J Forensic Sci, Jul. 1979, Vol. 24, No. 3

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Case Analysis of Fingerprint Detection by Laser

Laser detection of fingerprints, as described in an earlier paper [*1*], entails exposure of crime scene exhibits to laser light and photography (or direct viewing) of any fingerprints thereby induced. The Ontario Provincial Police Force has initiated laser examination of exhibits for fingerprints to evaluate the effectiveness of this technique and to obtain additional data that might further exploit the luminescence of fingerprints on materials under examination. Glass, metal, wood, cloth, stone, and plastic exhibits were examined for fingerprints under laser light. Many of these surfaces yielded localized luminescence that may or may not have been the result of fingerprint deposit.

Fewer specimens bore actual ridge detail and identifiable fingerprints. However, many of these exhibits were materials on which it is difficult, or virtually impossible, to detect fingerprints by conventional techniques. The laser technique has, on several occasions, revealed fingerprints that did not respond to conventional methods. One of these prints represented the first criminal identification effected by laser.

Procedure

To apply laser power more effectively, all-lines lasing was used instead of single line (514.5 nm) as originally reported. No significant increase in interference from background luminescence was noted, nor was there any apparent loss in sensitivity. Case 1 was examined by using a Coherent Radiation Model CR5 argon-ion laser with an approximate laser power of 5 W; Cases 2, 3, and 4 were examined by using a Control Model 558A argon-ion laser with an approximate laser power of 6 W. Feasible alternatives to laser excitation may involve using filters that greatly reduce the amount of desirable light [*1*].

Photography

When optimum exposure has been determined, conventional development will suffice. Factors governing exposure are (1) the laser power used, (2) the degree of expansion of the beam, and (3) the nature and color of background material. The response of the background to laser light causes a wide variation in exposure. The films used to date, Kodak High Contrast Copy Film No. 5069, Kodak Contrast Process Pan, and Kodak Ektachrome EPR-135, have all given good results. As fingerprint ridges will appear light against dark furrows on a printed negative, it is necessary to make a second-plate negative. The finished print will then reveal the ridges as black against white furrows, facilitating comparison.

To date, a lens from protective laser goggles (Fisher, 11-409-50A) has been used at the lens of the camera to isolate desirable luminescence for photography [*1*]. The luminescence may possibly be further enhanced and separated from background interference by use of this filter in combination with one of several band-pass filters. This possibility is presently being explored and the results will be reported in a later paper.

Received for publication 17 Oct. 1978; revised manuscript received 6 Feb. 1979; accepted for publication 7 Feb. 1979.

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Case 1

A piece of black plastic tape used to secure a packet of drugs came under investigation for fingerprints. A small portion of ridge detail was observed on the sticky side with oblique lighting, but it was insufficient for identification. When viewed under the laser, extremely faint ridge detail could be seen (Fig. 1). The print was photographed on Kodak High Contrast Copy Film No. 5069 with an optimum exposure of f/8 at 20 min.

The fingerprint was subsequently identified as belonging to a suspect against whom there was no previous evidence. It is the writer's opinion that no conventional fingerprint detection technique could have been used to recover this fingerprint. This represented the first criminal identification effected by the laser technique. Had an established method also revealed this fingerprint, the laser result would have been far less significant.

Case 2

More than two hundred checks and other documents seized in a fraud investigation were examined for fingerprints by laser. Several partial fingerprints suitable for comparison were located. One of these, referred to as "R1" (Fig. 2), was identified as that of a suspect. The exhibits were next treated with ninhydrin, and more than 90 partial fingerprints were developed. Identifications of a number of suspects were made with these ninhydrin prints. However, the print "R1" was not suitable for identification after being treated by either ninhydrin (Fig. 3) or silver nitrate (Fig. 4). In this case the laser-developed print was photographed on Kodak Contrast Process Pan Film with an optimum exposure of f/8 at 15 s. The extreme difference in exposure from that in Case 1 is apparently caused by the background luminescence emitted by the paper document on which the fingerprint was located.

Case 3

An envelope that had contained counterfeit money was placed under laser light. One fingerprint was located and photographed (Fig. 5). Ninhydrin also developed this fingerprint (Fig. 6), but it is obvious that the portion of the print developed by ninhydrin differs from that revealed by the laser. Both laser and ninhydrin versions of the fingerprint were suitable for identification, and it was identified as that of a person with legitimate access to the envelope.

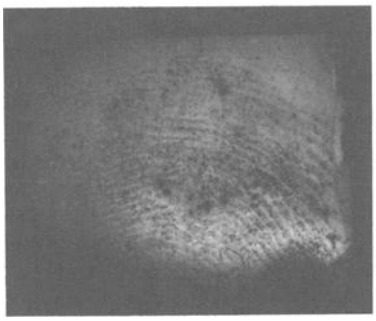

FIG. 1—*Fingerprint on black plastic tape photographed under laser light.*

FIG. 2—*Fingerprint "R1" revealed by laser.*

FIG. 3—*Fingerprint "R1" after ninhydrin treatment.*

FIG. 4—*Fingerprint "R1" after silver nitrate.*

Case 4

An Ontario road map with a multicolored cover was examined for fingerprints under laser light with negative results. It was then treated with ninhydrin and several partial fingerprints were developed. However, the multicolored nature of the background interfered with ridge detail, hampering comparison. When the map was again subjected to laser light, the background lightened considerably, luminescing yellow-orange. Conversely, the ninhydrin appeared darker because it does not visibly respond to the laser light. Therefore, by making the background lighter and the ninhydrin-processed fingerprints darker, in special circumstances, luminescence induced by laser may be used to advantage.

Case 5

Several exhibits were under examination by laser for an investigation conducted by another police agency. As the investigators passed the exhibits under the laser light, I noticed several bright areas of luminescence on their hands. Closer examination showed these to be fingerprints of excellent quality located along the ulnar edge of the right hand and a thumbprint on the back of the hand between the base of the thumb and the index

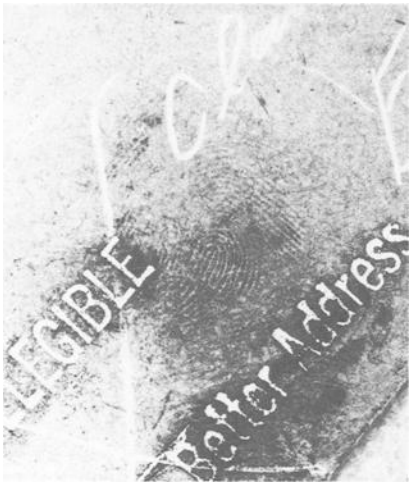

FIG. 5—*Fingerprint on envelope photographed under laser.*

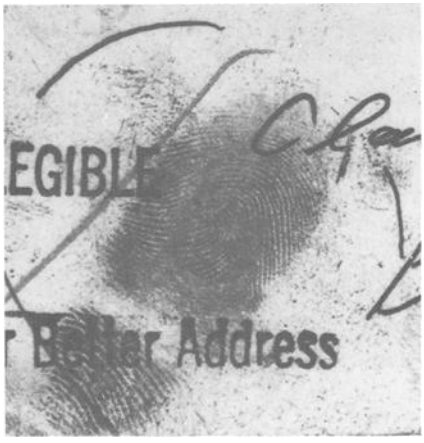

FIG. 6—*Fingerprint on envelope after ninhydrin treatment.*

finger. The position of these prints clearly indicate that they were acquired during a handshake.

It was reported in the first paper [*1*] that limited tests were conducted to determine the feasibility of detecting fingerprints on skin by laser and that these tests were successful. The prints on the hands, however, are the first fingerprints on skin detected by laser that were not part of a test but completely chance impressions. It is also significant that these fingerprints were eminently suitable for identification, even though the room temperature was in excess of 26°C (because of an air conditioning failure) and the time lapse between the deposit of the fingerprints and their discovery was at least 30 min.

Observations

1. All-lines lasing used laser power much more efficiently than did a single line without apparent loss in sensitivity.

2. It seems obvious from these results that the laser and ninhydrin techniques rely on different components of finger deposit and these components may or may not be present in the same fingerprint in sufficient quantity to be detectable by either method. From this it may be concluded that one technique has the potential for developing fingerprints that the other technique fails to detect.

3. It is encouraging that the laser method may be used with success on surfaces not always amenable to other techniques. This may be caused in part by the fact that, when laser is used, the surface material is touched not by any solution or powder but only by light.

4. Some fingerprints are within the reach of the laser method even under adverse conditions. The examination of fingerprints on skin has been admittedly limited, and Case 5 must be treated as a preliminary indication only.

Conclusion

The results reported here are an indication of early usage of the laser method. More work, on the detection of fingerprints on skin in particular, is needed to accurately assess the potential value to the investigator.

Acknowledgment

I wish to thank the Xerox Research Centre of Canada, and in particular Dr. J. M. Duff and Dr. E. R. Menzel, for their continued cooperation and assistance.

Reference

[*1*] Dalrymple, B. E., Duff, J. M., and Menzel, E. R., "Inherent Fingerprint Luminescence—Detection by Laser," *Journal of Forensic Sciences*, Vol. 22, No. 1, Jan. 1977, pp. 106-115.

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