Cyanoacrylate and DFO

From euphoria to reality

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In the late 1970's the use of the vapor of cyanoacrylate glue for the visualization of fingerprints was discovered in Japan and the USA and gained widespread use in the 1980's all around the world. The fuming technique became more sophisticated over the years and nowadays special cabinets with control over the humidity and air circulation are in daily use in many places.

Not only did the fuming method became more sophisticated, but also did the methods to find and document the cyanoacrylate visualized prints. In the beginning finding and photographing prints, especially on surfaces that did not contrast with the white cyanoacrylate developed prints was a problem. Photographing techniques and fingerprint powders were the only aids.

Fluorescent staining of the cyanoacrylate developed prints was known in the early 1980's. Initially this technique could only be used by labs equipped with a laser, like the argon ion laser, even today an expensive light source. With the availability of cheaper light sources, most of them specially built for the forensic community, fluorescent staining of prints developed with cyanoacrylate became an affordable and routine technique for many police forces.

Fluorescent staining is an important technique. A. it makes prints on non-contrasting surfaces easier to photograph and B. it is a more sensitive technique thereby allowing weak prints that are hardly or not visible to the naked eye to be found and photographed.

With the introduction of DFO in 1989 a fluorescent technique for fingerprints on porous surfaces became available. It now looked as if all problems were solved: both for non-porous and porous surfaces fluorescent techniques were at hand.

In reality however, there are areas were exactly fluorescence is causing problems that seem to be unsolvable in a high tech era, with advanced computer and digitizing techniques, and powerful tunable light sources at hand.

Common problem areas

a. The cyanoacrylate developed and stained fingerprint is found on an object that fluoresces in the same range as the dye that was used to treat the print (common example: soda cans photo 1 and 2).
b. The object with the fingerprint is contaminated and the contamination also absorbs some staining solution. Thereby causing a loss of contrast between the print and the background.
c. The object is inadvertently over developed, also resulting in a loss of contrast.
d. The item that may have prints on it is partly porous and partly non-porous. A bottle, can or spraycan with a paper lable is a common example.
e. Fluorescent prints are less sharp than the same prints photographed in white light.

Photograph 1, soda cans in white light

Photograph 2, soda cans fluorescing under green light

The use of DFO and ninhydrin on paper is also limited to certain papers. Limitations are found in the surface treatment of the paper and/or the color. Glossy or semi-gloss papers of magazines and packing material usually give poor or no results on treatment with DFO and/or ninhydrin.

The cause of the problems with the glossy paper might be due to the fact that this paper is not really porous anymore. Treatment with cyanoacrylate might therefore be a better option. However, the secondary treatment with fluorescent stains is not possible then. The paper is still absorbent enough to absorb these stains, so that no contrast will be found between the cyanoacrylate developed prints and the background.

Ideal solution

The ideal solution would be the total isolation of the print from it's background. Dr. E. Roland Menzel (Center for Forensic Studies, Texas Tech University) proposed and pioneered the use of phosphorescing stains, based on organometallic complexes of europium. Theonyl Europium Chelate, better known as TEC, is such a complex. The use of the complex for staining cyanoacrylate has been published by Canadians in 1993. Although the red fluorescence, excited by long wave UV is very nice, TEC suffers from excessive background staining (at least in our lab). This is probably the reason it never gained widespread use.

A simple and very effective solution

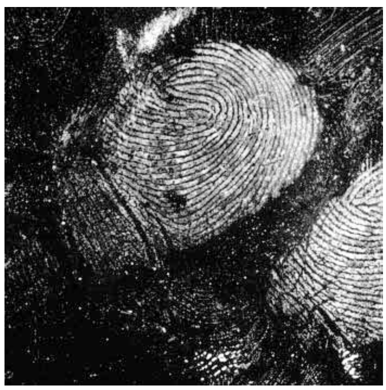
A solution to the problems mentioned was found when working on a case where a burglar had used a can with polyurethane foam to disable an alarm installation. This can was covered for 60% by a paper label, which fluoresced under a wide range of wavelengths. After fuming with cyanoacrylate, a faint fingerprint was visible on the label with oblique lighting. Use of a staining solution was out of the question, due to the the label being a paper substrate and being highly fluorescent.
The case was important enough to try something. Because of the good experience with black gelatin lifters, that will visualize even very faint traces of dust (footprints) a black gelatin lifter was applied to the label and removed. Surprisingly and almost complete fingerprint was visible. A second lift was even much clearer. Apparently, the first lift had removed most of the background. Photographing was easy, using oblique lighting.

After having obtained such a nice result, both more tests were done and the method used in case work. Often the resulting photographs after lifting with a black gelatin lifter were better and sharper than of the same prints photographed in fluorescence.

Two testprints on a soda can give a good example of a practical situation in which background fluorescence is encountered. Photograph 3 shows a detail of a Coca Cola Light can, that has been fumed with cyanoacrylate. Two prints were developed in the area with the word "Cola". This was followed by staining with Rhodamine 6G. As is shown in photo 4, the fluorescence of the print on the red lettering is obscured. The results after lifting with a black gelatin lifter speak for itself (photograph 5).

Photograph 3, cyanoacrylate developed print in white light

Photograph 4, after staining, fluorescence



Photograph 5, lifted

In a case where a plastic shopping bag was left behind in a garage where criminals had worked on stolen cars, fingerprints were developed (photograph 6) and subsequently stained with Ardrox. As photograph 7 shows, the background has absorbed some of the stain, thereby causing some loss of contrast. Photograph 8 shows the result of the lift with a black gelatin lifter.

Photograph 6, cyanoacrylate developed prints in white light

Photograph 7, after Ardrox staining, fluorescence

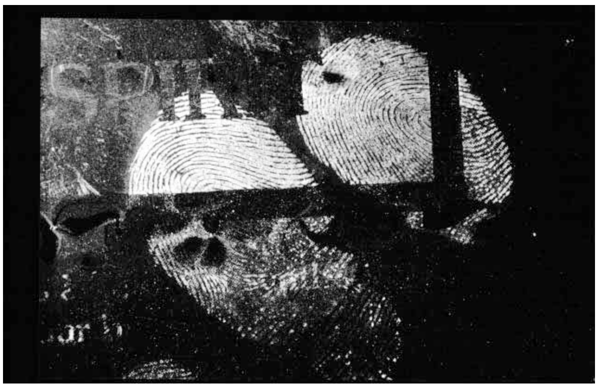
Photograph 8, lifted

A typical example of an object with a partly porous and non-porous surface is a bottle with a paper lable. In this case a plastic bottle for white spirit. The porous nature of the paper label precludes effective staining of the two vaguely visible prints on the label that have been developed with cyanoacrylate (photograph 10 in oblique lighting, photo 11 after staining with Rhodamine 6G: strong background). The prints are clearly discernible on the black gelatin lifter (photograph 11).

Photograph 9

Photograph 10, label after CA fuming, oblique lighting

Photograph 11, after Rhodamine 6G staining



Photograph 12, after lifting

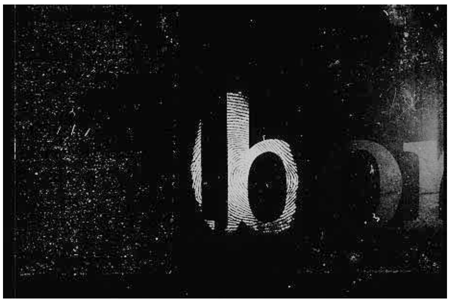
Cyanoacrylate and DFO

The paper that is used on packing boxes with color print on average yields poor results with either ninhydrin or DFO. However, fuming with cyanoacrylate can produce very usuable fingerprints. As mentioned before, use of staining solutions is not advantageous. However, DFO treatment is still possible and can yield prints on areas of the paper that are more porous than other parts (for example where there is less or no printing ink). Prior fuming does not seem to adversely effect the DFO treatment. Reversing the sequence: first DFO and then cyanoacrylate fuming is not possible. No results will then be obtained with CA fuming.

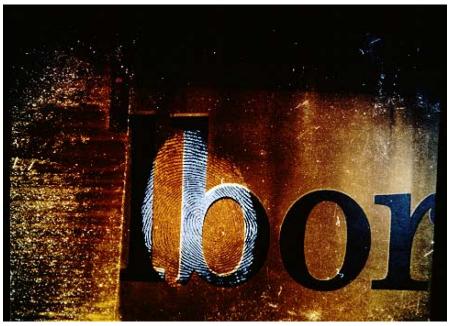
An example of a testprint on a cigarette packing box clearly demonstrates the complementary nature of the two techniques.

Photograph 13

Photograph 14 (DFO fluorescence)



Photograph 15 (CA lift)



Photograph 16 (CA lift/DFO combined)

Photograph 13 shows the partial package around a piece of wood (a con artists case). A testprint was placed on the letter "b".
Photograph 14 shows the fluorescing partial print that was developed with DFO, after fuming with cyanoacrylate. Note that with DFO only those parts of the print were developed that were in an unprinted area (the white background).
Photograph 15 shows the other part of the print, namely the one on the printed part, developed with cyanoacrylate and lifted with a black gelatin lifter.
Photograph 16 shows the complete print, obtained by overlay of the negatives of the DFO fluorescence and the cyanoacrylate lift.

Materials and equipment

Cyanoacrylate: ethyl cyanoacrylate (BVDA)
Fuming cabinet: Mason Vactron
DFO: petroleum ether based (BVDA)
Black gelatin lifters: BVDA
Camera: Pentax LX
Lens: Pentax Macro 1:4/50
Film: Fujicolor Superia 400 and Kodak T400 CN T-Max

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