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Shortwave Ultraviolet Light on the Appearance of Traces of Biological Material Evidence

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ABSTRACT This experiment uses 254nm short-wave ultraviolet to visualize the sweat fingerprints on common white walls, glass, photos, house cards, ceramics, and optical discs to study the display of sweat fingerprints on common objects by the short-wave ultraviolet absorption and reflection method.

KEY WORDS Forensic science; Crime scene investigation; Optical technology; Forensic engineering; Short-wave ultraviolet reflection display; Full-band CCD; Latent fingerprints; BOPP film

1. THE PRINCIPLE OF SHORTWAVE ULTRAVIOLET REVEALING BIOLOGICAL TRACES

There are mainly two methods for shortwave ultraviolet to show biological traces, one is fluorescence visualization and the other is absorption reflection. The fluorescence visualization method uses short-wave ultraviolet light to excite the fluorescence of biological traces to realize the visualization of biological traces. The absorption reflection method uses the brightness contrast caused by the difference in absorption and reflection characteristics between the object and the biological trace in the short-wave ultraviolet region to realize the appearance of the trace.

1.1 UV Fluorescence Visualization

45nm short-wave ultraviolet is widely used in field surveys. The short-wave ultraviolet photon energy in this band is relatively high. When irradiating biological traces, it will often stimulate the fluorescence of biological substances, especially semen, body fluids, bone debris and other biological traces. Under short-wave ultraviolet irradiation, it will emit strong fluorescence in the visible light range. Under darker conditions, biological traces will appear brighter. Since lasers have been widely used in site surveys, ultraviolet fluorescence visualization has been rarely used, mainly because lasers are far superior to ultraviolet light in terms of fluorescence excitation efficiency.

1.2 Absorption reflection method

In the field survey, short-wave ultraviolet showed biological traces, and in most cases, the short-wave ultraviolet absorption and reflection method was used. The short-wave ultraviolet absorption and reflection method uses the brightness contrast caused by the difference in absorption and reflection characteristics between the object and the biological trace in the short-wave ultraviolet region to realize the appearance of the trace.

2. EXPERIMENTAL EQUIPMENT AND METHODS

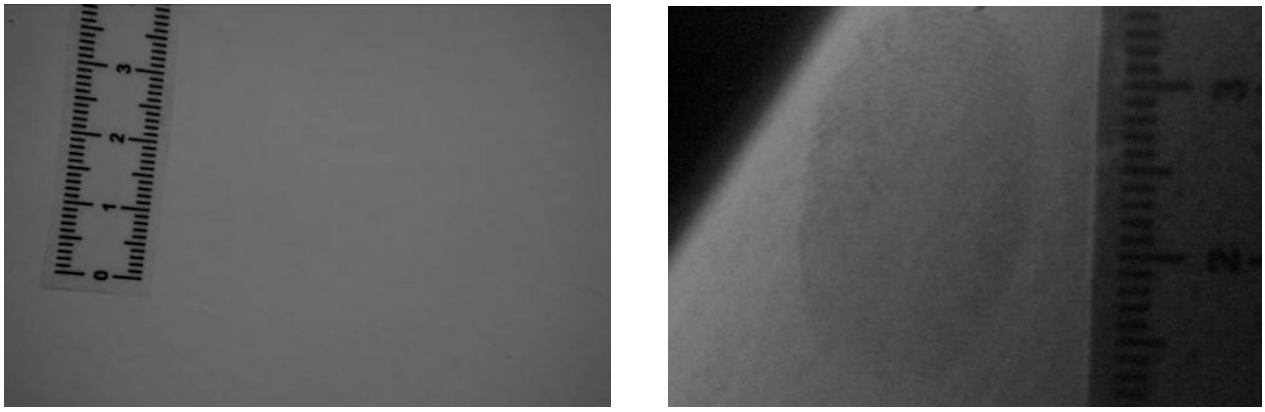
We chose a 254nm ultraviolet light source (Spectroline E/12-series, the U.S.), a full-band CCD (FLI PL4240-UV, the U.S.), and a 254nm narrow-band filter.

Aiming at the sweat fingerprints on white walls, glass ashtrays, photos, ceramics, room cards, CDs, boarding passes, and cigarette packaging plastic films, by adjusting the lighting angle of short-wave ultraviolet, the full-band CCD is

used to realize the display and display of sweat fingerprints. extract.

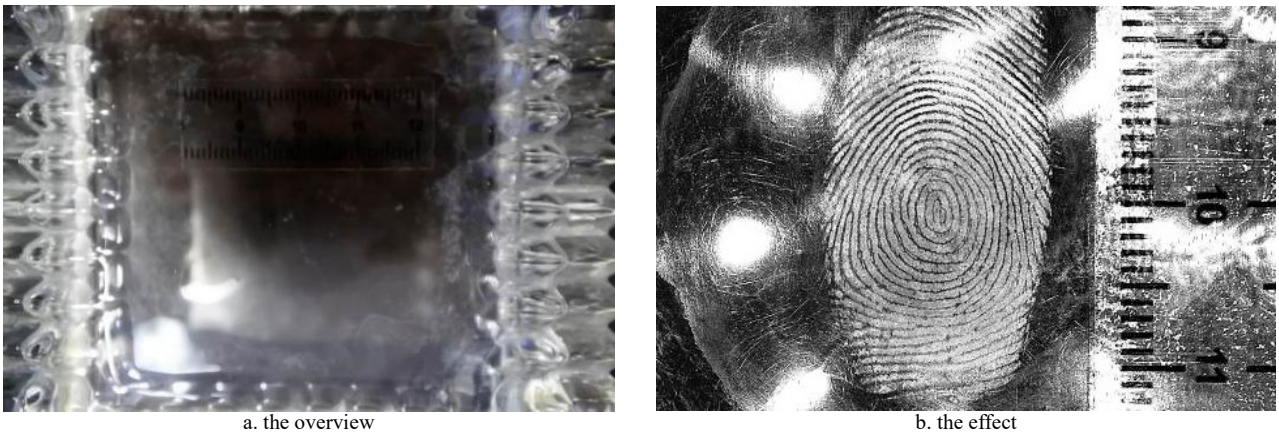
3 RESULTS

For white walls, glass ashtrays, photos, ceramics, room cards, CDs, and sweat fingerprints on boarding passes, the shortwave ultraviolet reflection method can be used to get a better display effect (as shown in Figures 1~6). Figure 7 shows the shortwave UV reflection effect obtained on the plastic film of the cigarette outer packaging. From Figure 7b, it can be seen that the fingerprints on the film are hardly visible. After placing a glass slide under the film, a better fingerprint is obtained. The effect appears as shown in Figure 7c.



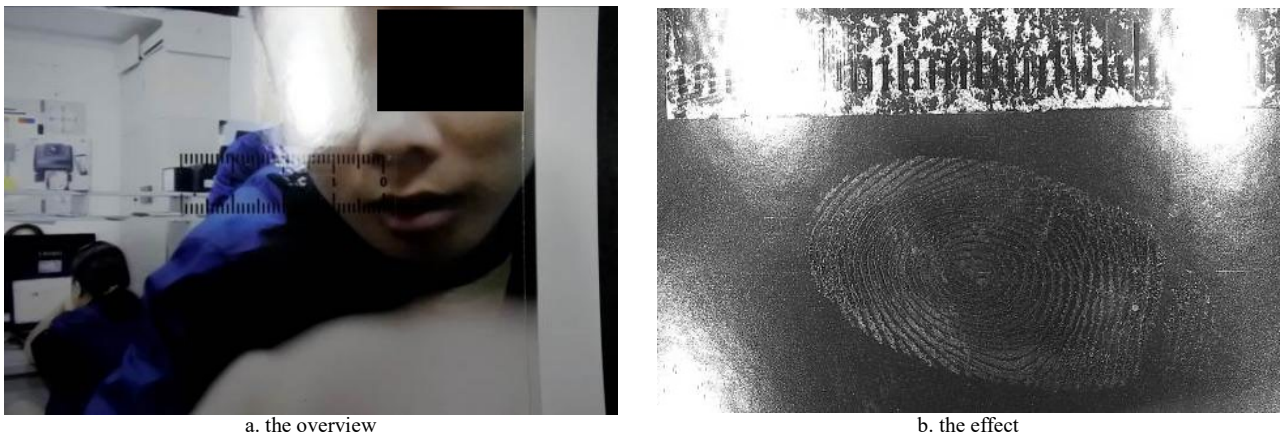
a. the overview b. the effect

Fig. 1 Shortwave UV reflection effect picture obtained on a white wall



a. the overview b. the effect

Fig. 2 Shortwave UV reflection effect obtained on the glass ashtray



a. the overview b. the effect

Fig. 3 The shortwave ultraviolet reflection effect obtained on the photo

a. the overview b. the effect

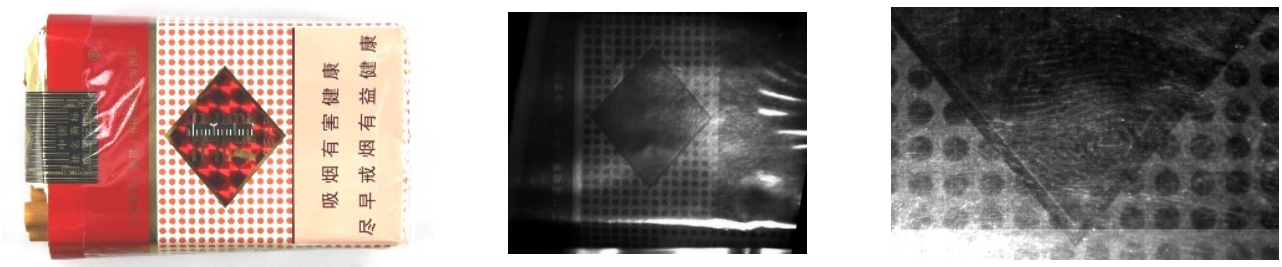
Fig. 4 The effect of shortwave ultraviolet reflection obtained on the room card

a. the overview b. the effect

Fig. 5 The shortwave ultraviolet reflection effect obtained on the optical disc

a. the overview b. the effect

Fig. 6 Shortwave UV reflection effect picture obtained on the boarding pass



a. the overview b. the effect c. the effect obtained after a glass slide is placed under the film

Fig. 7 The effect of shortwave ultraviolet reflection obtained on the plastic film of cigarette outer packaging

4 DISCUSSION AND CONCLUSION

The surfaces of objects such as white walls, glass ashtrays, photos, ceramics, room cards, CDs, boarding passes, *etc.* are basically smooth surfaces. When short-wave ultraviolet rays are irradiated on these objects, these objects have a strong absorption effect on short-wave ultraviolet. Where there are no fingerprints, the short-wave UV is completely absorbed by the object, while diffuse reflection occurs where there are fingerprints left. Part of the diffuse reflected light enters the CCD, resulting in a brightness difference between the fingerprint and the place without fingerprints. The result of shooting is shown as follows: The dark fingerprints lines under the bright background, so as to realize the appearance of fingerprints. As for the plastic film of cigarette outer packaging, the film is transparent and very thin. Although most objects have strong absorption of short-wave ultraviolet, short-wave ultraviolet has the problem of penetration depth when transmitted inside various materials. It is a thin transparent material. When using short-wave ultraviolet reflection method to show the traces of biological samples, due to the influence of the penetration depth, a better visualization effect cannot be obtained. At the same time, we should also pay special attention to the fact that short-wave ultraviolet has a great impact on DNA, and short-wave ultraviolet irradiation can easily cause damage to DNA. Therefore, in the process of on-site investigation and physical evidence identification, in order to ensure that DNA samples are not damaged, try your best Reduce the use of short-wave UV.

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