



## **Scientific Development Branch**

**Investigation, Enforcement and  
Protection Sector**

**Fingerprint Development and  
Imaging Newsletter**

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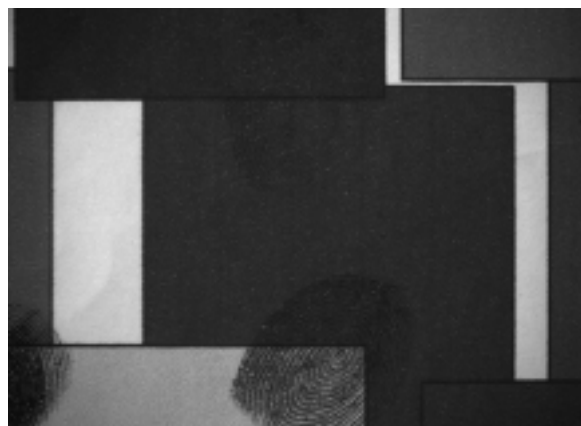
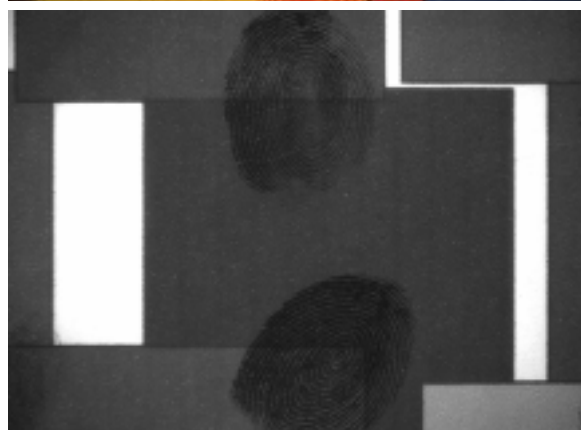
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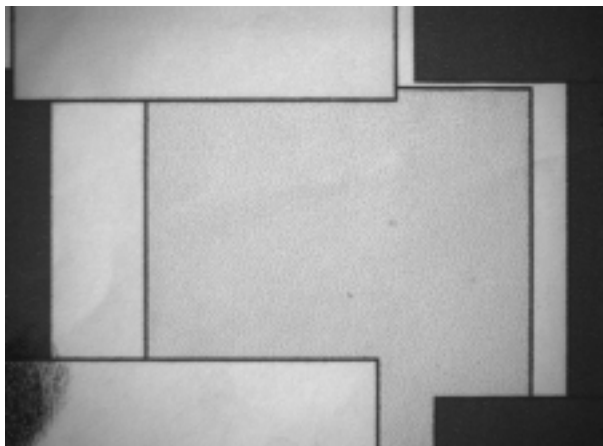
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## **Summary Reports of Recent Studies: Imaging Multispectral Imaging**

As part of the ongoing HOSDB programme to investigate developments in Fingerprint Imaging technology, the group has recently purchased a multispectral imaging system incorporating a liquid crystal tuneable filter. The filter can be electronically tuned to the wavelength of choice and has a very narrow (7nm) imaging bandwidth, enabling very subtle spectral differences to be resolved.

In the normal operating mode, the filter can be progressively tuned to obtain a series of images of the same sample over a range of wavelengths to form an 'image cube'. Images taken of the same sample at 480, 580 and 680 nm are shown here, below the original image.



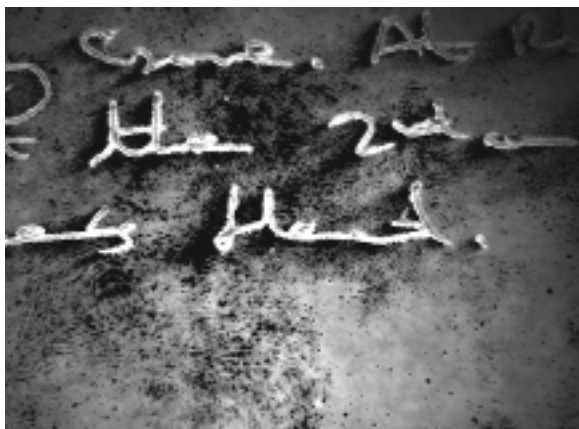


*Original plus images taken at 480, 580 and 680nm*

One area where it is envisaged that the multispectral imaging system will have potential applications is in resolving fingerprints on surfaces where there is high background fluorescence. There is the potential to separate out the spectrum of the pure fluorescence from that of the background fluorescence and hence locate some of the faintest fingerprints. An example of a faint DFO mark resolved against a highly fluorescing background is shown below.



*Original DFO development*



*Faint DFO mark resolved against the highly fluorescent background*

Another area where the system will be particularly useful is in resolving fingerprints from non-uniform, coloured backgrounds. In these cases the colour differences between fingerprint and background may be too subtle to be resolved using a monochromator and Fast Fourier Transform-based tools cannot be used because there is no regular pattern to remove. An example of a ninhydrin mark being extracted from the cluttered background of a £10 note is illustrated in the figures below.



*Ninhydrin mark developed on a £10 note*



*Ninhydrin mark revealed*

Although we are still evaluating the potential of the system, we are already convinced that it will be a valuable tool in obtaining additional fingerprint identifications. If any force would like to evaluate the system, or has any casework that they feel would benefit from this type of analysis please contact us.

### **Photocopying of Ninhydrin Marks**

In recent years, a number of police force fingerprint laboratories have used colour photocopiers to image ninhydrin-developed fingerprints. This offers advantages over

photography as articles can be imaged rapidly and large areas of ridge detail such as palm prints and fingerprint sequences can be captured at relatively low cost.

HOSDB's current recommendation is that fingerprints developed with ninhydrin should be photographed. However, we were unaware of any study that directly compared the results of photocopying and photography. The Fingerprint Development and Imaging User Group requested that such a study was carried out and also that we evaluated different photocopiers to identify whether there are any significant differences between photocopiers used for this purpose.

To compare the two methods of imaging a trial was conducted at a local force. In the trial a number of ninhydrin prints that had been marked up as 'identifiable' were imaged using a Canon 1180 colour photocopier and a digital capture system. Copies were made with the photocopier using two different settings: one standard setting and one with an increased level of magenta. The digital capture system was used in conjunction with a green filter to enhance the contrast of the mark.

Experimental results indicated the use of a digital capture system with a green filter was almost twice as effective as colour copying in the capture of identifiable marks. Increasing the magenta setting on the photocopier resulted in more identifiable marks being produced than using the standard setting.

To compare different models of colour photocopiers test cards were sent to various manufacturers, who were asked to return copies made using the standard and increased magenta setting. It could be seen from the copies returned that the different models produced different colours and different tonal ranges, which are thought to arise from differences in software and inks used.

Having carried out this work we would recommend the following practices for photocopying of fingerprints:

- If photocopiers are to be used to capture ninhydrin developed marks, copies should be carefully examined to ensure they have faithfully captured all fingerprints, in particular if the developed mark is faint.
- If faint marks have not been captured, the fingerprint should be imaged again using a

camera and appropriate green filter, as recommended in the Manual of Fingerprint Development Techniques.

- Although increasing the magenta level on Canon photocopiers appears to be beneficial, this may not be the case when fingerprint and background are of a similar dark tone. It is therefore suggested that in these cases a copy is produced without increasing the magenta level.
- If forces are changing make or model of photocopier, it is recommended that a comparative test is used to compare the performance of the replacement copier to ensure the performance is at least as good as the current one.

If as a result of this article you have any questions or comments please contact Andrew Gibson.

### **Summary Reports of Recent Studies: Development Techniques**

#### **- Development techniques for 'Sainsbury's' Greaseproof Paper**

HOSDB recently received an enquiry from the chemical treatment laboratory at Humberside Police regarding 'Sainsbury's' own brand greaseproof paper. This is being used as drugs wraps by some criminals in the Humberside area and the laboratory have yet to find a technique that is successful in developing marks on it, both on operational work and on test samples in a laboratory. Techniques used by Humberside included Ninhydrin, Physical Developer and Superglue/BY40.

HOSDB carried out a short study to confirm the findings of the Humberside laboratory, and to investigate alternative techniques that might yield positive results.

Two different types of greaseproof paper were obtained:

- Sainsbury's non-stick greaseproof baking paper (the product tested by Humberside)
- Royal Markets greaseproof paper roll

The Royal Market's product is a 'conventional' greaseproof paper, being white and translucent. The Sainsbury's product seems thicker than a conventional greaseproof paper, is brown in colour, and seems to have a smoother surface. It is also translucent.



Depletion series of 10 prints were deposited by five donors onto sheets of both types of paper. The sheets were left for 2-3 days prior to processing. The following development techniques were investigated:

DFO

Black Powder Suspension

Ninhydrin

Superglue/BY40

Vacuum Metal Deposition

DFO and Ninhydrin were used as sequential processes on the same sheet of paper. After development, the sheets of paper were re-examined and an assessment made about the effectiveness of the technique.

The results of the tests are summarised in the table below.

Process	Effectiveness	
	Sainsbury's	Royal Markets
DFO	Poor (no development)	Fair (2-3 marks from 2 donors)
Ninhydrin	Poor (no development)	Fair (2-3 marks from 2 donors)
Black Powder Suspension	Good (>50% of marks developed)	Poor (no development)
Superglue/BY40	Poor (faint 'reverse development')	Poor (no development – background stained)
Vacuum Metal Deposition	Poor (no development)	Good (>50% of marks developed)

It was seen that the only technique to produce results on the Sainsbury's greaseproof paper was Black Powder Suspension.

Imaging of the developed marks was improved by placing white paper behind the greaseproof paper to improve contrast. The paper seems more like a non-porous substrate than a porous one, but the normal processes recommended for non-porous surfaces (VMD and superglue) do not work.



*Development on 'Sainsbury's' greaseproof paper with Black Powder Suspension*

The best technique for the standard greaseproof paper was VMD, developing 10 times as many marks as either DFO or Ninhydrin.

The Sainsbury's non-stick greaseproof baking paper does cause problems for fingerprint development techniques. If this product is encountered, the only technique that can currently be recommended is Black Powder Suspension.

In this limited study, VMD was found to be far more effective than DFO and Ninhydrin for development of marks on 'normal' greaseproof paper. This may mean that VMD should be considered as a possible treatment technique for this type of material – further work may be required in this area.

#### **- Fingerprint Development on Car Surfaces Treated with WD40**

Thames Valley Police reported that a gang of thieves was spraying the cars they dumped with WD40. It was thought this was done to prevent the police from recovering fingerprints.

A small experiment was carried out, comparing three techniques: Solvent Black 3, SPR and Black Powder Suspension (BPS) on simulated car body panels. Fingerprints were laid on A4 panels of steel painted and prepared by a car body shop to simulate car body surfaces and then treated with WD40 before applying the development treatments.

Solvent Black 3 and SPR developed little ridge detail, mostly coating the whole panel as they stain the WD40. BPS, however, appears not to adhere to the WD40 and fingerprints were developed from two of the ten donors.



*No fingerprint development with Solvent Black 3*



*One of only a few fingerprints developed with SPR*



*Fingerprint Development with BPS*

We therefore recommend BPS as a treatment if this scenario is encountered.

### **Stability of PD Solutions**

Synperonic N, one of the co-detergents in the Physical Developer (PD) formulation is being phased out because of its negative environmental impact.

Whilst conducting work to find an alternative, we have found that the temperature recommendations in the Manual of Fingerprint Development Techniques (MoFDT) are critical to the stability and effectiveness of the solution.

Neither the distilled water, used for making up the PD, nor the made up PD working-solution must be allowed to fall below 17°C otherwise the solution becomes unstable and the detergents begin to cloud the solution. This in turn leads to silver being precipitated, making the solution much less effective.

Additionally we have had a contaminated batch of Ammonium Iron II Sulphate, which

did not dissolve completely. Do not use if the Physical Developer working solution does not appear to be clear.

### **Operational Performance of Nd:YAG Green (532nm) Laser**

In previous newsletters we have reported on the success of a 5W, 532nm frequency doubled Nd:YAG laser for fluorescence examination. Laboratory studies have shown that the laser detected marks that were missed by alternative high-intensity light sources. In addition, subsequent treatment with commonly used fingerprint development processes failed to develop some of the marks detected by the laser. This is likely to be due to fluorescence examination detecting fluorescent contaminants, whilst other fingerprint development processes target sebaceous and eccrine bodily sweat which is non- fluorescent.

Thames Valley Police kindly offered to run an operational trial over the Christmas period. They examined exhibits with the 532nm laser after their normal initial fluorescence examination procedure. The results are presented in Table 1 for a total of seventy cases. It can clearly be seen that there is a five-fold increase in the number of marks found with the laser compared to the Quaser using multiple band-pass filters.

Results from TVP	Total number of marks found	
	Quaser	Laser
Untreated	10	52
DFO	70	77

*Table 1: Trial results from Thames Valley Police*

Light of single wavelength, at 532nm is ideal for viewing DFO fluorescence for three reasons. Firstly, 532nm is close to the absorption peak of DFO. Secondly, the viewing filter transmission can be very close to the laser wavelength and still obey the safe selection rule. Thirdly, the absence of light at wavelengths shorter than 532nm means that background fluorescence, often induced by blue light, is significantly reduced – this is also an important point for initial examination.

Some of the exhibits from the seventy cases were treated with DFO and viewed using appropriate Quaser excitation filters. Our interest was to see if this laser would find

additional marks: the results in Table 1 show that 10% extra marks were detected.

For both initial fluorescence and DFO examination the operators found the marks easier to find with the laser, the mark was generally brighter and the background darker, meaning that marks are less likely to be missed than with the Quaser. This was consistent with our findings in our laboratory trial where a mark could be missed with the Quaser, but found with the laser. Once found with the laser, a subsequent Quaser examination enabled some weak marks to be seen and photographed but it was not always possible to see the same amount of detail. These very weakly fluorescing marks would have been missed without the use of the laser.

Over the past year the laser has been used by ten forces for initial fluorescence examination for serious crimes. This has been either at scenes or on exhibits brought to HOSDB for examination. In most cases marks were found in addition to those found with other high intensity light sources.

HOSDB is encouraging the use of such systems for use in the laboratory and at scenes where other light sources may be used currently. It must be emphasised, however, that the laser will miss marks which can be detected at other wavelengths and is therefore not a replacement for other systems such as the Quaser. Unfortunately there is not one wavelength that finds all!

There will soon be three manufacturers selling 532nm lasers to the forensic market. If you are interested in finding out more detail please contact us. In addition, we have recently purchased a second 532nm laser which is available for you to trial should you be considering purchasing such a system. We will continue to offer support to serious crime.

### **Last Call for IRIS Manufacture at HOSDB**

By the time this Newsletter reaches you, twenty three IRIS systems will have been manufactured by HOSDB, fifteen of these being produced in the last thirty months. We are, of course, delighted with the increased interest and orders for IRIS. However, it has not been our intention to continue to accommodate the manufacture at our workshops indefinitely and we have now taken the decision to transfer the manufacture

and marketing of IRIS to a third party. In order to enable a phased transition to take place we would like to issue a final call for IRIS systems to be manufactured by HOSDB.

Any force requiring an IRIS system for delivery by the end of FY06/07 (i.e. before 31<sup>st</sup> March 2007) should contact us as soon as possible and by 30 November 2006 at the latest, so that we can ensure purchase of sufficient components and can plan workshop time accordingly. After this date, our plan is for the existing IRIS design to be discontinued and a third party engaged to offer a modified system, which will take account of future user requirements.

Similarly, the support of the IRIS systems currently in service will be transferred over the coming financial year to a third party supplier familiar with the technology and software. HOSDB will continue to provide the initial year of support for all systems recently supplied.

This does not mean that HOSDB will stop IRIS Imager software development. The software developed during the programme has wider applications than control of the camera in the IRIS workstation and research will continue to develop a system for controlling UV-sensitive cameras for real-time UV imaging, and interfacing with larger area capture cameras for footwear imaging. The possibility of a version of the software for use on laptops at scenes of crime is also being explored.

### **Document Examination**

Following recent discussions with experts in document examination, we would like to publish a reminder regarding the preferred sequence for evaluation of fingerprint and other forensic evidence from documents. The information is published in the Manual of Fingerprint Development Techniques under the relevant chapters.

It is important that

- ESDA examinations at >75%RH
- Ink comparisons and
- Paper examinations

are carried out before fingerprint development whenever possible.

Handwriting examinations can be carried out after fingerprint development but they may be less effective as

- Inks are likely to run during treatment
- Handwriting may be obscured following heavy use of chemicals

It is also important to remember that labels identifying developed fingerprints should be applied carefully to avoid covering handwriting

### **Programme Update**

Support and advice given to police forces continues to form a major part of the work of the team: last year we fielded approaching 400 enquiries by phone or e-mail and made contact with almost all forces by some means.

Advice regarding laboratory designs has continued and specific information concerned with aspects of laboratory or scene techniques have formed a significant part of this effort. In addition, we have been increasingly involved in casework over the last year. This has largely originated from our ability to support forces with specialist equipment, such as VMD or the portable Nd:YAG lasers which forces may not have at their disposal.

We have also been called upon with regard to specific specialist knowledge, which now includes a wider understanding of fingerprint recovery from arson scenes (see **Recent Publications**, below). Information in the Arson Newsletter has already been put into practice with Bedfordshire and Essex Scientific Support units.

Looking to the programme for 2006/7, development of best practice for the use of powders on textured surfaces and evaluation of lifting media will continue. Further work on the application of powder suspensions on a variety of surfaces is planned.

Other projects include the development of a technique for the evaluation of high intensity light source applications and setting of standards for the digital capture of fingerprints and footwear. The study of fingerprint and DNA recovery from CBRN incidents continues to make good progress with the development of a simple imaging set-up using components of the IRIS system.



The introduction of footwear development techniques into the programme has resulted from a request by ACC Mick Creedon, who is taking the ACPO lead on the use of footwear impressions by forces.

### Recent Publications

Over the last year, we have distributed a number of publications in addition to the regular Newsletters.



The year started with the revised edition of the Fingerprint Development Handbook, which has been sent out to all forces.

Following the Part I study completed last year (Publication No. 54/04, August 2004), Part II of the Powders Special Edition series of newsletters was published in February (Publication No. 08/06).

Based on the results of the trial, recommendations were given for the most suitable powders to use on a variety of smooth surfaces:

- Scene examiners must receive appropriate training and maintain good application techniques when applying powders. This is likely to be as important as powder selection for some smooth surfaces.
- Glass should be powdered with aluminium powder unless contamination prohibits its use.
- Magnetic powders should be used on surfaces that are not perfectly smooth.

In March, additional fingerprint development techniques for adhesive surfaces were published in Publication No. 23/06. This newsletter included practical information for

the use of Black and White Powder Suspensions and Basic Violet 3. As already mentioned, further work is planned for the wider application of the powder suspensions in this year's programme of work.

Just about to go to press is a best practice guide for the recovery of fingerprints from arson scenes (Publication 26/06). This is the culmination of a number of studies conducted at HOSDB in collaboration with Gardiner Associates Ltd. and with help from students from Strathclyde University. It includes guidance on soot removal as well as advice on best sequences of development techniques to use on different surfaces.

We endeavour to target these publications to the right people but we are aware that this is not always effective, especially if multiple copies are needed. We can provide additional copies if necessary or the website ([www.hosdb.homeoffice.gov.uk](http://www.hosdb.homeoffice.gov.uk)) can be accessed to download pdf versions of all of the latest publications.

Please let us know if you have difficulty accessing the information you or your colleagues need.

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