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## COMMON CHEMICAL TECHNIQUES USED FOR LATENT FINGERPRINT DETECTION

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### TECHNICAL MEMORANDUM

Submitted by  
Canadian Police Research Centre

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## **EXECUTIVE SUMMARY**

This bulletin provides a comprehensive summary of current recipes for commonly used chemical processes in latent fingerprint detection.

## **SOMMAIRE**

Ce bulletin fournit un sommaire global des recettes de solutions chimiques utilisées couramment pour révéler des empreintes digitales latentes.

Ce bulletin est aussi disponible en français.

The Canadian Police Research Centre is grateful to Dr. Delia Wilkinson and the Royal Canadian Mounted Police Forensic Identification Research and Review Section for permission to reprint this bulletin as a Technical Memorandum.

For further technical information please contact Dr. Wilkinson at (613) 998-6188.

<b>FIRRS</b>	<b>BULLETIN</b>	No. 40 No _____ Date October 1997	<b>S.R.E.I. J.</b>
<b>Forensic Ident Research &amp; Review Sec. - RCMP HQ</b> 1200 Vanier Parkway NPS Bldg., Rm 503 Ottawa, Ontario K1A OR2 <b>[613-998-6188]</b>	<b>Title/Titre:</b> Common Chemical Techniques used for Latent Fingerprint Detection		La Section des recherches et des études de l'identité judiciaire /D.G. de la G.R.C. 1200, promenade Vanier Pavillon des SNP- Pièce 503 <b>Ottawa (Ontario) K1A OR2</b> <b>[613-998-6188]</b>
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**OBJECTIVE:**

The objective of this bulletin is to update Canadian Forensic Identification (FI) Specialists with the current recipes for commonly used chemical processes in latent fingerprint detection. There are only a few changes with regard to the actual formulation, all concerning the use of Ninhydrin and 1,8-Diazafluoren-9-one (DFO) on porous exhibits. The main purpose of writing this bulletin is to provide all the recipes in one package.

**INTRODUCTION:**

The information has been organized under subject headings that correspond to the type of surface being examined e.g. Non-porous: Cyanoacrylate-treated; Non-porous: Adhesive tape; etc. The recipes are tabulated and presented in abbreviated format for quick reference. Whenever possible the recipes for one particular subject heading have been kept on one page. For effective use, please photocopy the recipes and place them in a plastic document protector before fixing them on the wall in a convenient location such as over the weighing balance. To maintain the simple format, health and safety information for all chemicals, solvents and light sources has been summarized in the health and safety section. This section has been purposefully kept brief and for further information refer to Material Safety Data Sheets. Whenever a chemical order is made, the company will send out new MSDS's, please ensure that you receive these copies so that you can build a complete collection of MSDS's for your laboratory. Alternately, for RCMP members copies are available through their Regional Managers.

Some techniques, such as vacuum metal deposition and iodine fuming with a-naphthoflavone for the detection of fingerprints from human skin, have been included for the sake of completion. Such techniques are either not located or are not recommended for general use in every region, but anyone interested in having exhibits examined by vacuum metal deposition should contact the RCMP "A" Division Forensic Identification Section (FIS) (613)-993-4631. Anyone requiring further information with regard to examination of cadavers for fingerprints should contact RFISS or FIRRS (613) 998-6188.

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## RECIPES:

NON-POROUS: CYANOACRYLATE-TREATED		
DYE	FORMULA	LIGHT SOURCE
Brilliant Yellow 40 (Maxilon Brilliant Flavine) [1]	<p>Disolve 2g in 1 litre ethanol</p> <p>Immerse exhibit in solution for a few seconds. Rinse in gently running water. Air dry. Prints are yellow.</p>	Argon ion laser, or Luma-Lite 450 filter or equivalent; KV550 (orange)viewing filter
Rhodamine 6G [2]	<p><u>Stock:</u> 1g in 1 litre methanol</p> <p><u>Workina:</u> 30ml stock in 1 litre methanol</p> <p>Treat as above. Prints are yellow.</p>	Argon ion laser, or Luma-Lite 450 filter or equivalent; KV550 (orange)viewing filter
Ardrox (TracerTech 134D) [2,3]	<p>10ml in 1 litre methanol or water</p> <p>Treat as above. Prints are green-yellow.</p>	Argon ion laser, Luma-Lite 450 filter or equivalent, or ultraviolet lamp; KV550 (orange)viewing filter
TEC [4]	<p><u>Stock:</u> 1g thenoyltrifluoroacetone in 200mL methyl ethyl ketone (MEK). 0.5g of europium chloride in 800mL of water. Mix 30 mins in closed vessel.</p> <p><u>Workina:</u> 100ml of stock in 180mL MEK &amp; 720mL water, mixed for 30 mins. Store in sealed vessel.</p> <p>Immerse exhibit in solution for 10 seconds. Under UV light, rinse by spraying with 80% methanol in water. Prints are red.</p>	Ultraviolet lamp; KV550 (orange) or 615nm (narrow band) viewing filter

<b>NON-POROUS: ADHESIVE TAPE</b>	
<b>TREATMENT</b>	<b>FORMULA</b>
Gentian Violet (Crystal Violet) [5]	<p>1.5 grams in 100ml distilled water. Store in dark bottle.</p> <p>Immerse tape in solution for several minutes. Rinse in gently running water. Air dry.</p>
Sticky Side Powder [6]	<p>Commercial product available from Lightning Fingerprint Co.</p> <p>Paint solution onto adhesive side of tape. Let stand for 10 seconds. Immerse in water, then rinse under slow running water.</p>
Alternate Recipe [7]	<p>5g of lack fingerprint powder and sufficient quantities of photoflo and water (1:1) to make a thick paste. Mix well.</p> <p>Paint paste onto adhesive side of tape, leave 10 seconds. Immerse in water to clean off background. Air dry</p>

NON-POROUS: MISCELLANEOUS	
TREATMENT	FORMULA
Molybdenum Disulphide [8]	<p><u>Deteraent Solution</u>: 10g Aerosol OT in 1 litre water.</p> <p><u>Workina Solution</u>: 5g of molybdenum disulphide in 10ml of detergent solution &amp; 25mL water.</p> <p>Shake solution vigorously prior to use. Immerse exhibit and leave for 30 seconds. Remove carefully, immerse in water to clean off background. Air dry.</p> <p>Suitable treatment for large areas that have been wet e.g. car exteriors. In such cases spray on solution and gently rinse with water spray.</p>
Vacuum Metal Deposition [9]	<p>Exhibit is suspended inside vacuum chamber. Gold and zinc are sequentially evaporated to coat surface. Fingerprints appear against silver-grey background.</p> <p>Works especially well for old plastic exhibits. Anyone requiring further information on access to this technique should call "A" Division Ident. (613)-993-4631 or FIRRS (613)-998-6188.</p>

POROUS: AMINO ACID REAGENT		
REAGENT	FORMULA	LIGHT SOURCE
Ninhydrin #1 [10]	<u>Stock Solution:</u> 25g ninhydrin in 50mL acetic acid & 100ml ethanol.  <u>Workina:</u> 30mL stock in 50mL ethanol, diluted to 1 litre with heptane.	Not Applicable.
Ninhydrin #2 [11]	5g ninhydrin in 3mL acetic acid, 75mL ethanol, 25mL ethyl acetate & 1 litre heptane.	Not Applicable.
Ninhydrin #3 [12]	<u>Stock Solution:</u> 25g ninhydrin in 50mL acetic acid & 100ml ethanol.  <u>Workina Solution:</u> 30mL stock in 1 litre Vertrel-XF.	Not Applicable.
Ninhydrin #4 [13]	5g ninhydrin in 45mL ethanol, 2mL ethyl acetate, 5mL acetic acid, 1 litre Vertrel-XF.	Not Applicable.
DFO #1 [10]	0.25g DFO in 20mL acetic acid, 100ml ethanol, diluted to 1 litre with heptane.	Argon ion laser, or Luma-Lite 450 filter or equivalent; KV550 (orange) viewing filter. Or Luma-Lite 570 filter or equivalent; red viewing filter.
DFO #2 [11]	0.25g DFO in 75mL ethanol, 3mL acetic acid, 25mL ethyl acetate diluted to 1 litre with heptane	Argon ion laser, or Luma-Lite 450 filter or equivalent; KV550 (orange) viewing filter. Or Luma-Lite 570 filter or equivalent; red viewing filter.



POROUS: LIPID REAGENTS	
REAGENT	FORMULA
Physical Developer (One-step) [14]	<p>Commercial product available from Lightning Fingerprint Co.</p> <p><u>Maleic acid wash solution</u>: 25g maleic acid in 1 litre water.</p> <p>In clean glassware, add 5mL of Solution A to 90ml of Solution B.</p> <p>Immerse exhibit in acid wash solution for 5 mins or until bubbles cease. Immerse exhibit into working solution and gently rock tray until prints appear as silver-grey images or background darkens. Wash several times in trays of fresh water. Air dry.</p>
Physical Developer [15]	<p><u>Maleic acid wash solution</u>: 25g maleic acid in 1 litre water.</p> <p><u>Detergent Solution</u>: 4g n-dodecylamine acetate &amp; 4g synperonic N into 1 litre distilled water, mix for 30 mins.</p> <p><u>Silver Nitrate Solution</u>: 10g silver nitrate in 50mL distilled water, mix until completely dissolved.</p> <p><u>Working Solution</u>: 30g ferric nitrate, 80g ammonium ferrous sulphate &amp; 20g citric acid into 900ml distilled water. Add 40mL detergent solution &amp; silver nitrate solution,</p> <p>immerse exhibit in acid wash solution for 5 mins or until bubbles cease. Immerse exhibit into working solution and gently rock tray until prints appear as silver-grey images, or background darkens. Wash several times in trays of fresh water. Air dry.</p>

MISCELLANEOUS	
REAGENT	FORMULA
Amido Black (Blood Prints) [16]	1g amido black in 450mL methanol, 50mL acetic acid.  Gently spray exhibit.
Iodine Fuming/Silver Plate Lift (Fingerprints on Skin) [17]	Using a standard glass iodine pipe direct fumes onto the skin with approximately 10 pumps on the bulb. Press clean silver plate onto fumed area, and expose plate to light.
Iodine Fuming/ $\alpha$ - Naphthoflavone (Fingerprints on Skin) [18]	0.3g $\alpha$ -naphthoflavone in 10ml chloroform & 90ml cyclohexane, pour into aerosol applicator.  Apply iodine as above. Wait several seconds if area is completely discoloured. Gently spray fumed area with naphthoflavone solution at distance of approximately 10cms.
Cyanoacrylate Fuming/ Powder (Fingerprints on Skin) [19]	Enclose region of body to be examined within a plastic tent, Place hot plate inside and heat cyanoacrylate until fumes are visible. Leave for 30 mins. Remove tent. Lightly powder skin. Photograph prints prior to lifting.
Silver Nitrate [5, 15]	10g silver nitrate in 500mL methanol. Store in dark bottle.  Immerse exhibit for 5 seconds. Dry in the dark. Illuminate exhibit and fingerprints will appear as brown images. Photograph immediately. Store in dark to avoid over-exposure.  OR  3g in 100ml water. Store in dark bottle.  Use as described above.

**HEALTH & SAFETY:****GENERAL:**

Always wear a laboratory coat to protect your clothes, appropriate goggles or a face shield to protect your eyes and latex gloves to protect your skin when handling chemicals or solvents and when working with light sources.

Prepare and apply solutions in a fume hood to reduce exposure to solvent vapours.

Always direct the beam of a light source away from people and reflective surfaces. In addition, when not in continual use, lower the intensity of the beam on the Luma-Lite, turn off the beam on the laser light guide, and place the ultraviolet lamp on a non-reflective surface behind a shield. Turning off these lights when you anticipate using them again within a short period is not efficient since they require cool down periods.

<b>HEALTH &amp; SAFETY : CHEMICALS</b>	
<b>CHEMICAL</b>	<b>HEALTH&amp;SAFETY</b>
Aerosol OT	Irritant
Amido Black	Do not breath dust
Ammonium Ferrous Sulphate	irritant
Ardrox	Irritant
Brilliant Yellow 40	Do not breath dust
Citric Acid	Irritant
<b>1,8-Diazafluoren-9-One (DFO)</b>	Do not breath dust
n-Dodecylamine Acetate	
Europium Trichloride Hexahydrate	Do not breath dust
Ferric Nitrate	Irritant
Gentian Violet	Highly toxic, suspected carcinogen
Iodine	Highly toxic
Maleic Acid	Irritant
Molybdenum Disulphide	Irritant
a-Napthhoflavone	Do not breath dust
Ninhydrin	Irritant
Physical Developer (One Step)	Highly toxic
Rhodamine 6G	Harmful
Silver Nitrate	Highly toxic
Sticky Side Powder	Do not breath dust
Synperonic N	
Thenoyl Trifluoroacetone	Irritant

<b>HEALTH&amp;SAFETY: SOLVENTS</b>		
<b>SOLVENT</b>	<b>HEALTH</b>	<b>SAFETY</b>
Acetic Acid	Harmful	Flammable, TLV 10ppm, Flash point 39 °C
Chloroform	Highly toxic Suspected carcinogen	TLV 10ppm
Cyclohexane	Irritant	Flammable, TLV 300ppm, Flash point -18°C
Ethanol	Irritant	Flammable, TLV 1 000ppm, Flash point 8°C
Ethyl Acetate	Central nervous system depressant	Flammable, TLV 200ppm Flash point 12°C
Heptane	Irritant	Flammable, TLV 1 000ppm, Flash point -1 °C
Methanol	Central nervous system depressant	Flammable, TLV 200ppm, Flash point 12°C
Methyl Ethyl Ketone	Central nervous system depressant	Flammable, TLV 200ppm, Flash point -4°C
Vertrel XF		Volatile

<b>HEALTH &amp; SAFETY: LIGHT SOURCES</b>		
<b>LIGHT SOURCE</b>	<b>HEALTH</b>	<b>SAFETY</b>
Luma-Lite 450 & 485 Filters	Protect Eyes	Orange (KV550) or red goggles
Luma-Lite 530 & 570 Filters	Protect Eyes	Red goggles
Argon ion Laser	Immediate damage to eyes and skin on exposure to beam. Protect eyes and skin from beam and reflections.	Orange (KV550) or red goggles. Latex gloves on hands. Wear laboratory coat to protect skin.
Ultraviolet Lamp	Protect eyes & skin from prolonged & direct exposure.	Polycarbonate, yellow, orange (KV550), red goggles or face shield. Latex gloves or UV blocking skin cream.

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