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Visualize fingerprints on brass after removal of secretions

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A novel method takes advantage of corrosion to reveal prints even after perspiration residue is no longer present.

The use of fingerprints left at the scene of a crime to identify an offender was first suggested in the nineteenth century,[1,2] and this branch of forensics continues to play an integral role in a wide range of criminal investigations.[3] Sweat secretions deposited onto a surface leave an impression of the papillary ridge pattern of the finger, referred to as a latent fingerprint. Latent prints are not easily visible to the naked eye, and various techniques have been developed to enhance and make them visible.[4] In general, because these methods all require physical or chemical interaction between the enhancing reagent and fingerprint deposit, secretions must still be present.

To tackle the problem of enhancing fingerprints on brass after removal of secretions, we have developed a technique that exploits a natural chemical reaction occurring between fingerprints and metal. Recent research has shown that this reaction, which involves corrosion, can change both the chemical and physical characteristics of the metal surface.[5,6] Unlike conventional treatments, our technique requires no enhancement of the fingerprint deposit prior to visualization. For our research, we selected brass because it is used to manufacture gun cartridge cases. Fingerprint enhancement on spent cases has attracted considerable attention, not least due to the problems it presents in terms of heat damage to the secretions during the firing process.[7]

We recently showed how fingerprints on brass cartridge cases that we left out for several days in open air at room temperature can still produce corrosion sufficient for visualization, even after they have been washed in warm water and detergent to remove the residue.[8] Our technique required application of a potential to the brass ($\sim$1,500V) followed by introduction of a conducting carbon powder (grain size $\sim 10\mu$m). This process was facilitated by the use of a cascade developer (Foster and Freeman, Evesham, UK), an electrostatic detection device usually employed to enhance indented writing on paper, that coats tiny ($\sim 400\mu$m) spherical beads with the conducting powder.

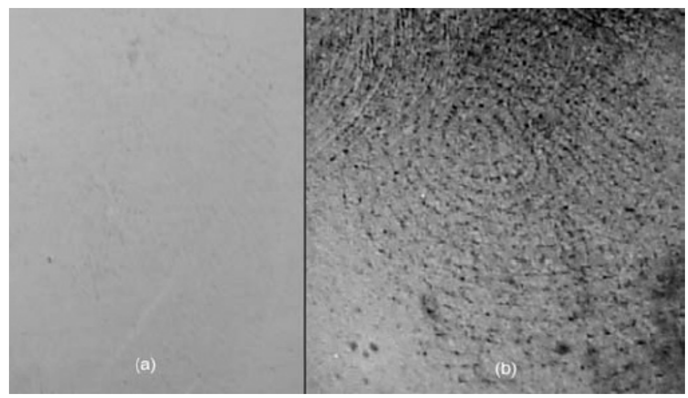

Figure 1. *Fingerprint deposited on brass, left for five days, washed and then photographed (a) before and (b) after the application of a potential and a conducting powder.*

By rolling the spherical beads back and forth across the charged brass surface, we found that the powder adhered preferentially to areas of corrosion, thus enabling the fingerprint to be visualized. Figure 1 shows a typical example. Corroded parts of the brass have lower potential than the bulk, typically 12V for an applied potential of 1,500V.[9] We believe that the carbon powder becomes 'stuck' on these areas of lower potential, coincident with the original fingerprint deposit.

This technique was reproducible even if an excess of powder was used. In such a case, the brass can be washed as described above and the treatment re-applied. Once treated, however, the conducting powder proved extremely vulnerable to disturbance after the electrical potential had been removed. By subsequently heating the brass to $\sim 150^{\circ}$C, we found that the powder would bind to the brass, producing a more durable sample.

The degree of enhancement varied among brass samples, and we theorize that this was due to the variable composition and quantity of perspiration secreted by individuals.[10] In particular, in keeping with corrosion science, we believe that the presence of aggressive ions in secretions (such as chloride) intensifies the reaction on brass and, possibly, the degree to which the applied potential and conducting powder would enhance visualization.[11]

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Figure 2. *Ridge development visualized post-firing for fingerprint deposited on brass 9mm pistol cartridge prior to loading. The cartridge case was washed before the electric potential and conducting powder were applied.*

We applied this technique with some success to fingerprints deposited on brass cartridge cases before they were fired. (Figure 2 shows a typical example.) After firing and washing, a fingerprint was enhanced in ∼5% of cases examined. This relatively low success rate was likely due in part to the physical contact that cartridge cases undergo during loading and ejection from the weapon, which would tend to obliterate fingerprint deposits.

In conclusion, our technique offers the prospect of enhancing fingerprints on metal surfaces after initial secretions have been removed. Future work will focus on the nature of the reaction between the metal and fingerprint secretions and the electrical properties of the metal/corrosion junction, with a view to improving enhancement.

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