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Fingerprint Research Progress - 1993

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TECHNICAL MEMORANDUM

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NOTE: Further information about this report can be obtained by calling the CPRC information number (613) 998-6343

SUMMARY

Progress has been made in the following areas of research: (1) Development of a New Europium Based Fluorescent Dye, (2) Development of TEC for Detection of Cyanoacrylate Prints on Skin and (3) Forensic Light Source Comparison

Excellent progress has been made in the development of a new fluorescent europium dye for lipid detection. Chemical modification of TEC by the addition of two bulky molecules of a chemical called TOPO have resulted in good transfer characteristics of the dye into lipids. Fine tuning of the solvent system and adjustment of the pH have lead to the observation of good contrasting fingerprints on most paper products with the exception of cardboard. Much time has been spent on investigating techniques that reduce the quantity of fluorescent dye in the background. These methods include variation of TECTOPO concentration, predye washing with citric acid solutions and post-dye washing with methanol and water solutions. The results are encouraging but consistent and thorough removal of the background still remains illusive. The use of surfactants is currently being studied as a possible solution to the problem.

The progress on this aspect of the project has been slow. Approximately ten cadavers have become available through our collaboration with the Riverside hospital. So far we have only been able to duplicate the results we observed at the Civic (washed and cooled skin) once by super-fuming for a limited time with high concentrations of CA. We have tried several experiments designed to improve the durability of the fingerprints. None have proved successful. Currently we are looking at techniques that will confirm whether good quality prints were originally deposited and whether they absorb quickly into the upper layer of the skin's epidermis. The most promising method to date at visualising immediately deposited prints involves initial iodine fuming followed by treatment with a solution of 7,8-benzaflavone which detects the lipids present. Application of lipid detecting chemicals including TECTOPO is an exciting alternative approach that we would like to pursue.

The Polilight, Luma-Lite and Spectrum 9000 are comparable forensic light sources currently available within North America. This research involved measuring the spectral transmission and power output through the various filters of these light sources. In addition, a circle of light produced by each source was photographed to illustrate the uniformity of the beam. Each light has its advantages and disadvantages so the final choice of light source is dependant on the users requirements. As far as crime scene searches which is the primary use for the RCMP the Luma-Lite provides the largest power output and is therefore the best light in this regard.

RÉSUMÉ

Des progrès ont été réalsiés dans les domaines de recherche suivants : 1) mise au point d'un nouveau colorant fluorescent à base d'europium, 2) mise au point d'un CET pour deceler des empreintes digitales de cyanoacrylate sur la peau et 3) comparaison de sources lumineuses employees dans le domaine judiciaire.

D'importants progres ont été réalisés dans la mise au point d'un nouveau colorant fluorescent à base d'europium destine à deceler des lipides. La modification chimique du CET grace à l'addition de deux grosses molecules d'un produit chimique appelé TOPO a permis d'obtenir un bon transfert des caracteristiques du colorant dans les lipides. En perfectionnant le système de solvant et en ajustant le pH, on a pu observer des empreintes digitales bien contrastees sur la plupart des produits de papier, sauf sur le carton. On a passe beaucoup de temps à étudier des techniques visant à réduire la quantité de colorant fluorescent de fond. Ces techniques ont consisté entre autres à faire varier la concentration de CET-TOPO, à effectuer un lavage avec des solutions d'acide citrique avant l'application du colorant et à effectuer un lavage avec des solutions aqueuses de methanol après l'application du colorant. Les résultats sont encourageants, mais on n'est pas parvenu à éliminer régulièrement et completement la fluorescence de fond. On envisage actuellement d'employer des agents tensio-actifs pour résoudre ce problème.

Cet aspect du projet a progressé lentement. On a pu se procurer environ dix cadavres grace à notre collaboration avec l'hôpital Riverside. Jusqu'a present, nous avons seulement réussi à reproduire une fois les résultats observes à l'hôpital Civic (peau lavée et refroidie), grace à une forte exposition à des vapeurs de CA. Nous avons effectué en vain plusieurs experiences pour tenter d'améliorer la durabilité des empreintes digitales. Nous envisageons actuellement des techniques qui permettront de determiner avec certitude si les empreintes déposées sont de bonne qualité et si elles sont rapidement absorbées dans la couche superieure de l'épiderme. La méthode la plus prometteuse jusqu'a present pour visualiser des empreintes venant d'être déposées consiste à les exposer d'abord à des vapeurs d'iode, puis à effectuer un traitement avec une solution de 7,8-benzaflavone pour deceler la presence de lipides. Nous envisageons avec enthousiasme la possibilité d'utiliser des produits chimiques permettant de deceler les lipides, notamment le CET-TOPO.

Polilight, Luma-Lite et Spectrum 9000 sont des sources lumineuses cornparables, actuellement employees dans le domaine judiciaire en Amerique du Nord. Les travaux de recherche ont porté sur la transmission spectrale et la puissance obtenues avec les divers filtres de ces sources lumineuses. Une photographie du cercle de lumière produit par chacune de ces sources a aussi été obtenue pour illustrer l'uniformite du faisceau. Chacune de ces lampes présente des avantages et des inconvénients, si bien que le choix final depend des besoins des utilisateurs. Pour ce qui est des recherches sur la scene même du crime, qui constituent la principale utilisation dans le cas de la GRC, la lampe Luma-Lite est la plus puissante et donc la meilleure.

The research described in this report was conducted between April 1993 and March 1994. Progress has been made in the following areas of research: (1) Development of a New Europium Based Fluorescent Dye, (2) Development of TEC for Detection of Cyanoacrylate Prints on Skin and (3) Forensic Light Source Comparison

Development of a New Europium Based Fluorescent Dye

Introduction

Fingerprints deposited on porous surfaces, such as paper, cannot be detected by cyanoacrylate techniques since a film of polymer develops on the background surface. Subsequent treatment with fluorescent dyes does not produce the necessary contrast between print and background. Other chemical strategies have been developed to tackle this problem. Most of these treatments rely on a chemical reaction with the amino acids present within the fingerprint residues [I, 2]. The majority produce non-fluorescent reaction products that can be rendered fluorescent by further treatment with suitable metal ions to produce a chelation compound [3]. The preparation of a lipid sensitive fluorescent reagent would dramatically improve sensitivity since it is believed that lipids make up the majority of the fingerprint composition.

Concept

During the previous year I developed along with my colleague Dr John E. Watkin a new fluorescent dye for the visualisation of cyanoacrylate treated fingerprints [4] Extremely fluorescent europium chelates are produced by the reaction of europium trivalent cations with aryl-B-diketones. Excitation of the organic ligand occurs at 350 nm for europium tris(thenoyltrifluoroacetone) (TEC) [5] and europium narrow band (10 nm) emission is observed at 614 nm as a result of an intramolecular energy transfer. These spectral characteristics are ideal for fingerprint detection since they allow for flexible filtering of unwanted backgrounds. It is likely that TEC is transferred into the interior of the polymeric cyanoacrylate from an aqueous methyl ethyl ketone solution. A two phase system is established with methyl ethyl ketone, water and chelate outside the polymer and methyl ethyl ketone and chelate inside. As the print dries the ketone evaporates ‘locking’ the chelate inside the polycyanoacrylate.

Since TEC has spectral qualities well suited for fingerprint detection I wanted to find a system for transferring TEC into untreated fingerprints that are found on non-porous and porous surfaces. I hoped that by using different solvent combinations it would be possible to develop a two phase system similar to that which works so well for cyanoacrylate treated fingerprints.

Experiments

Fingerprints are comprised of two components in varying quantities; sweat and sebum. The mixture of sweat and sebum takes the form of an emulsion. Methods currently available for fingerprint detection on porous surfaces react with either one of two chemical groups present within this emulsion; the amino acids which are contained within the sweat of a fingerprint or the lipids which are contained within the sebum.

Do finaerorints contain more lipid than amino acid?

The ratio of sweat (water soluble) to lipid (water insoluble) in a fingerprint was determined. For my prints 60% of the residue is insoluble in water (lipid) and 40% is soluble in water (sweat). Of the sweat component only 2% of this is amino acids. Therefore the true ratio of lipid to amino acid in my prints is 60:0.8.

Findino the ideal solvent for transfer to lipids

Lipids are soluble in methanol but not water. The solubility of TEC in methanol/ water was determined since this is likely to be an ideal solvent mixture for the transfer of TEC into lipids. The solubility was observed to be 0.4g/L of TEC in 60% MeOH in water. The solubility of TEC in cooking oil, which is a mixture of tri-esters of glycerol, was also determined (1.2 g/L). The cooking oil acts as an artificial fingerprint and by observing the fluorescence brightness of this solution an idea of the maximum 'print ' brightness possible for TEC dissolved in 'lipid' is obtained. The resulting 'print' was extremely bright.

Determinina the spectral oarameters for TEC and NEC in MeOH

The molar absorbance of TEC in methanol was found to be 40,000. The molar absorbance of the related naphthyl-chelate was also measured in methanol (74,000) which is significantly higher than TEC.

The quantum yield of a compound provides information on the efficiency of the photochemical process. It is a measure of the proportion of light absorbed by the compound that is re-emitted. It would be valuable to know the relative quantum yields of TEC and NEC (naphthyl-derivative), to determine if there is an obvious advantage in choosing one over the other for a lipid reagent. The quantum yield for TEC is reported in the literature as 0.19 in 95% ethanol, I determined the quantum yield of NEC to be 0.25 in 95% ethanol using a comparative method.

To detect prints on paper it is essential to have the most efficient dye possible, NEC based on its spectral parameters would appear to be a better dye than TEC.

Observing the transfer of TEC and NEC into latents on foil

Greasy prints (fingers wiped across forehead) deposited on foil were immersed in the TEC methanol/ water solution to observe the transfer of TEC into

lipids. Fingerprints were visualised on foil but when normal prints were deposited the images were extremely faint. An improvement in the brightness of fluorescence on normal prints was observed when NEC was used. However, the contrast is still two weak for the technique to work on paper.

Observing the transfer of TECTOPO and NECTOPO into latents

TEC has two co-ordination sites occupied by water molecules which quench some of the europium fluorescence. Replacing these water molecules with organic synergetic reagents will lower the solubility of TEC in the aqueous solution and force more TEC to transfer into the lipid.

The two water molecules in TEC and NEC where replaced by tri-n-octyl phosphine producing two compounds which will be referred to as TECTOPO and NECTOPO, respectively. Experiments with these two compounds showed significant improvement in fluorescence output for normal prints on foil. The more bulky compounds are significantly less soluble in methanol and water. The solubility of the extremely bulky NECTOPO was a major problem so efforts were again focused on TECTOPO.

Destruction of TECTOPO in the backaround paper

The next stage for the lipid project is to destroy the fluorescent background that is observed when these materials are used on paper. Several strategies were identified as possible solutions to this next step but only one showed encouraging results. Replacement of the ligand within the fluorescent TEC (only in the background material) with another chelating ligand that does not form a fluorescent compound such as citric acid. A predye soak in 1% citric acid significantly reduced the background fluorescence but caused some deterioration of ridge quality.

Removal of TECTOPO from the backaround paper

A post-dye soak of the paper sample in 80% methanol in water reduced the amount of TECTOPO in the background without any degradation of the ridge detail.

Reduction of TECTOPO concentration to reduce backaround

The ideal concentration of TECTOPO in methanol/ water required to develop prints on paper was determined in the hope that reducing the dye concentration will result in print visualisation whilst reducing background fluorescence. The weakest solution developed the prints with the best contrast since there was no background fluorescence.

Determination of a Workino Solution

An experiment to observe the effect of varying the TECTOPO concentration on the transfer of the fluor into lipid prints deposited onto Xerox paper was completed. A 0.10 g/l solution containing 70% MeOH gave the brightest best contrasting prints in the 10 second time frame. However, 0.05 g/l solution visualised prints and produced the lowest background fluorescence. When the dipping time was increased to 1 minute the best contrasting prints were consistently observed for the 0.05 g/l solution.

Decreasing the MeOH % to 60% further enhances print visualisation by concentrating the TECTOPO into a smaller volume.

Effect of PH variation on Transfer of TECTOPO

A final experiment to observe the effect of pH clearly showed that solution fluorescence increases dramatically with pH = 8 but transfer into the lipids is significantly reduced. The preferred formulation to date requires O.O5g/l TECTOPO in 60% MeOH at pH = 4. Unbuffered solution naturally has a pH of 4 addition of a buffer may help maintain the life of the solution by keeping the pH always close to 4.

Discussion

A working system has been successfully developed that is capable of visualising fingerprints on paper. The fingerprints all show excellent continuous ridge detail that is brightly fluorescent. The current recommended solution contains 0.05 g/l TECTOPO in 60% MeOH with a pH of 4 (buffered with tris and trizma when required). Two drawbacks with this technique at present are that most inks will run as a consequence of the solvents used and that the solutions have only been tested on fresh prints.

Future Research

1 Future research still needs to focus on improving the contrast by reducing the background fluorescence before the system is ready for comparison studies with Physical Developer. One possible strategy is the use of surfactants to solubilise the TECTOPO without interfering with its transfer abilities.

2 Work needs to be done to determine if TECTOPO treatment can be used sequentially after ninhydrin or DFO. Also older samples need to be tested to confirm that the solution does not just work on freshly deposited prints.

3 Immediate testing of this system on fingerprints deposited on non-porous surfaces should proceed since this system could potentially negate the need for CA fuming as a step in fingerprint visualisation.

4 Finally a series of comparison tests of TECTOPO to all the current fingerprint treatments available for porous surfaces.

Development of TEC for Detection of Cyanoacrylate Prints on Skin

Introduction

Several case work examples exist in North America where fingerprints were successfully recovered from the skin of a murder victim and identified to a suspect. In four out of the six cases the identifiable print was observed from a lifted impression. In the Spa murders [6] and the Palm Beach murder [7] the lifted impression was obtained by pressing frosted tape against the powdered print and then mounting the tape against a background to provide contrast with the powder. In the Chilliwack [8] and OPP [9] cases the skin was exposed to iodine fumes which revealed the lipids of the fingerprint. An image was obtained by pressing a freshly cleaned silver plate onto the iodine treated print which results in a darkening of the plate as silver iodide forms. The quality with which prints can be recovered by lifting depends upon the pressure applied to the print during the lift. If the pressure is too great the ridge detail of the fingerprint will be obliterated and if the pressure is too weak then not all the detail will be transferred. Three of the cases relied on the application of powder to the skin. This is an extremely unreliable method since the possibilities of background skin attracting the powder to result in loss of ridge detail is too great. The final method depends on blood contamination of the print which does not occur in the majority of murder scenarios obviously when it does occur it is of great importance.

Concept

Development of prints by cyanoacrylate and then subsequent visualisation of the CA with TEC. The belief that TEC is transferred into the polymeric CA will mean that TEC in the background skin can be more effectively washed away than other cyanoacrylate fluorescent dyes currently available. Use of a fluorescent technique allows total removal of the background skin pattern that sometimes interferes with ridge detail on magna powdered prints.

This theory has already been proven when applied to prints on post-autopsy cadavers where the skin has been washed and has cooled. It now remains to test the theory on unwashed skin that is close to body temperature. A collaboration with the Riverside Hospital that took several months to instigate allows us access to such cadavers albeit in limited numbers.

Experiments

Development of better wash solutions

April 6th, a female cadaver. Nurses prints had been deposited 1 hr 15 min. after death (good quality witness prints could be seen on foil). The external skin temperature was measured from 29.6 C down to 25.3 C. Fingerprints were

deposited during this cooling process. After CA fuming, treatment with TEC revealed only partial ridge detail on one of our prints and possible ridge detail on one of the nurses prints. It was very difficult to clear TEC from the background skin.

Alternative wash solutions were investigated. The most promising is an aqueous solution of citric acid buffer which clears TEC very quickly from live skin. Citric acid is capable of chelating with the europium metal in much the same way as the thenoyl ligand in TEC. However, the product when citric acid forms a chelate with europium is not fluorescent. Since TEC is safe within the polymeric CA in the print washing with an aqueous solution of citric acid should destroy the fluorescent chelate in the background without effecting the print fluorescence.

"Pre-washing" reason for previous success?

April 23rd, a male cadaver. Nurses prints had been deposited 1 hr after death (good quality witness prints could be seen on foil). One leg was washed with water and the other was left untreated. Prints were deposited during the cooling process. After CA fuming, treatment with TEC revealed excellent ridge detail only on the washed leg. Only the shape of the nurses print could be observed and it was impossible to clear TEC from the background skin of the unwashed leg. Washing with an alcohol solution of citric acid buffer at pH 4 proved to be very good at clearing TEC from the washed leg which indicated that background CA has formed on the untreated leg. This implies that our previous successes at the Civic Hospital were because the skin had been washed with water after autopsy which meant background CA did not develop.

Forced cooling as a method to protect print

Early June, a male cadaver. Greasy prints were deposited onto the skin at normal body temperatures. The cadaver was then moved into the morgue cooler and allowed to reach room temperature (approx. 16 C). After removing the cadaver from the cooler the skin surface on one leg was washed with water and left to dry in a stream of room temperature air. The body was fumed with cyanoacrylate and any prints visualised with TEC. Prints were observed on the unwashed leg only along with a spotty background of cyanoacrylate which is likely to result from the sweat pores of the skin.

Need for greasy print deposition

July 4th, a female cadaver. The procedure described in step 3 was repeated but no print detail was recovered. One major concern at this stage was, are prints of good enough quality being deposited? Can the spotty background CA pattern be removed without destroying the print?

Deposition of greasy prints

Monday 6th December, a female cadaver. Greasy prints were deposited on the legs and right arm of the cadaver. The left leg was exposed to cyanoacrylate immediately (skin temperature 30 degrees C) for a period of one hour. No ridge detail was observed under room lighting. After visualisation with TEC very faint prints could be observed but the build up of CA appeared very weak. The second leg was fumed when the skin temperature was close to room temperature. Again fuming lasted for approximately one hour but two applications of glue were made. After visualisation with TEC ridge detail was apparent but still the amount of CA on the print was low.

The fingerprints deposited on the arm were treated with TECTOPO solutions in methanol and water. Only one print was revealed using TECTOPO (0.1 g/l 70% MeOH) but the ridge detail was extremely good. The remaining prints were swamped with background dye. For both the lipid and the CA-treated prints removal of background dye was a serious problem.

Recovery of prints using Magna Powder

Sunday 23rd January, a female cadaver. Greasy prints were placed on the legs of the cadaver. Fingerprints deposited on the soft flesh of the thighs were irretrievable using the magna brush so it was concluded that detectable prints were not being deposited on this region. Fingerprints deposited on the bony regions could be visualised using the magna brush but the quality deteriorated over a 30 minute period. This appeared to support the theory that the fingerprints are absorbing into the skin over time making them impossible to detect using either magna brush or CA.

One leg was vigorously washed with water to remove the skin surface lipids and sweat. When both legs were fumed prints were visible on both legs but more were recovered from the washed leg. We now began to focus on the recovery of fresh prints that we know have been deposited in an identifiable form.

Superfuming of recoverable prints

Tuesday 15th February, a male cadaver. Fresh greasy prints were deposited in clusters onto the ankle and shin. Immediate detection with magna powder of one of the prints revealed ridge detail which indicated that the prints had been deposited in a recoverable manner. Application of cyanoacrylate by pouring the glue onto pads of sodium hydroxide saturated cotton wool did develop some prints but the cyanoacrylate was extremely thin and did not hold the magna powder well. In fact the background skin where CA had developed showed only a faint build-up of powder which was in contrast to the surrounding skin which attracted a lot of powder.

'Superfuming' of the other leg involved construction of a small "tent" around the shin and foot. The heater was heated to approximately 400 C before the glue

was deposited into the dish. Fuming began immediately and was extremely heavy. After approximately four minutes the bag was removed. Several prints had developed and could be observed after visualisation with TEC. Dye in the background skin was easily removed by 75% Methanol, 15% water and 10% surfactant suggesting that build-up of CA on the background was not a problem.

Recovery of orints bv Iodine and 7.8-benzaflavone

Sunday 6th March, a female cadaver. Fresh greasy prints were deposited in clusters on the thigh, shin and foot. Immediate recovery with magna powder resulted in no ridge detail from prints on the thigh. However when a similar cluster was visualised with iodine fuming followed by treatment with a solution of 7,8-benzaflavone excellent ridge detail was observed. Prints were recovered after 45 min. on the foot using this technique which was far superior than magna powder.

Discussion

Significant progress has been made in this project considering the limited availability of experimental cadavers. For CA fuming the best quality and quantity of fingerprints were recovered by the superfuming approach. The ideal TEC solution contains 1 .0 g/l of TEC in 20% MEK in water. The most effective wash solutions appear to be 80% MeOH in water containing 1% citric acid and 75% MeOH in water containing 10% surfactant.

However, in contrast to the poor results observed in the laboratory for detecting fingerprints on paper with iodine and 7,9-benzaflavone, this technique produced excellent ridge detail and has the advantage over CA/ TEC of being quick and simple.

Future Research

1 At present I feel that the iodine and 7,8-benzaflavone approach offers the most potential for reliable detection of fingerprints on skin.

2 The recent introduction of a fuming wand by 3M would significantly simplify the CA fuming process and needs to be thoroughly tested on skin before the CA/ TEC process is rejected in favour of the lipid detecting methods.

3 The most recent working solution from the lipid research deserves testing on skin since if successful this would remove the need for CA fuming completely and would result in a simple one step procedure to produce fluorescent prints.

Forensic Light Source Comparison

Introduction

The light source comparison involves several factors: the range of wavelengths available through the choice of filters; the total power output passing through each filter; the quality of filter blocking outside the wavelength range; the uniformity of the beam; and the ease of use.

Experiments

Spectral Output

The emission monochromator of an SLM 8000C spectrofluorimeter was used to measure the spectral output of each filter. The beam of light was focused through a pinhole onto the input lens of a double monochromator coupled to a photon counter.

Power Measurement

The power output of the forensic light sources in all possible modes of operation was recorded using a Scientech 3610 power meter which has a linear response from the ultraviolet (UV) far into the infrared (IR). These measurements were corrected for excess IR output.

Uniformity of the beam is important, when photographing a weak print, since the areas where the “hot spots” of light do not fall may be lost by the camera. The image of a 5 cm diameter circle of light formed by the beam intersecting with a piece of paper positioned vertically in front of the light source was photographed using automatic exposure.

Results

Ultraviolet

The Polilight produces 0.16 watts (W) of power in a 32 nm band centred at 356 nm (labelled 350 nm). The Spectrum 9000 ultraviolet band labelled 400 nm produces a 20 nm band centred at 400 nm with 1.24 W of power in a wavelength range that borders on the UV and visible. The Luma-Lite produces negligible power in the UV (0.08 W in a band centred at 365 nm) which is expected since there is very little UV generated by the source.

Blue Lioht

The Luma-Lite uses a very wide band filter (72 nm) that results in a lot of power in this band (12 W) with some in the near UV and violet. The Spectrum 9000 uses a 60 nm band filter that produces almost 3 W at the end of the fibre optic light guide with some violet but no UV. This filter is labelled as 530 nm which would fall in the green but the peak occurs at 474 nm and only 0.1% of the light is transmitted

at 530 nm. The Polilight produces a 56 nm band containing 0.56 W at the end of a 2 metre liquid guide.

Green/ Yellow Liaht

In this area the Polilight offers three filters with peaks at 530, 555 and 590 nm, the Luma-Lite has two filters at 530 and 570 nm, and the Spectrum 9000 has one filter at 570 nm. The Spectrum 9000 and the Luma-lite have the highest power output in the green of 0.8 W compared to an average of 0.4 W for the filters of the Polilight. All lamps appear to have sharp well blocked filters in this region.

Red and Infrared Liaht

The Polilight has two filters in the red at 620 and 650 nm which makes it the only light source to provide output in the red. Only the Polilight and the Spectrum 9000 have filters for the infrared. The Polilight allows infrared above 700 nm to pass (see Figure la) and has a total output power of 0.35 W. The Spectrum 9000 when used with the liquid light guide passes infrared above 676 nm and has an output power of 7.7 W.

Tuning

The Polilight provides a mechanical means of tilting each filter providing a short range of variation of each filter. It works well but at the expense of reducing the power by about 50% at the maximum tuning. The Spectrum 9000 has a non-tuneable filter output (discrete setting) and a continuously variable grating output (variable setting) both using the same lamp. Unfortunately the optics are such that the power output in the variable mode is negligible even at maximum bandwidth of 100 nm. The Luma-Lite can not be tuned.

Qualitv of Filters

This can be quantitatively judged by the difference in nanometres from the wavelength position of the 50% maximum cut-off point to the 0.1% cut-off point which measures the effectiveness of the filter. For the broadband filters used to achieve high power in the blue range such as the 450 nm filter of the Luma-Lite and 530 nm filter of the Spectrum 9000 this difference can be as high as 28 and 24 nm respectively. This is not a problem if sufficient print fluorescence can be observed beyond this point. For most of the remaining narrow band filters it is about 10 nm which shows the attention all manufacturers have paid to this feature.

Uniformitv of Beam

The best uniformity is shown by the direct beam of the Luma-Lite. Reasonable uniformity but with a more intense central area is observed for the Polilight through a liquid light guide and the filter wheel system of the Spectrum 9000 through its fibre optic guide. Very irregular spatial distributions of light can be produced by the liquid guides transmitting the output of the infrared port of the grating and filter wheel systems of the Spectrum 9000 and the Polilight. This irregularity is emphasised if the guides are bent sharply.

Ease of Use

At the crime scene, the Luma-Lite will provide the brightest light, with a uniform cross-section. Usually, crime scenes are searched with the direct output through the filters which necessitates carrying a relatively heavy instrument around the scene. The Polilight and Spectrum 9000, on the other hand, are usually used with either a liquid light guide or fibre optic cable. The machine can be set down in one location, and the wand on the end of the cable used to direct the light around the scene.

If wavelengths are to be changed, both the Polilight and Spectrum 9000 can do so by simply turning a dial on the front panel of the lamp. The Luma-Lite requires physically removing each filter that has to be replaced.

Conclusion

The choice of lamp will generally depend on the intended use. For crime scene searches power will be a major consideration and from these measurements the Luma-Lite provides greatest power in the wavelengths most useful for this purpose. For laboratory examinations, and use in other disciplines such as examination of questioned documents, the Polilight may offer the best combination of filters and tuneability.

Both the Polilight and the Spectrum 9000 produce UV and IR emission, although the latter has significantly increased power output in these regions compared to the former. The Luma-Lite does not produce significant output in either of these regions of the spectrum.

Publications

A paper entitled “A Comparison of Thenoyl Europium Chelate with Ardrox and Rhodamine 6G for the Fluorescent Detection of Cyanoacrylate Prints” is under review for publication in the Journal of Forensic Identification.

A paper entitled “Cyanoacrylate Fuming of Latent Prints-Vacuum Versus Heat & Humidity” is under review for publication in the Journal of Forensic Identification.

A paper entitled “A Comparison of the Forensic Light Sources: Polilight, Luma-Lite and Spectrum 9000” has been submitted to the Journal of Forensic Identification for publication.

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