TECHNICAL NOTE

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Visualization Method for Fingerprints on Skin by Impression on a Polyethylene Terephthalate (PET) Semirigid Sheet

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ABSTRACT: Based on the phenomenon that static electricity attracts dust, a polyethylene terephthalate (PET) semirigid sheet coated with printing ink was used to visualize impressions of fingerprints on the skin of living and dead bodies. Compared with visualization methods for perspiration fingerprints, this method recovers better images for a longer time after the fingerprint has been deposited on skin. Fingerprints transferred to the PET sheet are photographed with sidelighting using an ordinary light source. For fingerprints that yield inadequate contrast, an argon-ion laser can be used to improve the contrast.

KEYWORDS: criminalistics, fingerprints, skin, polyethylene terephthalate, static electricity

Visualization methods for fingerprints on skin have long received a great deal of attention and have led to intense studies among forensic scientists in many countries [*1*]. So far, no generally successful methods have emerged for practical casework. However, fingerprints on skin can on occasion be detected by a variety of techniques (see Ref *2* and references therein). At crime scenes, particularly in murder and rape cases, the collection of evidence is limited and affected by the surroundings. Therefore, the visualization of fingerprints on the skin of the victim is especially important in investigation of such cases.

In order to search for a new practical way to visualize fingerprints on skin, we studied the conditions of formation of fingerprints on skin. We noticed that human hands and skin secrete oils at higher temperatures, and that, in winter, skin protection oils are used. These oils attract dust, not only from the air, but also from contact with objects. The method of impression using polyethylene terephthalate (PET) semirigid sheets, described in this paper, takes advantage of the oil and dust content of fingerprint residue.

Principles

Rubbing produces electricity, and static electricity attracts dust. These phenomena are known to us all. The method presented in this paper is one in which a polyethylene

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terephthalate (PET) semirigid sheet is rubbed to produce static electricity, which attracts the dust and oil in skin fingerprints onto the PET sheet, and then the fingerprint impression is visualized using sidelighting.

The PET material (polyethylene terephthlate) is the condensation polymerization product of terephthalic acid and ethylene glycol.

The PET semirigid sheet is characterized by good electrostatic effects [*3*], and this material can carry either a positive charge or a negative charge [*4*] and has wide application, a volume electric resistance of $10^{16}\ \Omega \cdot$ cm, and slow electrostatic decay. Compared with other high-polymer materials, the PET semirigid sheet possesses the advantages of softness; high adaptability to temperatures (-20 to 150°C); resistance to wear, aging, oil, chemical reagents, and wetting; good ability to take coloration; and ability to stand up to voltage.

The PET sheet used for visualization of fingerprints is smeared at one side with a coating of dark printing ink. This increases the friction factor, produces high shading ability and a uniform color [*5*], and provides a sharp contrast to the impressed fingerprints, which can be photographed with an ordinary light source using sidelighting. This sheet, smeared with a coating at one side, possesses the ability to attract dust and oil in fingerprints. The coating material is selected to be analyzed using an argon-ion laser.

Materials and Method

Materials

The following materials were used:

(*a*) PET semirigid sheet (0.015 mm thick), coated with the colors dark blue, dark green, or dark gray (produced at Luoyang, Honan Province, China);

(*b*) an insulation pressing plate—one piece of thick glass; and

(*c*) friction material—finespun chemical fiber cloth.

Method

Cut out the PET semirigid sheet according to the position and area of the fingerprint. Put the PET sheet on the pressing plate or in the hands with the coated side upward. Rub the sheet repeatedly with the hands or the chemical fiber cloth. After the PET sheet feels warmer, continue rubbing several more times. Then quickly put the rubbed sheet in contact with the position to be checked for fingerprints. Press the PET sheet with the hands or with the insulation pressing plate to let it come in contact closely and evenly with the surface to be checked. When the temperature of the impression sheet decreases (usually after several seconds of contact), take the PET sheet away lightly and smoothly. Thus, if the position to be tested has fingerprints, clear fingerprints can be obtained on the side of the impression sheet in contact with the object. With a background of a dark color, photographs of the fingerprints can be taken even with ordinary lamplight.

Method of Observation and Photographing of the Impressed Fingerprints

The fingerprint impressions on the PET impression sheet can usually be photographed with ordinary lamplight. If the contrast is weak, a laser can be used to improve visualization.

After being extended by a beam extending lens, the laser is used to illuminate the impression sheet. The illuminating angle is adjusted to let the lines of the hoops and whorls of the fingerprint show clearly. A filter lens of Yellow No. 5, No. 50, or No. 99 (produced by The Beijing Film Factory, Beijing, China) is selected according to the photographic need. Figure 1 shows the lighting method for photographing fingerprints.

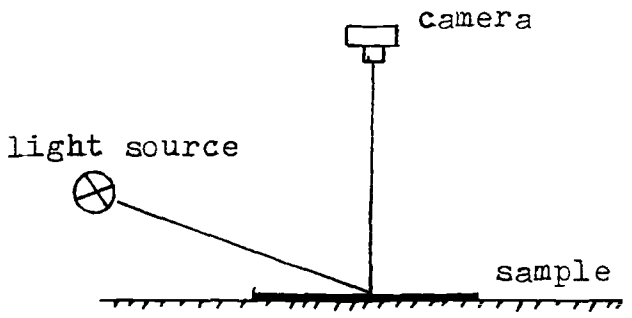

FIG. 1—*Lighting method for photographing fingerprints: θ is the incidence angle of lamplight or laser and equals 80, 85, or 85°.*

Experimental Results

According to the conditions of formation, fingerprints on skin are divided into three categories: (*a*) dust fingerprints, (*b*) oily fingerprints, and (*c*) trace dust fingerprints. For each category and for different times, ten experimental samples were taken from the skin of human bodies (living and dead): from different locations, including the face, neck, wrists, back of the hands, upper chest, and front side of the leg. Table 1 shows the experiment results for fingerprints impressed onto PET semirigid sheets. Examples of the fingerprints obtained are shown in Figs. 2 through 7.

TABLE 1—*Visualization results for fingerprints stamped on living and dead bodies for different time periods.*[a]

Time	Category	Object		Remarks
		Dead Body Skin	Living Body Skin	
12 h	A	+ + +	+ + +	
	B	+ + +	+ + +	
	C	+ + +	+ + +	
24 h	A	+ + +	+ + +	
	B	+ + +	+ + +	
	C	+ + +	+ + +	
48 h	A	+ + +	+ + +	
	B	+ + +	+ + +	
	C	+ + +	+ + +	
3 days	A	+ + +	+ + +	Laser is used
	B	+ + +	+ + +	
	C	+ +	+ +	
1 week	A	+ + +	+ + +	
	B	+ + +		
	C			

[a]Key to abbreviations:
A = dust fingerprints.
B = oiliness fingerprints.
C = trace dust fingerprints.
+ + + = the best image.
+ + = better image.

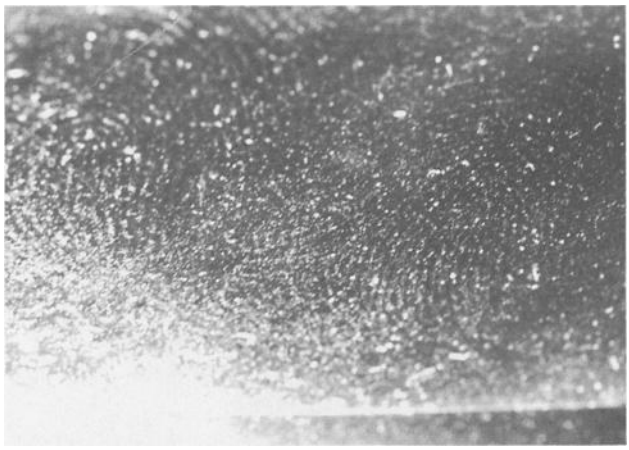

FIG. 2—*Potential fingerprint on the neck of a living body (after 48 h).*

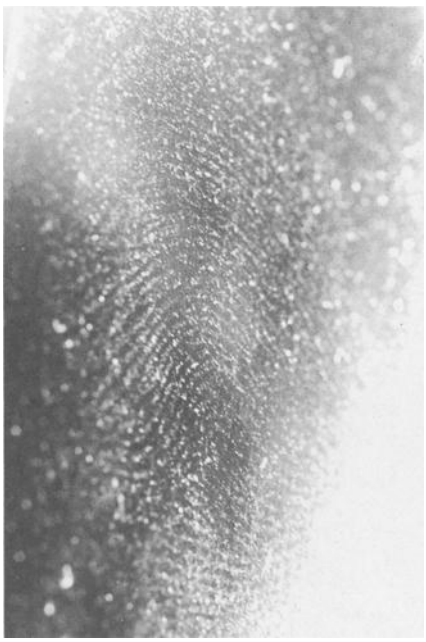

FIG. 3—*Potential fingerprint on the arm of a living body (after 72 h).*

Conclusions and Discussion

1. This method has been tested on living and dead bodies. The fingerprint impressions all show good visualization results. The visualization effect is best for older fingerprints on dusty or oily skin. In most cases, the fingerprints left on skin by unclean hands can be visualized using ordinary lamplight to show the loops and whorls. Fingerprints with weak contrast can also be improved by using a laser beam.

FIG. 4—*Perspiration fingerprint on the back of a hand (developed after 20 min).*

FIG. 5—*Oily fingerprint on an arm (rinsed with water for 10 min and then developed).*

2. Owing to the adhesion of human skin, skin fingerprints with dust and oil show good stability. Therefore, this method can be used to visualize fingerprints left on skin after a long period of time. By impressing on the impression sheet the trace materials in the skin fingerprints, one can avoid having the fingerprints interfered with by the skin; thus, this method is more sensitive than the visualization of perspiration fingerprints.

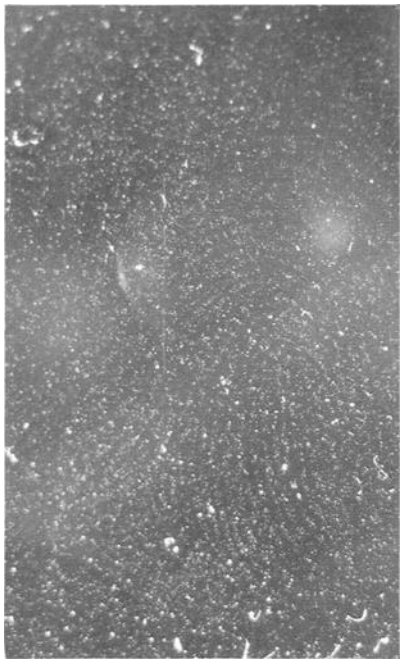

FIG. 6—*Latent fingerprint on the leg of a dead body (after 72 h).*

FIG. 7—*Latent fingerprint on the leg of a dead body (after 72 h).*

3. As long as the area of skin where the fingerprints are located is not worn off, old fingerprints with dust and oil can be visualized. In order to study the sensitivity of this method, experiments were conducted under some special conditions:

(*a*) After the hands and the back of the hands of the subject had been washed clean, fingerprints with little or no perspiration were stamped on the back of the hands. Baked at a distance of 2 cm with a 100-W desk lamp for 20 min, the fingerprints were visualized as Fig. 4.

(*b*) Fingerprints on the forearm area were stamped on by hands with a little face protection cream, and then washed with tap water for 10 min and baked with a lamp. The visualization result is shown as Fig. 5. Experiments show that, for fingerprints with dust and oil, which are left on dead bodies for more than one week or on living bodies for three days, the visualization results are not significantly different from those for fingerprints newly formed.

4. After using this method, other visualization methods for perspiration fingerprints can also be used, and their visualization effects will not be disturbed.

5. The PET semirigid sheet is flexible, not limited by the shapes and colors of the objects tested, and suitable for a wide range of applications. It can visualize fingerprints that cannot be visualized by other methods.

6. The advantages of this method are that it is simple to perform, easy to master, economic, able to be used many times, and convenient for preservation of the material evidence.

Matters of Special Concern

1. When taking photographs of the impressed semirigid sheet, the requirements of the incident angle must be strictly followed, and a metal lampshade may be used to avoid the interference of diffusion light.

2. When rubbing the PET semirigid sheet, its insulation must be assured to avoid a decrease in electrostatic effects; a tiny amount of oiliness (for example, face protection cream) should be smeared on the impression sheet to avoid its being scored. The convenient way of rubbing is to hold one corner of the impression sheet with one hand, rubbing repeatedly with the other hand.

3. When taking impressions of fingerprints located on skin, the impression sheet should be pressed hard to be in close contact with the skin for several seconds. When taking impressions of fingerprints located on other materials, a medium pressing force is enough. When the skin is covered by floating dust, one should blow away the floating dust first before taking the fingerprint impressions.

4. To store the impression sheet, it must be kept dry and clean, and care must be taken to prevent the lines of loops and whorls of the fingerprints from being interfered with by scoring on the impression surface.

References

[*1*] Hammer, H.-J., "Über Methoden zur Darstellung von Latenten Fingerabdrücken auf der Menschlichen Haut," *Forensic Science International*, Vol. 16, 1980, pp. 35–41.

[*2*] Bettencourt, D. S., "A Compilation of Techniques for Processing Deceased Human Skin for Latent Prints," *Journal of Forensic Identification*, Vol. 41, No. 2, 1991, pp. 111–120.

[*3*] Adcock, J. M., "Development of Latent Fingerprints on Human Skin: The Iodine-Silver Plate Transfer Method," *Journal of Forensic Sciences*, Vol. 22, No. 3, July 1977, p. 599.

[4] Feldman, M. A., Meloan, C. E., and Lambert, J. L., "New Method for Recovering Latent Fingerprints from Skin," *Journal of Forensic Sciences*, Vol. 27, No. 4, Oct. 1982, p. 806.
[5] Zhang, J., "EGX 874 Visualization Method of Latent Fingerprints on Skin," *Proceedings*, Second National Conference on Evidence Technology, 1988, pp. 33–40 (in Chinese).

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