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## TECHNICAL NOTE

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# Deciphering Indented Impressions on Plastic

**ABSTRACT:** The questioned document laboratory is often called upon to decipher writing that has been erased, obliterated, or that has faded. In cases like these, the original writing is no longer legible to the naked eye, but may be enhanced using various light sources. Certain remnants of the ink's components absorb into the substrate's fibers and can be visualized, usually as luminescence or absorbance.

A case is described here that involved the theft of a credit card. An empty plastic credit card holder was found in the possession of a suspect, and was submitted for examination. Indented impressions could be discerned on its clear plastic window and presumably originated from the credit card that had been held in the envelope. These indented impressions were deciphered in the hope that they would reveal enough details from the credit card to establish a connection between the plastic envelope and the stolen credit card.

With methods generally utilized in the toolmarks and materials laboratory and the photography laboratory of the Israel Police, most of the indented impressions on the plastic were deciphered and a connection between the plastic envelope and the stolen credit card was demonstrated.

**KEYWORDS:** forensic science, questioned documents, indented impressions, plastic

The questioned document laboratory is often called upon to reveal and decipher writing that has been erased, obliterated, or that has faded. Ink is composed of several materials including the colorant, solvents, and resins; in many cases, some of these components remain in the substrate even when the ink is no longer visible to the naked eye. The writing may still be made legible through visualization of these remnants. In such cases, the document is examined utilizing different sources of illumination from the ultraviolet (UV) through the visible spectrum and into the infrared, with visual and machine-assisted observation in the same ranges of resultant visible color changes and the phenomena of luminescence and absorbance.

Sometimes we are asked to visualize "writing" that appears only as indentations in the paper; this paper would have been located beneath the paper bearing the original writing. In these cases, there has been no actual contact between the ink and the paper, but the "writing" may be observed using side lighting or an instrument for their electrostatic detection such as the ESDA (electrostatic detection apparatus).

The case reported here involved a type of indented writing, although not on paper but on a plastic surface. A credit card that had been held in a plastic envelope of a credit card holder (Fig. 1) left indented impressions on the inside surface of the clear plastic window of the envelope.

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As there were no actual remnants of ink on the substrate and it was anticipated that the plastic window itself was too thick a surface for developing impressions with an electrostatic detection device, expectations of successfully deciphering the indented impressions were not high.

The plastic window was examined utilizing methods practiced in the questioned documents laboratory and subsequently with methods used in the toolmarks laboratory, until a sufficient amount of detail had been retrieved from the indented impressions left on the inner face of the plastic.

### Materials and Methods

#### *Visual Examination*

The plastic envelope was initially examined it in its entirety using the various illumination sources and other standard tools and techniques available in the questioned document laboratory. The embossed impressions on the plastic's outer surface were found to disperse the lights in all directions, making it difficult to examine. As the intensity of the light sources was increased to cover a larger area of the plastic, the reflected light blinded the camera.

The embossed impressions were best observed when the plastic envelope was held in a darkened room with the clear window facing the open door towards light entering from the adjacent room. While many might favor the use of high intensity light sources, the seemingly counterintuitive use of a dull, low intensity source for viewing and photography has been found useful in the decipherment of erased or faint pencil writing (1). Under these viewing conditions, the name of the cardholder was seen quite clearly, as was the last digit of the credit card number, a numeral "2". The remainder of the impressions on the plastic envelope could not be deciphered under these conditions.

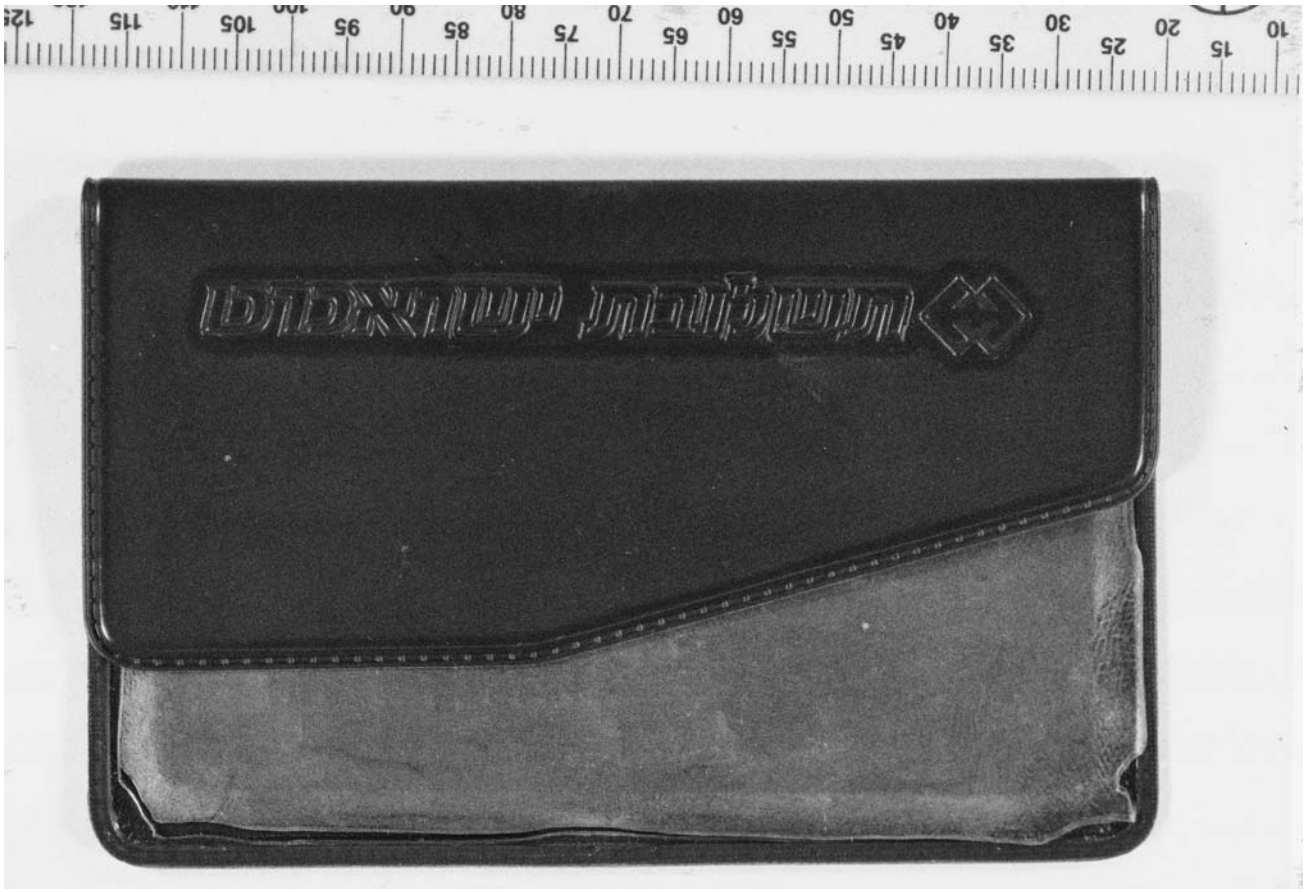

FIG. 1—*The plastic credit card holder received for examination.*

It was decided to separate the clear window from the rest of the plastic envelope of the credit card holder to facilitate examination of the inside face of the window where the impressions were indented, rather than the outer side of the window where the impressions were in relief form (i.e., embossed).

*ESDA Examination*

At this stage the window was examined using the ESDA (Foster + Freeman, Evesham, Worcestershire, UK).

Generally, when using the ESDA, the paper containing the indented impressions is placed in a humidity chamber for a few minutes. It is then placed face up on the ESDA's surface and held down by use of a vacuum pump. The document is covered with a thin film of plastic sheeting and charged with a corona. Toner-coated glass beads are cascaded over the surface, developing the indented impressions of the writing. With this technique it is often possible to visualize and read writing that originated on a sheet of paper located *above* the one being examined.

The degree of success in developing indented writing with this technique is dependent on several parameters. If the paper being examined is too thick, for example, cardboard, the indented writing will generally not develop. Development of indented writing is also dependent on the moisture content of the paper being examined. In the case described here, no indented impressions were visualized with the ESDA, probably due to the two parameters mentioned above; the plastic window is relatively thick and it is not clear what influence humidity might have on plastic.

The clear plastic window was taken to the toolmarks and materials laboratory in order to utilize their methods to try and decipher the rest of the indented impressions (2).

*Treatment with Silver Powder*

Initially the internal side of the clear plastic window was brushed lightly with silver powder, (Lightning Powder Co., Inc., Salem, OR) usually used for fingerprint development.

After a few applications, the last four digits of the credit card number were seen to be "6052". Furthermore, the stylized letter "V" was observed in the appropriate position above the name of the cardholder, revealing that the credit card was from the "Visa" company (Fig. 2).

Black fingerprint developing powder was also tried but the results were not as good.

*Photographic Techniques*

The newly revealed impressions were documented at the photography laboratory. Usually when photographing indented writing, the document is illuminated with low-angle side lighting. The angle is adjusted depending on the shadows cast on the document. In photographing indented writing the purpose is to clearly show the relief topography on the surface of the paper.

This type of lighting was not effective in bringing out significant detail when photographing the front of the window. The plastic of the window is relatively thick, which could account for the insuffi-

FIG. 2—*The internal side of the clear plastic window of the credit card holder after treatment with the silver fingerprint development powder. The plastic was scanned and the resulting image enhanced with the "Levels" histogram (gray levels) tool of Adobe Photoshop® 5.0 and then reversed using the "Flip" function.*

cient sharpness of the characters embossed on the front of the window from contact of the back of the window with the raised characters of the credit card. As an alternative, the inner side of the plastic could be photographed with side lighting to bring out the indentations.

The best illumination for photography of the indented impressions on the plastic in this case was flat, diffused lighting, such as tent lighting or a diffused ring light. Under these conditions, different areas of the plastic window yielded reasonable results.

*Computer Scanning*

The best result was achieved by scanning the plastic on a flatbed scanner. This type of scanner provides a flat, homogenous light on all areas of the item being scanned. The back of the plastic window was scanned with a UMAX PowerLook III scanner at a resolution of 600 dpi (optical resolution) in 8-bit grayscale mode (256 shades of gray). The scanning software was used to manually adjust the scan to increase contrast, but no filters were used.

The scanned image was enhanced with the "Levels" histogram (gray levels) tool of Adobe Photoshop® 5.0 in order to increase the contrast and legibility of the information from the indentations (Fig. 3).

The image was laterally reversed to a more readily legible orientation using the "Flip" function.

*Treatment with Silicon Rubber*

The clear window was next treated with a silicon rubber compound known for its versatile casting properties in toolmark cases (3–6). This material is a polymer that forms when the monomer (RTV; manufacturer Polymer Gvulot, Kibbutz Gvulot, Israel) is mixed with a polymerizing solvent. The monomer and polymerizing agent are mixed in a petri dish, and while the mixture is still liquid, it is poured in a thin uniform layer over the area to be examined. After several minutes the polymer hardens, yet remains flexible. At this stage it may be removed and the cast impression of the surface examined. This impression is a mirror image of the original. As in other cases of contact impressions where the casting is a "replica" of the tool that made the mark, in the case described here the cast impression from the inner side of the plastic window where

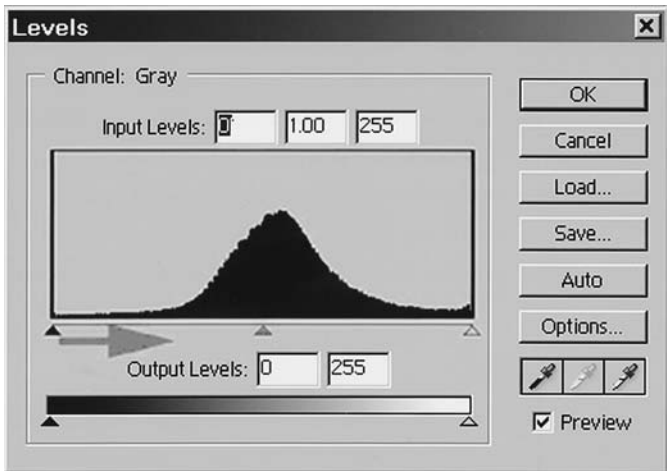


FIG. 3—*"Levels" histogram.*

the figures are reversed, acted as a "negative" mold, yielding a right reading "positive" model of the information on the credit card.

Development of the polymer cast (Fig. 4) enabled more of the indentations to be deciphered, so that all in all the following impressions were read:

4??? ?601 4?60 6052

*V*

Name of cardholder (*in Hebrew*)

It should be noted that the photographic reproduction of the polymer cast (Fig. 4) does not show as much detail as can be seen when actually holding the cast and varying its angle to the light.

**Discussion**

In the case described here, we were asked to visualize non-inked impressions on an unconventional substrate, i.e., embossed impressions on the clear plastic window of a credit card holder.

As an initial step the plastic window was examined using the questioned document laboratory's conventional illumination and

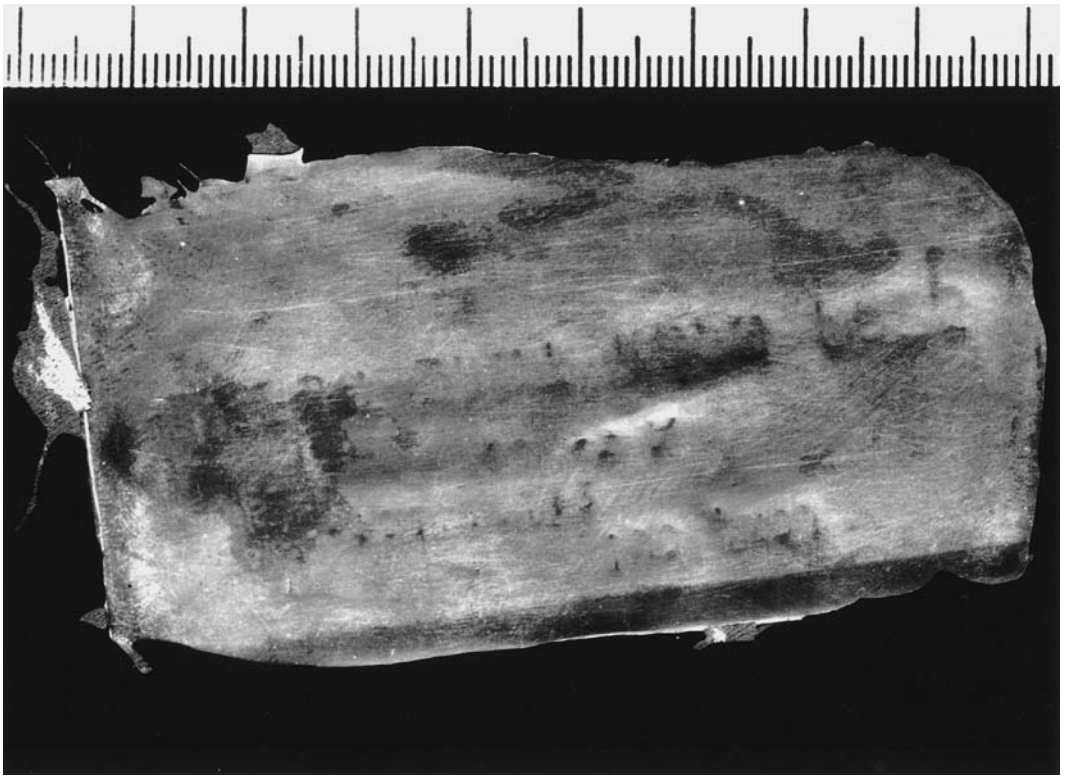

FIG. 4—*Polymer cast taken of the internal side of the clear plastic window of the plastic credit card holder.*

instrumental methods for revealing erased writing or indented impressions on paper, but without much success.

The clear plastic window of the credit card holder was subsequently examined using additional methods generally employed by other sections of the Division of Identification and Forensic Science. As described above, the impressions were successfully revealed using silver fingerprint development powder. After using a small quantity of the powder, a limited amount of the impressions were revealed very clearly. It should be noted that although the findings were recorded in the case notes, the plastic was not photographed at this stage, as we believed, that with further processing with the silver powder more impressions would become legible. In retrospect this was an unwise decision as with further treatment with the silver powder, not only were more impressions *not* visualized, those that had been so very clearly legible beforehand became less discernible. (Thus Fig. 2 shows the "poorer" result after treatment with an excessive amount of the silver powder.) This experience emphasizes the need to visually document results frequently in the course of such an examination. Even at the stage where the impressions first become legible, they should be photographed before further treatment, as results received so far may be subsequently affected.

The decipherment of the name of the cardholder, the Visa logo, and the last four digits of the credit card number at this stage of the examination basically identified the card. These details were checked with the Visa credit card company and were found to accurately match those on the stolen credit card.

In an effort to garner more information from the impressions, the plastic window was examined with various imaging techniques (photographic and computerized) and then treated with the silicone polymer.

The polymer did indeed make more impressions legible and in the future, this seems to be the preferred method with which to start the physical stage of the examination when insufficient information can be obtained from optical techniques (e.g., visual inspection, imaging with appropriate lighting, or computerized enhancement). This is due to the fact that more impressions were legible using this method than that using the fingerprint powder, and furthermore, the polymer left no traces on the plastic when the cast was peeled off whereas the powder could not be completely removed even after washing, or rubbing with a fine cloth.

## Conclusion

In the case described here, part of the indented impressions left by the embossed type of a credit card on the clear plastic window of its plastic envelope holder were successfully deciphered. Fortunately, those impressions that were deciphered, including the name of the cardholder, the logo of the issuing company, and the last four digits of the card number, were those that provided the identification of the card's owner.

These findings established a connection between the plastic cardholder found in the possession of the suspect and the credit card that had been stolen.

The embossed impressions were deciphered using methods generally employed by the toolmarks and materials laboratory and captured by the photography laboratory.

In future, treatment of exhibits of this kind should begin with methods usually used in the questioned documents laboratory such as illumination with light of varying wavelengths and with the ESDA, photographic techniques (including scanning and computer enhancement), followed by the polymerized silicon and then the silver fingerprint development powder.

Most important, when any of the indented impressions are deciphered, they should be photographed at each stage of the examination in order to reduce the risk of loss of information with further treatment of the item.

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