Visualization of Bloodstains on Dark Surfaces using Polarized Light

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Why Visualization is Important

Accurately visualizing and documenting bloodstains and patterns is an integral part of crime scene investigation and provides crucial information for both the analysis of evidence in the laboratory and crime scene reconstruction efforts.

Visualization of bloodstains is trivial on white or lightly colored surfaces. However, on darkly colored or black surfaces, it can be extremely difficult.

There are three main aspects of bloodstain analysis that visualization and documentation contribute to:

1:The presence of blood may not be recognized at critical stages in the investigation:

~The presence, location and morphology of blood stains are often of great importance in any investigation, and the earlier this information is available, the better.

~Where the presence of blood is not recognized, handling of the evidence may disrupt and compromise the bloodstain evidence.

2:Intelligence driven sampling-being able to visualize the stains allows for more selective processing of the surface:

~Stains are commonly analyzed in order to confirm that they are blood, and often further analyzed to determine their origin.

~In cases where the surface examined is large, fewer samples need to be taken as the sampling can be focused on specific areas.

~Where there are multiple sources of blood, the occurrence of mixed profiles in consequent DNA analysis can be minimized by sampling stains individually.

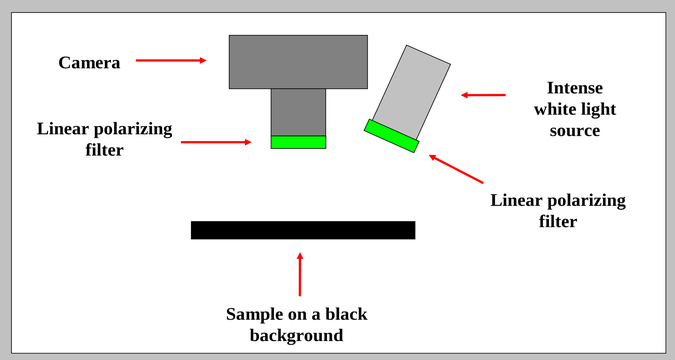
3:Interpretation of the evidence:

~The location and morphology of the stains are key elements not only in the investigation, but also in any event reconstruction efforts.

`~In a significant number of cases knowing how the bloodstains were formed is more important than knowing the biological source of the stains. In most cases the two types of information are complementary.

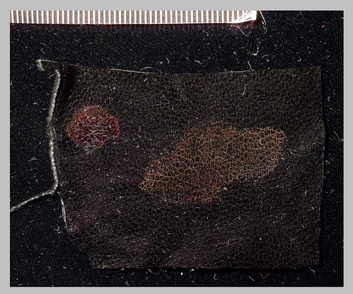
~ The ability to assign a DNA profile to a particular stain as opposed to a surface or collection of stains is important both in cases with multiple sources of blood or DNA but also where there is a single source of blood or DNA.

Polarized Light Method Setup



Blood on Leather

Uncrossed



Crossed

Light Source

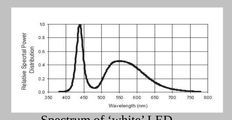
~The enhancement works best with a full spectrum of white light

~Fiber optics and Xenon lights work well but cause significant heat damage to the polarizing filter in a short amount of time

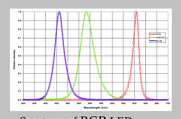
~LEDs do not cause heat damage to the polarizers

~Not all LEDs output a sufficient and suitable spectrum; ‘white’ LED’s performance is significantly inferior to that of RGB LEDs

White vs RGB LED Technology



Spectrum of ‘white’ LED



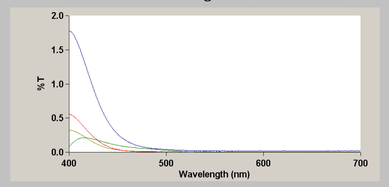
Spectrum of RGB LED

Blood on leather

Blood on leather

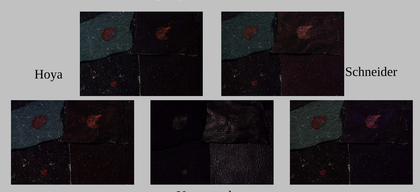
Performance of the Polarizing Filters

% Transmission through two crossed filters



Blue = B&W, Red = Heliopan, Khaki = Hoya, Green = True Pol

Photographs with the filters



Stain Types

~Stains that were absorbed into the substrate and did not leave a thin film on the surface of the substrate were harder to visualize

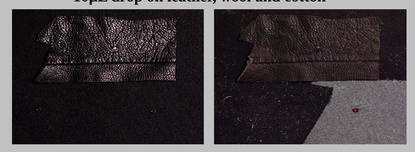
~Thick stains are not enhanced, but can be visualized using oblique light

~Small spatter was particularly successfully enhanced

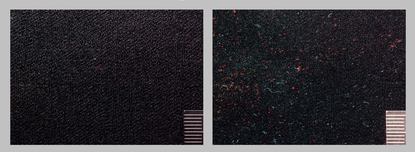
~Small spatter was very seldom apparent when looking through the viewfinder

Contact stain on leather, wool and cotton

10µL drop on leather, wool and cotton



Small spatter on wool



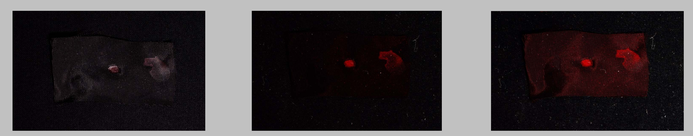
Smear stain on leather, wool and cotton

Orientation of Incident Light

~The effect of the orientation of the incident polarized light is substrate dependent

~This change in substrate appearance is not readily apparent through the viewfinder

Polyester



Uncrossed | Crossed | Crossed rotated ~20°

Silk

Features & Limitations of Substrate Types

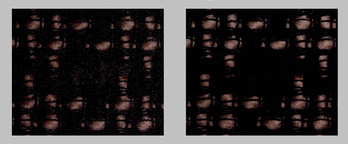
~Substrates did not interact with the blood or the polarized light in a uniform manner

~If the substrate is uneven, it can be difficult to illuminate it so that the entire field of view is under crossed polar lighting simultaneously

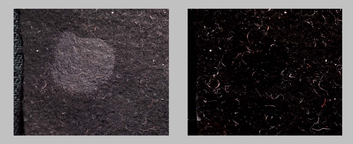
~Stains on substrates which contain one or more lighter colored elements show barely any enhancement

~On suede, stains can be visualized with regular lighting by the localized matting of the surface. This subtle matting can be less apparent with crossed polarized illumination, making the stains more difficult to visualize

Black/white upholstery fabric with smear and spatter



Suede with contact stain



False Positives, Negatives and Dilutions

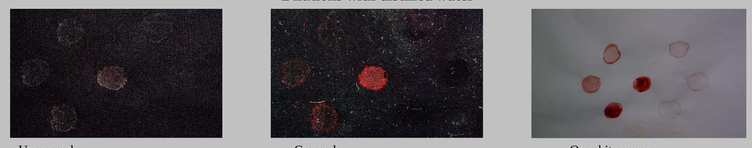
~Several red substances produced stains similar in appearance to bloodstains

~While mixing the blood with certain chemicals changed its appearance, the stains remained visible

~Dilutions up to 1:10 and 1:25 could be visualized on less absorptive substrates

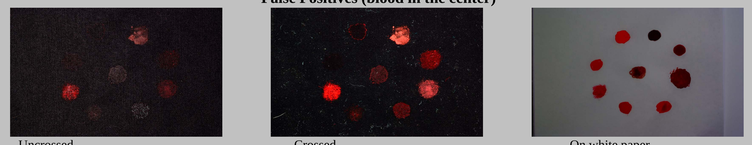
~As is the case with blood on lighter substrates, one should be aware of the possibility of false positives, false negatives and the effects of dilution.

Dilutions with distilled water



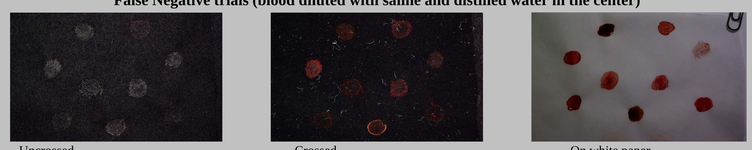
Uncrossed | Crossed | On white paper

False Positives (blood in the center)



Uncrossed | Crossed | On white paper

False Negative trials (blood diluted with saline and distilled water in the center)



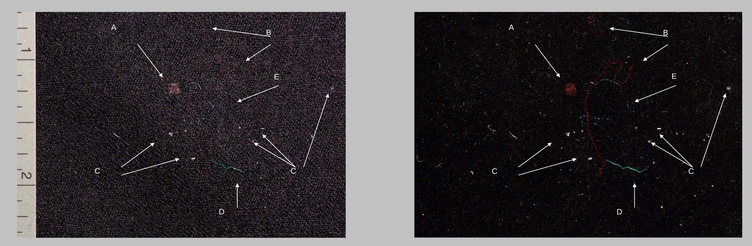
Uncrossed | Crossed | On white paper

Materials other than Blood

~As is apparent from the false positive testing, this enhancement is not unique to blood, other brightly colored items and materials are also enhanced

~This is particularly useful for documenting fibers and small glass fragments that can be visualized using oblique light but are difficult to photograph

Blood, Fibers and Glass on Wool



N.B. Scale in inches

Bloodstain (A), Red Acrylic fiber (B), Glass shards (C), Green Olefin fiber (D), Blue Rayon fiber (E)

For further information or a PDF of this presentation, Please contact Rebecca Bucht at rbucht@gc.cuny.edu