CASE REPORT

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Visualization of a Restored Serial Number Using Scanning Electron Microscopy (SEM)

REFERENCE: Mongan AL. Visualization of a restored serial number using scanning electron microscopy (SEM). J Forensic Sci 1996;41(6):1074–1076.

ABSTRACT: The restoration of obliterated serial numbers by both chemical and physical means has been well documented in the field of forensic science. An interesting case of a severely obliterated serial number was submitted to our laboratory for restoration. Despite development with Fry's etchant, the visualization, documentation, and photography of the restored serial number proved difficult because of the deep "pock" type of obliteration. The scanning electron microscope was explored as a potential means for assisting in the examination of the restored serial number. The scanning electron microscope successfully provided a simple means for the visualization, documentation, and photography of the restored serial number.

KEYWORDS: forensic science, firearms identification, serial number restoration, scanning electron microscopy

Serial numbers can be found on firearms, automobiles, bicycles, motorcycles, and various pieces of electronic equipment. The restoration of obliterated serial numbers can be accomplished by several different chemical and physical means (1–3). Once the serial number has been restored, the visualization and documentation of the restored serial number is important for interpretation and quality assurance purposes. This paper describes a technique whereby a scanning electron microscope was used to assist in the visualization and documentation of the restored serial number.

Materials and Methods

Serial Number Restoration

The firearm submitted to our laboratory was a Rossi .38 Special that had a severely obliterated serial number. The serial number had been obliterated by a means of a grinding and punching process resulting in deep "pock" marks. The pock marks appeared as depressions in the metal frame approximately 1 to 2 mm deep. See Fig. 1.

The area of the obliterated serial number was prepared before the use of Fry's etchant by polishing with a shank mounted abrasive nylon fiber filament wheel impregnated with silicon carbide grain. Fry's etchant was prepared as described in the NASA report (1). (9 g of $CuCl_2$, 10 mL of water with 12 mL of HCl). The Fry's etchant was applied and the area was swabbed alternately with 10% nitric acid and water when the reaction was close to completion. The development of the serial number occurred relatively rapidly (within 5 min), however, the deep pock marks made the interpretation very difficult. See Fig. 2.

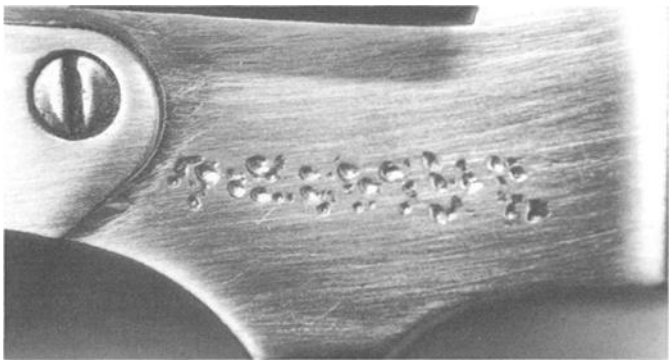

FIG. 1—*Photograph showing area of obliterated serial number prior to restoration.*

Scanning Electron Microscope

Following restoration with Fry's etchant, the Rossi .38 Special was placed on the motorized stage of a Hitachi S-570 SEM with Kevex Delta III EDX detector. The entire firearm fit easily on the stage inside the chamber, requiring only 5 to 10 additional minutes pump down time for full high vacuum. The working distance was set at 45 mm with a magnification of 22x. The accelerating voltage was set at 20 KeV with the emission of 80 μa. Photographs were taken using a standard Polaroid attachment. Various areas of the serial number were examined using the motorized stage. At magnification of 22x, the digits (approximately 1.8 mm in height) were able to be photographed two at a time.

Results and Discussion

Following restoration, the serial number appeared to be a seven digit number with a full space between the first and second digits. Figures 3 to 6 show SEM photographs taken from different regions

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FIG. 2—*Photograph showing area of obliterated serial number following restoration with Fry's etchant.*

of the restored serial number. Figure 3 shows the region that represents the first digit and the full space. The first digit was reported as being a "D" and the space or lack of alpha-numeric digit is clearly represented adjacent to it. Figure 4 shows the next two digits that are clearly represented as "8", "8." The following two digits are displayed in Fig. 5. The first of the two digits was assigned the candidates "0" and "9", whereas the second digit was defined as a "0." Figure 6 shows the remaining two digits, the first clearly visible as a "2" and the last digit having the candidates "3", "5", and "6."

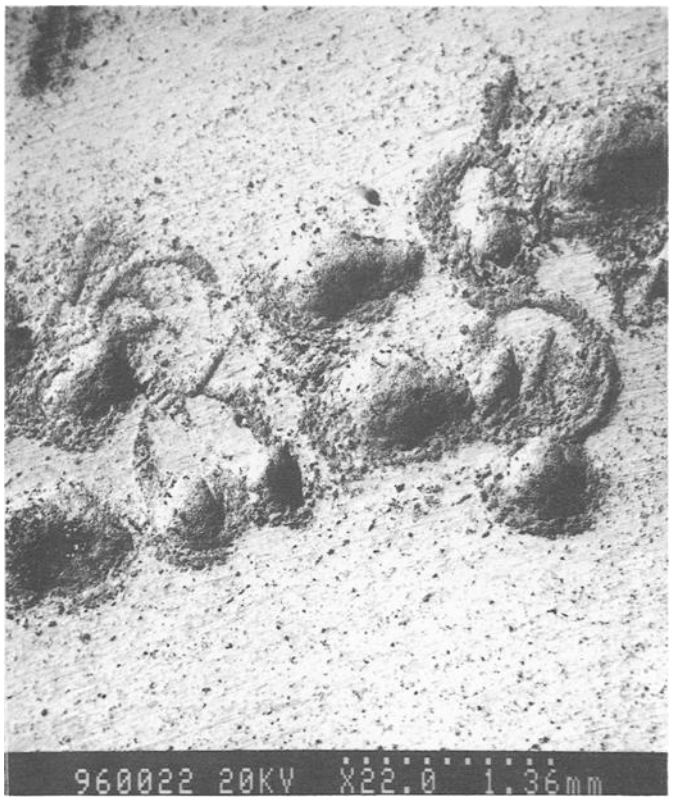

FIG. 4—*SEM photomicrograph showing second and third digit of restored serial number.*

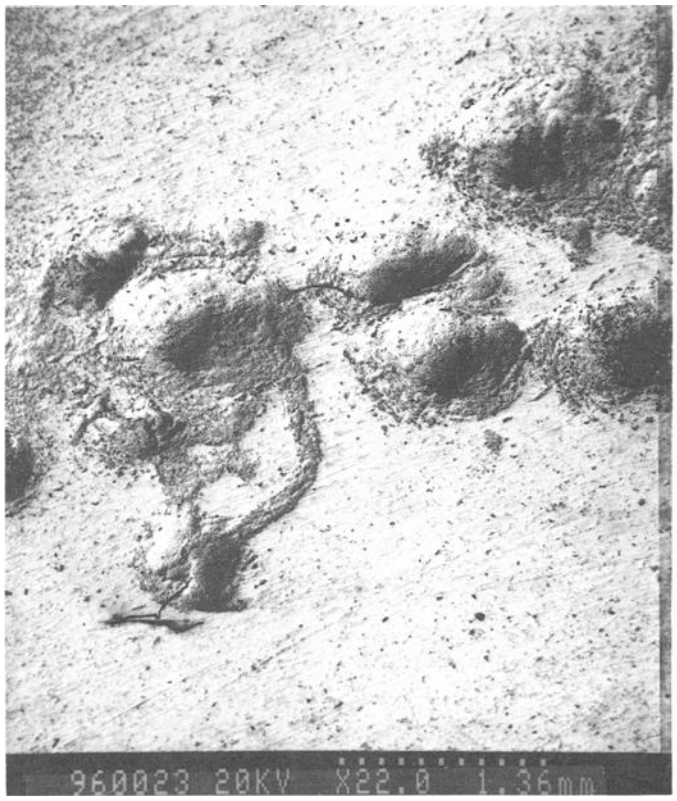

FIG. 3—*SEM photomicrograph showing first digit and adjacent full space of restored serial number.*

FIG. 5—*SEM photomicrograph showing fourth and fifth digit of restored serial number.*

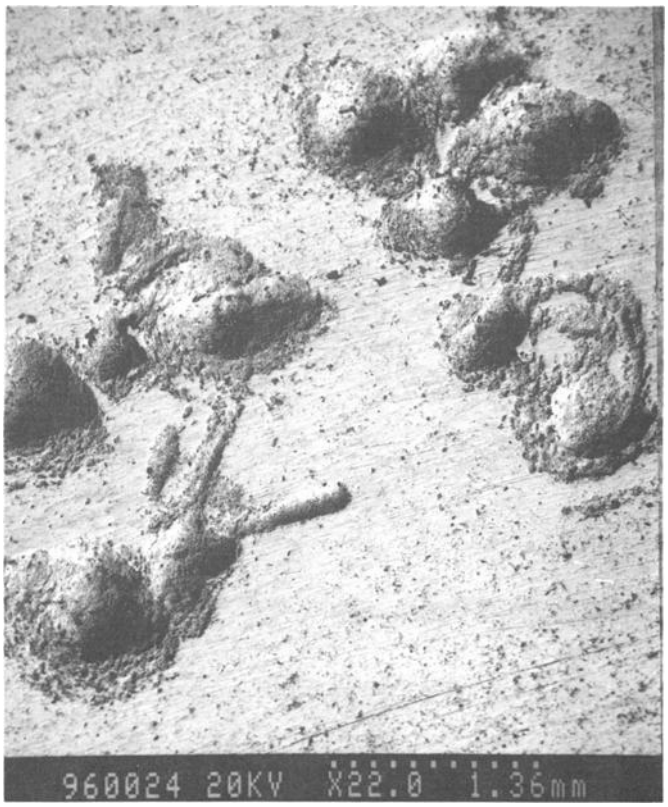

FIG. 6—*SEM photomicrograph showing last two digits of restored serial number.*

Photographing impression-type evidence often proves challenging as a result of specific lighting requirements and the inability to represent the object adequately. The scanning electron microscope was able to produce high contrast images that were markedly superior to conventional photographic images. The SEM was also helpful in narrowing down the candidates of the unresolved digits.

Although the SEM did not provide an absolute discrimination of the entire serial number, it greatly enhanced the visualization and the documentation of the developed serial number. In this particular case example, we were able to report the restored numbers with greater confidence. An obvious limitation to this technique is that the size of the object in question must be small enough to fit into the sample chamber of the scanning electron microscope. The SEM used in our laboratory easily accommodated the size of the firearm that in this case was approximately $7^1/_2$ in. total length, however, an overall length of greater than 9 in. would prove more difficult.

References

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