Forensic Light Source Application Review

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Abstract

A forensic light source is a crime scene investigator's and lab technician's tool for enhancing observation, photography and collection of evidence including latent fingerprints, body fluids, hair and fibers, bruises, bite marks, wound patterns, shoe and foot imprints, gun shot residues, drug traces, questioned documents, bone fragment detection, etc. It provides more sensitivity than traditional methods thus increasing the amount of evidence uncovered and the quality of the evidence photographed and collected.A forensic light source is made up of a powerful lamp such as xenon or metal halide bulbs, containing the ultra-violet, visible and infrared components of light. It then filters down the light into individual color bands (wavelengths) that enhance the visualization of evidence by light interaction techniques including fluorescence (evidence glows), absorption (evidence darkens), and oblique lighting (small particle evidence revealed).

1 Latent Fingerprint Detection

The primary application of a forensic light source is for enhancing the detection of latent fingerprints. The use of fluorescent enhancement processes that compliment a light source greatly increases the types of surfaces from which a latent fingerprint can be detected.

Consider the difficulties of dusting and lifting a print off of the following surfaces: thin plastic bags, rigid duct tape, thin aluminum foil, heavily grained wood, concrete wall, brick, printed glossy magazine pages, paper products, etc. Using traditional methods, fingerprint evidence on these and other types of surfaces may go undetected or even dismissed because they could not be detected with enough detail.

Forensic light source techniques have been successfully utilized for revealing latent prints on these and many other types of textured surfaces, backgrounds which mask ridge detail, fragile surfaces, and contaminated surfaces. Different color bands (wavelengths) are required for processing different types of surfaces making a forensic light source with tunable or multiple wavelengths a coveted tool for any crime scene investigator. In many cases the background surface will also glow under light source illumination. In these cases it is necessary to tune to a wavelength of light that causes the print to glow and not the background.

The quality and quantity of evidence revealed is proportional to the output power and the extent of color tunability of the light source. This ability is exclusive to a forensic light source. UV lights or Blue lights cannot offer this selectivity due to their limited number of wavelengths and low power output.

• Fluorescent Powder

Surface Treated in two steps with Cyanoacrylate Fuming (vapors react with the fingerprint residues to form a faint white polymer which can be penetrated by the subsequent fluorescent dye) followed with Basic-Yellow-40 fluorescent dye. Illumination at 455 nm and viewing with orange long pass (550 nm) camera filters. Photography is done by darkening the crime scene (Fig. 1).

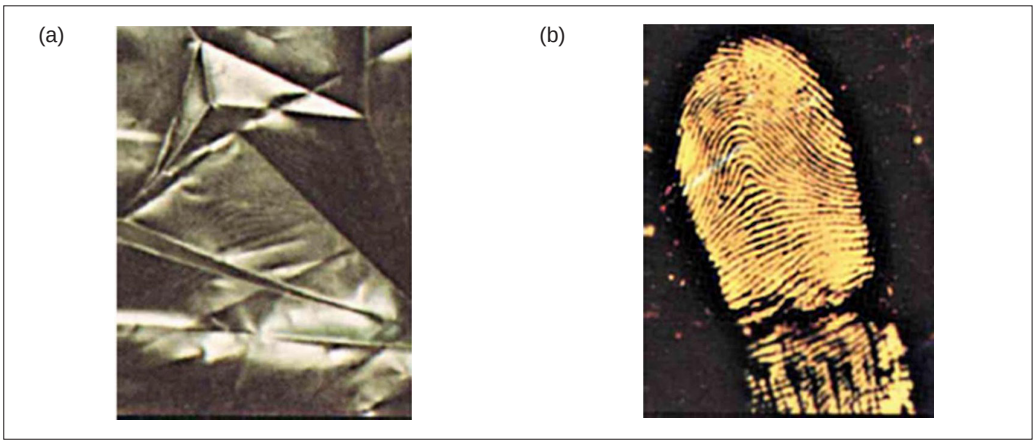

Fig. 1 Latent Fingerprint Image using Basic-Yellow-40 Fluorescent Dye on Dark Cellophane
(a) White Light
(b) 445 nm Narrow Band

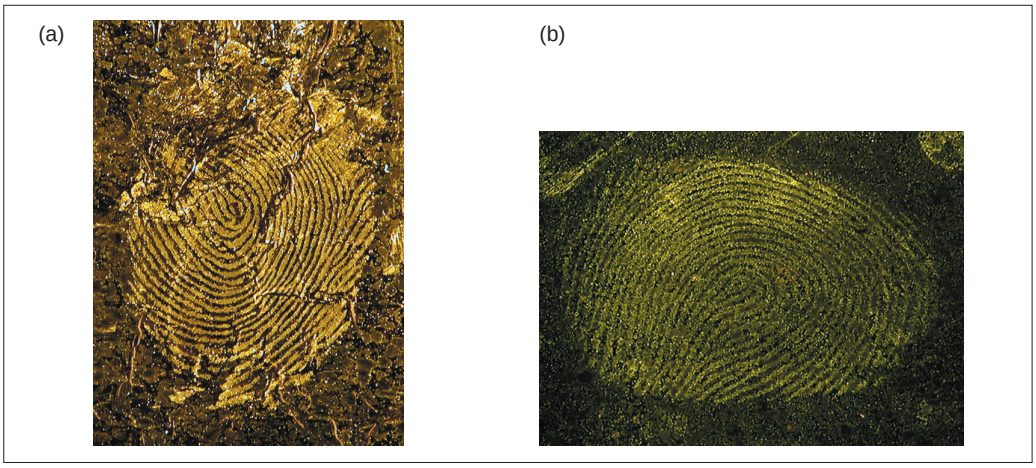

Fig. 2 Effect of the Fluorescent Dye
(a) Rhodamine Treatment
(b) Ardrox Treatment

Utilizing forensic light source techniques allows the latent print to be detected with much more sensitivity (10 – 100 times more!) than the conventional method of black powder dusting and lifting. Since fluorescent techniques are very sensitive, only trace amounts of fluorescent powder are required when dusting for prints at a crime scene. It therefore leaves the scene much cleaner than when using black powder.

The crime scene specialists tend to use Fluorescence powder when taking a light source to the crime scene. This is the "easy" solution but it does not give optimum results. Fuming the evidence at the crime scene with Cyanoacrylate (superglue vapors) and processing the fumed evidence in the lab with dyes such as Rhodamine (Fig. 2(a)), Ardrox (Fig. 2(b)) or Basic-Yellow-40 as in above fingerprint photos provides superior resolution quality and powder processing problems as in the red print below (Fig. 3) can be avoided.

Fig. 3 Red Powder

2 Body Fluids Search

Since body fluids like semen, saliva, and vaginal fluids are naturally fluorescent, the use of a light source offers a unique method for locating them. A crime scene investigator can narrow down the specific locations of stains for collection instead of testing entire, large pieces of evidence such as a mattress, a carpet, a sheet, an article of clothing, etc... Fig. 4 shows a fluorescent image of saliva and Fig. 5 shows a fluorescent image of semen.

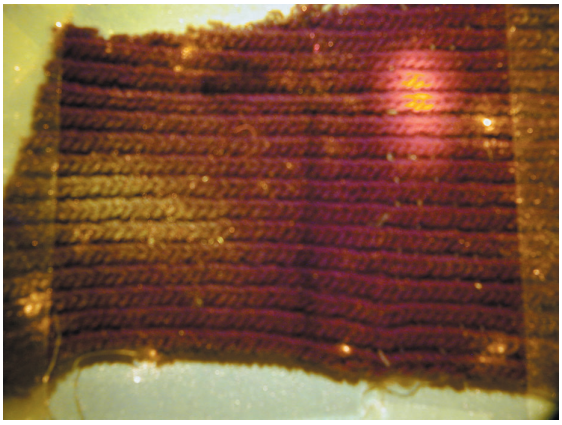

Fig. 4 Fluorescent image of Saliva

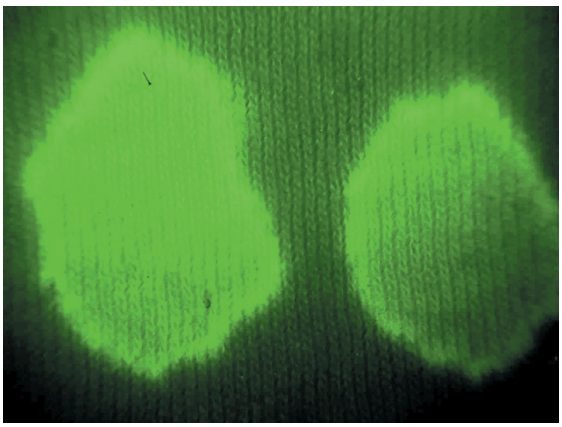

Fig. 5 Fluorescent image of Semen

The dried body fluids will actually glow under the light source illumination. Although the body fluids will fluoresce under an ordinary UV black light, many articles on which you would find them including clothing and sheets will also glow and deter their detection. It is therefore necessary to tune to visible wavelengths to eliminate the background interference. Considering that many searches for body fluids are in high profile, capital crime cases, the more body fluid evidence you can reveal the better. Again, the more powerful and more tunable your light source, the more evidence you will uncover. Although blood does not glow in the visible range, it has a unique wavelength under which the blood stain will darken to enhance its contrast by approximately 4 times. This is most effective in photographing blood prints because more of the detail of the blood print will be revealed by the enhanced contrast.

• Wavelength Adjustment

Many background surfaces glow under UV light and therefore a simple UV Black light will not yield the quality and the quantity of evidence that can be achieved with a tunable or multiple color band forensic light source.

Though no visible blood trace on the concrete floor can be recognized in the room light illumination (Fig. 6(a)), many clear bootprints reveal on the same surface under 455 nm CrimeScope illumination (Fig. 6(b)).

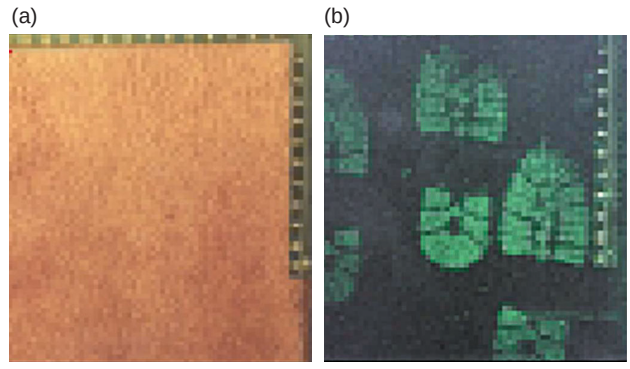

Fig. 6 Blood Trace on the Floor
(a) Room Light Illumination
(b) 455 nm CrimeScope Illumination and Fluorescein Spray

3 Other Powerful Applications

3.1 Hair and Fibers at Crime Scenes or in Document Examination

Two light illumination methods can be employed to locate hair and fibers with a forensic light source. First, oblique or parallel lighting of a surface such as a floor or carpet with a strong white light (the more powerful the better) will reveal small particles like hair and fibers for collection. Second, some hair and fibers will also glow under UV or visible light and will stand out strongly for collection. For the best chance of collecting the maximum number of hair and fibers at the crime scene, you need a powerful light source that offers strong White light illumination as well as strong UV and visible color bands (wavelengths); all of which are available only in a forensic light source. Fibers in official documents can be detected at specific wavelengths. Fig. 7(a) (Forged) and Fig. 7(b) (Valid) demonstrate a usefulness of the forensic light source. Crime Scene Search for fibers yields results at various wavelengths of the UV-visible spectrum (Fig. 8).

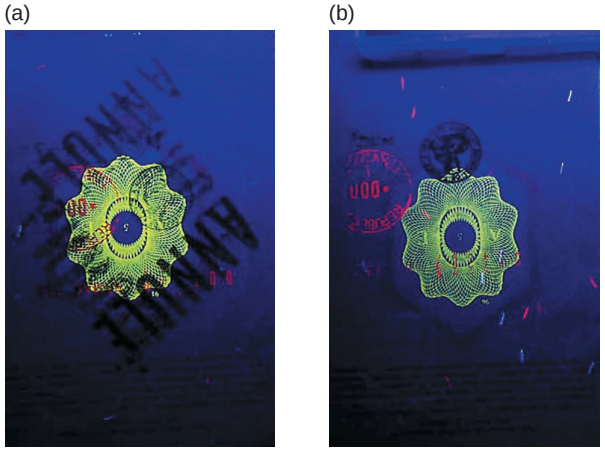

Fig. 7 Fibers in Official Documents (Passport)
(a) 415 nm Excitation (Forged Passport)
(b) 415 nm Excitation (Valid Passport)

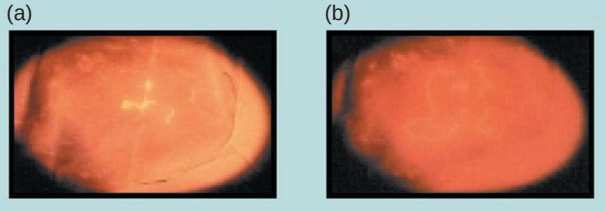

Fig. 8 Crime Scene Search for Fibers at Various Wavelengths
(a) 475 nm
(b) 535 nm

3.2 Bruises / Bite Marks/ Pattern Wounds

The use of a tunable or multiple wavelength forensic light source can reveal bruise and patterned wound details that are invisible under normal white light illumination. Details of a bruise pattern in a suspects palm can link a suspect to a weapon. Furthermore, details of a bruise on a victim, for instance, a bite mark or a shoe mark, can link a suspect to the victim. Multiple wavelengths are necessary because different colors penetrate to different depths within the skin and therefore depending on the depth of the bruise or wound you will need to vary the wavelength of the instrument. Deep wounds may require infrared illumination to get enough skin penetration. Only a forensic light source gives you the versatility of UV, visible, and IR color bands for enhancing bruise or wound pattern detail. Fig. 9 shows on-site investigation using the Mini-Crimescope-400 W.

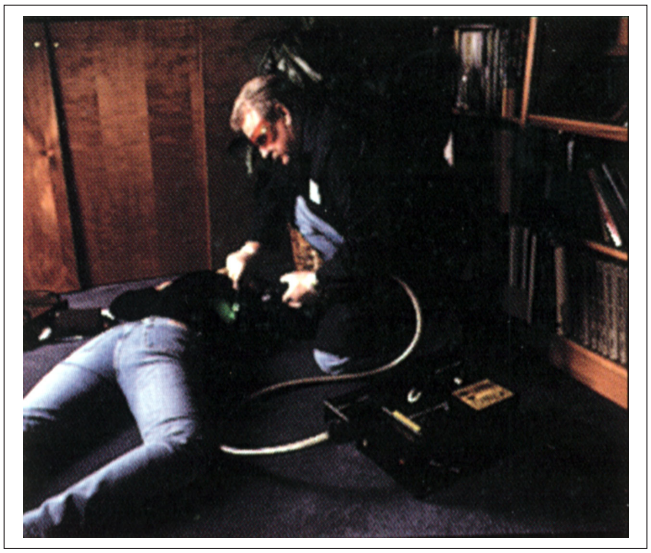

Fig. 9 On-site Investigation using the Mini-CrimeScope-400W

3.3 Questioned Documents

Inks have different formulations, even within the same apparent color type. A tunable forensic light source can be used to identify slight variations in ink type by viewing ink responses as the color of the light is tuned through the visible and infrared regions. Regardless of the skill of the forger, this examination would reveal that 2 different pens were used on the document. Principles used range from Absorption to Transmission to Fluorescence.

Fig. 10(a) and Fig. 10(b) are application example for official document examination. These result show that Infrared Fluorescence (>800 nm) under UV-BLUE nm illumination reveal various hidden ink patterns.

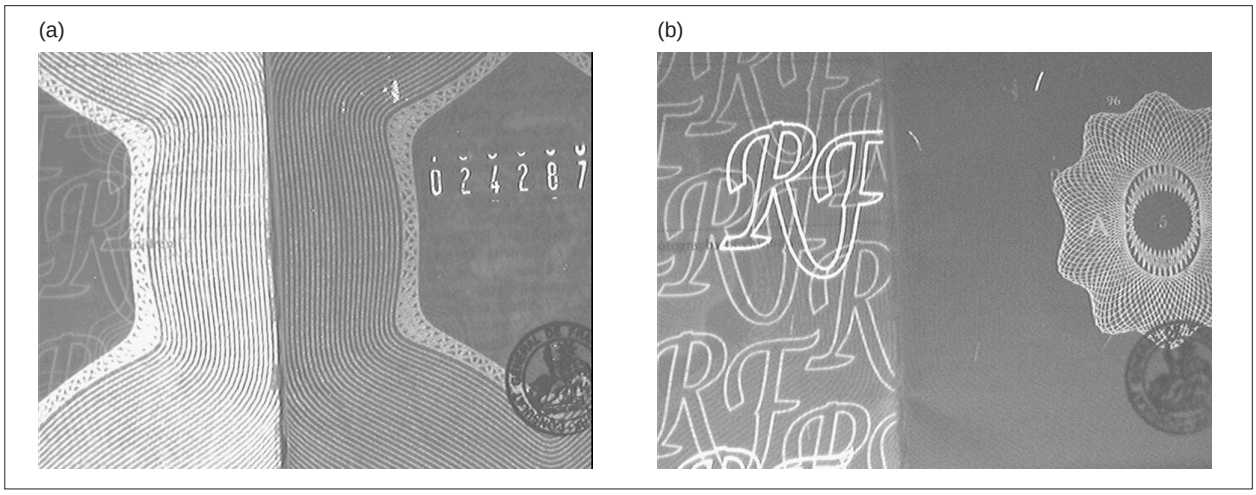

Fig. 10 Official Document Examination
(a) 455 nm Illumination
(b) 365 nm Illumination

3.4 Bone Fragment Collection in the Field

Bone fragments can be located when searching a burial site, an old crime scene to locate very small fragments of bones mixed with dirt and rocks. Bones and the enamel of teeth will fluoresce strongly under blue light in the range of 425-500 nm. Fig. 11 shows bone fragment screening, Fig. 11(a) is fluorescence image and Fig.11(b) room light image.

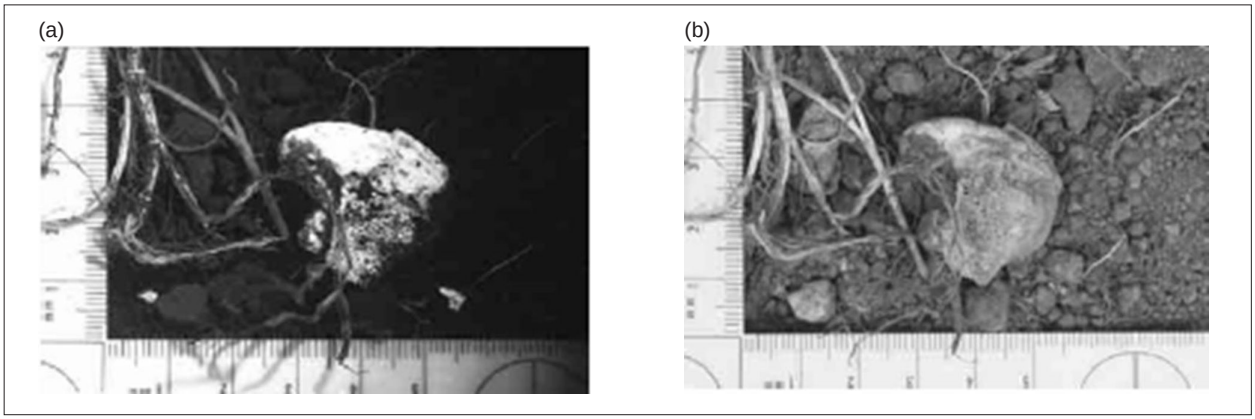

Fig. 11 Bone Fragment Screening
(a) Fluorescence
(b) Room Light

4 Why Choose the CrimeScope Series Forensic Light Sources?

The Jobin Yvon (JY) Spex Mini-CrimeScope 400 multiple wavelength forensic light source and the JY-Spex CrimeScope CS-16 tunable forensic light source offer the following advantages over other available forensic light sources:

(1) More Power

Both units offer considerably more power output than even the nearest competitor. The difference is visibly apparent and the advantage is clearly evident in the ability to look at fainter evidence with our units. The reason for the greater power is design. Both units take advantage of the latest in Liquid Light Guide technology as well as incorporate the highest quality optics.

(2) More Color Bands

Both units offer more wavelengths than their competitors. The Mini-CrimeScope 400 offers 6, 8, 12, 16, or more wavelengths with field interchangeable filter wheels. The CrimeScope CS-16 incorporates 22 wavelengths for the UV, Visible and the IR, our nearest competitor offers only 12 wavelengths. The CrimeScope also offers 15 positions for continuous tunability, more than any other light source giving the highest overall intensity throughout the spectrum.

(3) More User Friendly

The CrimeScope line of forensic slight sources are the only units that offer true ONE HAND OPERATION of color band (wavelength) selection and light direction; the Mini-CrimeScope 400 with its patented 6 position thumbwheel at the working end of the light guide, and the CrimeScope CS-16 with its automated remote control at the working end of the light guide. These are the only units on the market which allow you to take advantage of the 2 meter light guides while processing hard to reach areas like the insides of vehicles. Additionally, ONE HAND OPERATION of the light source allows the other hand the opportunity to dust or collect for evidence.

(4) Fully Upgradeable

The forensic light sources of the CrimeScope line have the ability to be upgraded at any time in the future. If a new application is developed for the light sources, filters can be added to both units to cover that new application. This upgradeability is cost effective, as you only need to purchase today what wavelengths you need and can afford, upgrades allow you to spread the cost of the unit over multiple budgets.

(5) Application Targeted Design

The CrimeScope line was not designed overnight. It evolved from a prototype unit built for a customer to a commercial product to 2 distinct classes of light sources, and then to the “State of the Art” forensic instruments you see today. Each step of the way the designers worked with professionals in the forensics field from the federal, state, and local levels to find out what the community needed and wanted. The resulting CrimeScopes are the most versatile, most rugged and easiest to use of any light sources available. Because of their performance, JY-Spex forensic light sources have the most loyal users in the field, returning to us for more units when they expand their department’s capabilities. The United States Federal Bureau of Investigation (FBI) alone owns 141 MCS-400’s and 25 CS-16 CrimeScopes. The Carabinieri police force in Italy has purchased 107 MCS-400’s and 6 CS-16 CrimeScopes.

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