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Lumicyano – fluorescent cyanoacrylate

Summary

Lumicyano is a new reagent used to reveal fingermarks on non-porous and semi-porous surfaces. It can be applied in trace visualization process instead of cyanoacrylate and fluorescent dyes (in the case of non-absorbent surfaces) or cyanoacrylate and dactyloscopic powders (in the case of semi-porous surfaces). Fingerprints are revealed in the traditional cyanoacrylate fuming chambers. The present work, the effectiveness of Lumicyano was investigated, in comparison to previously used sequences of laboratory techniques, i.e. cyanoacrylate + Basic Yellow 40 and cyanoacrylate + Black Ruby dactyloscopic powder.

Keywords: Lumicyano, cyanoacrylate, fingerprints, fluorescent traces

Description of the method

Lumicyano is a fluorescent chemical used to develop fingerprints on non-porous (e.g. plastic, metal, glass) and semi-porous (e.g. glossy papers, leather and leather-like materials) surfaces. It is composed of cyanoacrylate and fluorescent dye, and therefore it does not require the use of contrasting fluorescent dyes or dactyloscopic powders. Lumicyano-based visualization is thus a one-stage process.

To develop traces (fingermarks) with the abovementioned agent, traditional cyanoacrylate fuming chambers are used, whose parameters are set in the same way as when using cyanoacrylate alone (heating plate temperature approx. 120°C; humidity approx. 80%). Before applying Lumicyano, it is essential to remove any residues of cyanoacrylate from the chamber. The time of Lumicyano vapour deposition depends on the chamber volume and it ranges from 15 to 30 minutes.

Lumicyano appears in the form of a sticky, orange liquid, which is ready to use directly or in the form of liquid cyanoacrylate that needs to be admixed with an appropriate amount of orange powder (Fig. 1, 2).

Ready to use product should be stored away from light, in a cool, dry place, at a constant temperature, ideally in the refrigerator. Maximum storage time of an unopened bottle of ready to use Lumicyano is up to 6 months. After opening, the bottle should not be stored for longer than 3 months, which period guarantees an optimal performance. Before using, the solution should be brought to ambient temperature and shaken vigorously in order to obtain a homogeneous liquid.

Fig. 1. Lumicyano as a two-component formula.

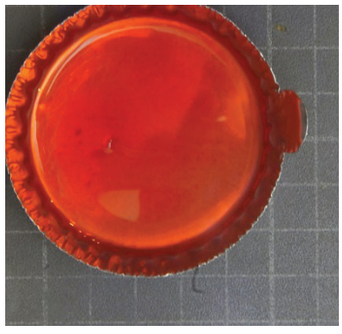


Fig. 2. Lumicyano working solution obtained by mixing both components.

In the case of a two-component formula, the shelf-life of both Lumicyano Powder and Lumicyano Solution is approx. 1 year. The components must be stored in a dark place, without access to sunlight, at room temperature, ideally in the laboratory cabinet.

The concentration of Lumicyano working solution is approx. 5%. The quantity of Lumicyano needed to carry out the process of fingerprint visualization is dependent on the volume of the cyanoacrylate fuming chamber. Table 1 shows exemplary quantities of the two-component Lumicyano solution needed to carry out the process of fingermarks visualization for specified cyanoacrylate chamber volumes.

Table 1. Quantities of the two-component Lumicyano solution in relation to the size of the chamber.

Cyanoacrylate chamber volume	Develop-ment time	Lumicyano working solution
170 liters	20 min	cyanoacrylate adhesive: 0.8 g (26 drops)
		Lumicyano powder: 0.04 g
650 liters	25 min	cyanoacrylate adhesive: 2.7 g (90 drops)
		Lumicyano powder: 0.135 g
2000 liters	30 min	cyanoacrylate adhesive: 4 g (132 drops)
		Lumicyano powder: 0.2 g

In the absence of an analytical balance, the appropriate amounts of Lumicyano powder can be dispensed by using a special spoon delivered with the product by the manufacturer.

Table 2 shows the quantities of the ready-to-use Lumicyano solution needed to carry out the process of fingerprint visualization for specified cyanoacrylate chamber volumes.

Table 2. Quantities of the one-component Lumicyano solution in relation to the size of the chamber.

Cyanoacrylate chamber volume	Development time	Lumicyano working solution, ready-to-use
170 liters	20 min	1 g
650 liters	25 min	3 g
2000 liters	30 min	4.5 g

Fingerprints are best photographed up to 24 hours from the moment they were developed with Lumicyano, i.e. when the fluorescence is the most intense. Evidence should not be left in places exposed to direct sunlight or high temperatures. Storing evidence in a dry and well-ventilated place ensures sufficient fluorescence for about a week. If necessary, Lumicyano can be re-used without loss of quality.

According to the information provided by the manufacturer, Lumicyano exhibits fluorescence in the 325-532 nm excitation wavelength range (detailed data are presented in Table 3).

Table 3. Fluorescence excitation ranges for Lumicyano.

Item #	Wave-length	Edge filter color	Notes
1	325 nm	dark yellow	recommended for removing background fluorescence or background noise
2	495 nm 480 nm	orange	especially recommended for white/multicolored or highly reflective surfaces
3	515 nm	orange	
4	532 nm	dark orange	
5	450 nm	pale yellow	recommended for matt white surfaces

When carrying out macroscopic examination, the selection of excitation wavelength and emission filter should be made on the basis of own observation. The legibility of traces (fingermarks) largely depends on the type of surface and the composition of deposited substance (sweat and sebum).

Author's own research

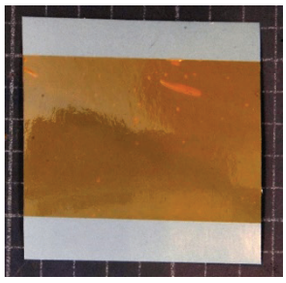
In order to verify the effectiveness of Lumicyano, it was applied onto test traces and its performance was compared against the following methods: cyanoacrylate + contrasting with Basic Yellow 40 fluorescent dye (for traces deposited onto non-porous surfaces) and cyanoacrylate + contrasting with Black Ruby dactyloscopic powder (for traces deposited onto semi-porous surfaces).

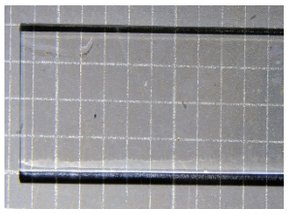
Research material

Research material consisted of fingermarks (sweat and sebum substance) deposited onto various non-porous and semi-porous surfaces listed below (fig.3–10).

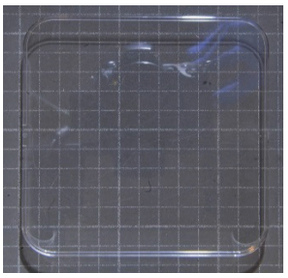
Non-porous surfaces:
- non-sticky side of brown self-adhesive tape,
- glass plate,
- aluminum foil,
- transparent plastic box,
- styrofoam, white,

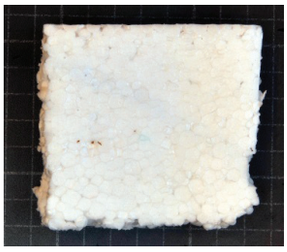
Semi-porous surfaces:
- leather-like upholstery fabric,
- Fireboard,


Non-sticky side of self-adhesive tape


Glass plate


Aluminum foil


Plastic box


Styrofoam


Leather-like fabric


Fireboard

Multicolored box

Fig. 3–10. Types of surfaces selected for the study.

– Multicolored box, smooth and shiny surface.

Preparation of samples:

Fingermarks were deposited onto the selected surfaces. Before the deposition, the donors thoroughly washed and dried their hands, and next, performed routine activities for 45 minutes.

Two donors deposited a single fingermarks (one each) onto each of the selected surfaces, using any finger, making a single contact with the surface. In this manner, 10 test traces were obtained on non-porous surfaces and 6 on semi-porous surfaces, all of which were subjected to cyanoacrylate (revealing agent) and contrasted Basic Yellow 40 or Black Ruby dactyloscopic powder, whereas an analogical number of traces were subjected to the Lumicyano-based developing method. In total, 32 test samples were obtained that were stored for a period of two days prior to the use of appropriate methods.

Due to the small quantity of Lumicyano provided by the manufacturer for testing purposes, the experiment was limited to carrying out a pilot study, without performing a full validation of Lumicyano.

Equipment and reagents.

The study involved the use of a Foster + Freeman MVC 3000 cyanoacrylate chamber, a Polilight PL500 forensic light source and a NIKON D700 camera equipped with an Af Micro-Nikkor 60 mm f/2.8 D lens and yellow, orange and red long-pass edge filters.

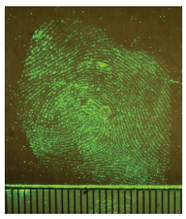
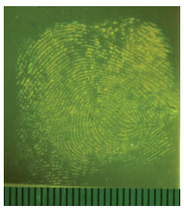
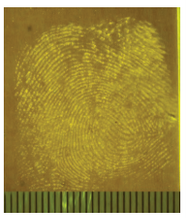
Traces were developed using a two-component Lumicyano solution from Crime Scene Technology (CST) and a "Cyanobloom" cyanoacrylate adhesive from Foster + Freeman, and contrasted with a solution of Basic Yellow 40 (Sirche) in ethyl alcohol or with Black Ruby dactyloscopic powder from Lightning Powder.

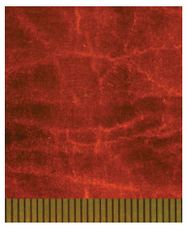
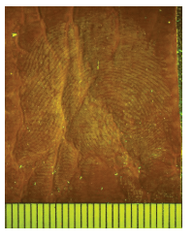
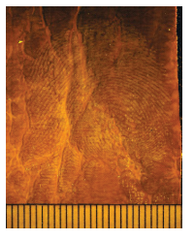
Developing test traces

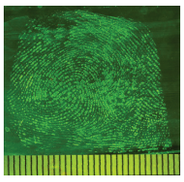
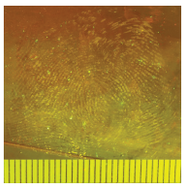
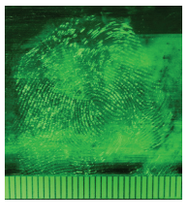
The surfaces exhibiting test traces intended to be developed by the cyanoacrylate-based method were placed in the Foster + Freeman MVC 3000 chamber, which operating parameters were set as follows: humidity 80%; heating plate temperature 120°C; vapor deposition time 5 minutes. The traces developed with Lumicyano were treated in a similar manner, with the only difference that vapor deposition time was 25 minutes (in accordance with the manufacturer's recommendation).

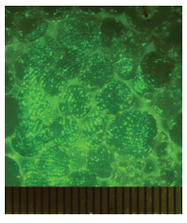
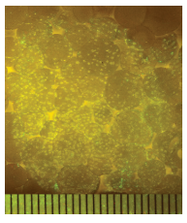
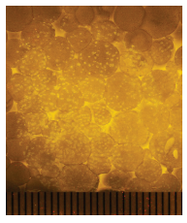
After applying cyanoacrylate, traces deposited onto non-porous surfaces were contrasted with a solution of Basic Yellow 40, whereas those applied onto semi-porous surfaces were treated with Black Ruby dactyloscopic powder. Macroscopic examination, both in the case of Basic Yellow 40 and Black Ruby, was conducted at a wavelength of 470 nm, using a yellow emission filter.

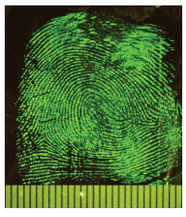
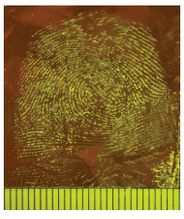
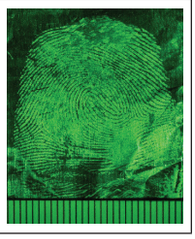
The choice of light color appropriate for macroscopic examination of Lumicyano-treated surfaces was guided by the manufacturer's recommendations as well as operating capabilities of

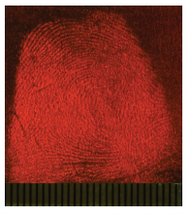
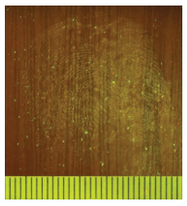
Non-sticky side of brown self-adhesive tape		
Basic Yellow 40 (470 nm, yellow filter)	Lumicyano (470 nm, yellow filter)	Lumicyano (470 nm, orange filter)
		

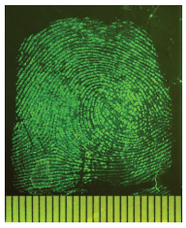
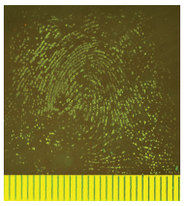
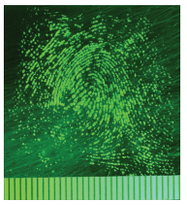
Leather-like fabric		
Black Ruby (470 nm, yellow filter)	Lumicyano (470 nm, yellow filter)	Lumicyano (505 nm, orange filter)
		

Glass plate		
Basic Yellow 40 (470 nm, yellow filter)	Lumicyano (470 nm, yellow filter)	Lumicyano (505 nm, yellow filter)
		

Styrofoam		
Basic Yellow 40 (470 nm, yellow filter)	Lumicyano (470 nm, yellow filter)	Lumicyano (505 nm, yellow filter)
		

Aluminum foil		
Basic Yellow 40 (470 nm, yellow filter)	Lumicyano (470 nm, yellow filter)	Lumicyano (505 nm, yellow filter)
		

Fireboard		
Black Ruby (470 nm, yellow filter)	Lumicyano (470 nm, yellow filter)	Lumicyano (505 nm, orange filter)
		

Plastic box		
Basic Yellow 40 (470 nm, yellow filter)	Lumicyano (470 nm, yellow filter)	Lumicyano (505 nm, yellow filter)
		

Multicolored box		
Black Ruby (470 nm, yellow filter)	Lumicyano (470 nm, yellow filter)	Lumicyano (505 nm, yellow filter)
		

Fig. 11–34. Images of revealed fingerprints.

the Polilight PL500 forensic light source held by the laboratory. Hence, macroscopic examination was conducted at wavelengths of 470 nm and 505 nm, emitted by the light source. These parameters were similar to the manufacturer's recommendations, i.e. 480 nm and 515 nm for white, multicolored and highly reflective surfaces. Yellow and orange emission filters were applied at both wavelengths used.

Figure 11÷34 shows exemplary fingermark images developed with Basic Yellow 40, Black Ruby and Lumicyano-based techniques.

After two weeks of storage, the samples treated with Lumicyano were re-evaluated by macroscopic examination. A significant loss of fluorescence was observed. Next, the samples were once again placed in the chamber, treated with the above agent and subjected to macroscopic examination. After the second treatment, an increase in fluorescence intensity was observed, without loss of quality. The exemplary images are shown in figure 35÷37.

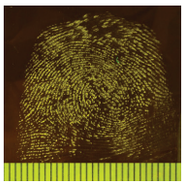
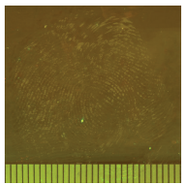
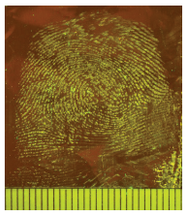
Glass plate		
trace revealed with Lumicyano, recorded directly after visualization	trace revealed with Lumicyano, recorded after two weeks of storage	trace recorded after retreatment with Lumicyano
		

Fig. 35–37. Images of fingerprints revealed with Lumicyano.

Summary and conclusions

In summary, the study results have shown that in the case of non-porous surfaces, contrasting with the solution of Basic Yellow 40 fluorescent dye ensured better quality as compared with Lumicyano treatment. In the case of semi-porous surfaces, good quality fingermarks were developed by using Lumicyano only on leather-like material. The treatment of leather-like surfaces with Black Ruby dactyloscopic powder failed to develop fingermarks. As regards the remaining semi-porous surfaces, i.e. fireboard and multicolored box made of glossy paper, contrasting with dactyloscopic powder brought better results than the use of Lumicyano.

Re-application of Lumicyano intended to enhance fluorescence intensity did not result in a loss of quality of the developed traces.

Developing fingermarks on leather and leather-like surfaces poses a major problem in visualization research. To date, none of the known and practically applied methods for revealing fingerprints on this type of surfaces have been given a positive recommendation by the experts. Lumicyano can prove a valid alternative for research methods used so far.

Source of figures and tables: authors

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