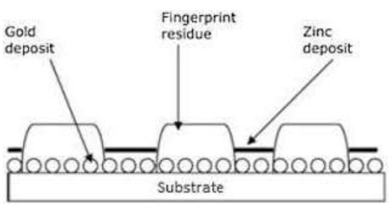

Figure 1. Placement of metal dispersion.

With an increase in gun-related offenses in the United States, it is important to understand the best processes for retrieval of latent prints on various types of fired ammunition. Development of friction ridge on fired ammunition casings is difficult due to the small surface area of ammunition that is used in smaller handguns as well as the firing process that occurs which often damages any fingerprint residues. This study aimed to analyze various metal combinations used in the VMD on fired casings to determine the best combination for visualization. The goal was also to determine which metal combinations are best suited for two of the commonly purchased metal casing types, brass, and aluminum.

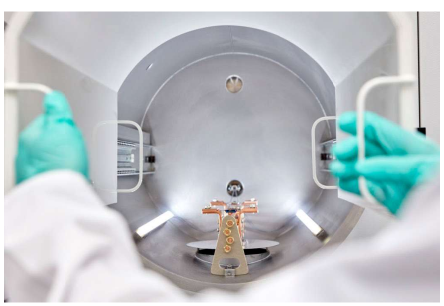

Figure 2. Inside Chamber of VMD560.

Methods

Evidence Preparation

Volunteers from the Criminal Investigation Division (CID), Dave Miller, and the Cumberland County Sheriff's Department, Brady Morris, alternated the loading and firing of various firearms. The subject pressed their fingers into the bullet while loading the magazine and gathered natural oils from their forehead onto their fingers after each 5th casing. As a standard, they rubbed their fingers in "latent print reference pad sebaceous oil secretions" before pressing down and loading one round of ammunition for each of the various metal and bullet types.

Metal combinations: Gold/Zinc, Copper/Zinc, Silver and Sterling Silver

Ammunition Types: 9mm, .40, and .45 all with Brass and Aluminum

VMD560: The West Technology VMD560 was used to process all fired casings. During each run, a piece of white paper with self-made sebaceous fingermarks was placed in the VMD as a control. The designated magnetic mount was used to secure the casings before attaching them to the evidence holder inside the VMD. To ensure proper metal deposition on the whole surface area, each casing was processed once, rotated 180 degrees, and then processed a second time.

Figure 3. West Technology Forensics VMD560

Photographing Fingerprints: Each fingerprint was visually examined and viewed with an alternate light source, FSIS II (Full Spectrum Imaging System). Friction ridge detail observed was captured either using the FSIS II, a Nikon D3500 DSLR Camera with AF-P DX Nikkor 18-55mm lens, or the DCS5 Cylindrical Surface Unwrapper (CSU). Images were enhanced using Photoshop and/or the DCS5 enhancement software for visualization purposes.

Results

Out of 260 total casings, 30 casings developed low to high-quality friction ridge detail, but only 6.7% were determined to be potential prints of value. The VMD developed approximately 11.5% of the prints well enough to see some ridge detail. Exactly half were aluminum casings, and the other half were brass casings. Of the Aluminum casings, 53% were developed from Gold/Zinc and 47% from Copper/Zinc. The brass casings were developed from 40% Sterling Silver, 27% Silver, 27% Copper/Zinc, and 6% Gold/Zinc. These results show that Gold/Zinc was the best combination for development on aluminum casings and Sterling Silver was the best for brass casings. The casings also showed a direct correlation between increasing size and the likelihood of getting fingerprint markings. The 9mm casings accounted for 20% of the prints, the .40 casings consisted of 37%, and the .45 casings made up 43%.

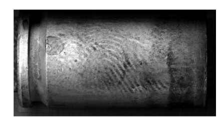

Figure 4. Aluminum 9mm Casing with Gold/Zinc

Figure 5. Aluminum .45 Casing with Gold/Zinc using DCS5 CSU

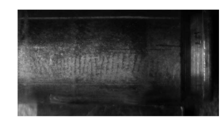

Figure 6. Brass .40 Casing with Sterling Silver

Future Directions

The results of this project will be used by the fingerprint technician at the Office of District Attorney, Cumberland County Forensic Laboratory and information will be given to West Technology for their knowledge and future advancements.

Acknowledgments

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