TECHNICAL NOTE

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Laser Detection of Latent Fingerprints: Preparation of Fluorescent Dusting Powders and the Feasibility of a Portable System

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ABSTRACT: A simple procedure for the preparation of dusting powders with a variety of fluorescent colors is described. Such powders permit detection of latent prints by laser even when the surfaces holding the latent prints luminesce strongly. A possible portable laser detection system is also suggested.

KEY WORDS: criminalistics, fingerprints, lasers

Previous articles in this journal have described a variety of procedures for the detection of latent fingerprints using argon laser illumination of exhibits and photography of the latent print luminescence. This luminescence can be inherent to the latent print [*1*], can be caused by luminescent material with which the latent print is dusted or stained [*1-4*], or can arise from the chemical reaction of treatment compounds with fingerprint residue, forming luminescent reaction products [*2*]. Unfortunately, the laser method is confined to forensic science laboratories because argon lasers of the required power are not portable.

Dusting with luminescent powders is particularly convenient for reasonably fresh prints since they can be detected either in the conventional way or by laser examination. However, only a few commercial dusting powders show luminescence. Mars Red (Criminal Research Products) shows red luminescence on argon laser illumination. Powders such as DP 002 and FMP 01 (Sirchie) display green luminescence when illuminated by ultraviolet (UV) light from an ordinary UV lamp or, with increased sensitivity, from a UV-option-equipped argon laser and can be used with the customary laser examination procedure [*1*] or a phosphorescence detection mode [*3*]. The long-lived luminescence component (afterglow) of these powders is actually delayed fluorescence rather than phosphorescence, and light chopping [*3*] should be at 100 to 1000 Hz for best detectability. When luminescent dusting powders are employed with the usual laser detection procedure, substrate luminescence of the same color as that of the dusting powder can inhibit detectability. It

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would therefore be useful to have dusting powders with a variety of luminescence colors to allow elimination (or at least reduction) of the background luminescence by use of appropriate filters. This paper describes a simple procedure for the preparation of such powders and suggests a portable laser system for detection of latent prints.

General Information

Approximately 0.1 g of a fluorescent dye is dissolved in roughly 50 ml of methanol. About 10 g of FMP 01 magnetic dusting powder is added to this solution. The mixture is stirred until the methanol has evaporated. Gentle heating or blowing air over the solution expedites evaporation. The preparation procedure is similar to that reported by Thornton [4] for coumarin 6. The fluorescent dye is thus deposited onto the particles of the dusting powder. The powder is applied by magnetic brush and laser examination reveals latent prints by the fluorescence of the dye. The proportions of solvent, dye, and powder are not critical and were chosen somewhat arbitrarily. A number of dyes have been successfully used:

1. Acridine yellow fluoresces yellow in solution but orange when coated onto the FMP 01 powder. The adherence of the powder to latent prints is detrimentally affected by the dye, but not to the point of rendering the powder useless.
2. Rhodamine 6G and rhodamine B fluoresce orange and red, respectively. Powder adhesion to latent prints does not appear to be significantly affected. A latent print developed by powder prepared with rhodamine 6G and then examined by laser is shown in Fig. 1.
3. Nile blue A perchlorate yields red and near-infrared fluorescence. Powder adhesion remains good.
4. Oxazine 1 perchlorate, 3,3′-diethyloxadicarbocyanine iodide (DODC), and 3,3′-diethylthiatricarbocyanine iodide (DTTC) provide near-infrared fluorescence and do not appear to significantly reduce the powder adherence quality. The dye fluorescence tails into the red spectral region so that faint red luminescence may be observed.

Nile blue, oxazine, DODC, and DTTC require red light illumination and are thus not directly employable with argon lasers. If one has a continuous-wave dye laser pumped by an argon laser, however, then illumination presents no difficulty. Alternatively, a helium-

FIG. 1—*Latent print on plastic dusted with FMP 01/rhodamine 6G and developed by argon laser illumination.*

neon laser (632.8 nm) with about 50 mW can be used. Figures 2 and 3 show latent prints developed with red laser excitation (610.0 nm) from a dye laser using, respectively, powders prepared with Nile blue and DODC. Photography and inspection were done with a filter that transmits only wavelengths longer than 630.0 nm. Photographs were taken with Tri-X Pan film. The left print in Fig. 3 could not be observed by inspection under the laser or in room light, a clear demonstration of high detection sensitivity. To make these dyes amenable to argon laser excitation, methanol solutions of about one part rhodamine B and three parts of infrared fluorescent dye can be stirred to dryness with dusting powder. The rhodamine, which responds to argon laser light, sensitizes the red or near-infrared fluorescent dye by energy transfer or rhodamine fluorescence reabsorption.

Discussion

Undoubtedly the described powder preparation procedure can be used with a large number of dusting powders, magnetic or other. We have chosen the FMP 01 powder because it already displays green luminescence and because powder consumption during dusting is very low. This is helpful since the dyes are expensive. The choice of methanol as

FIG. 2—*Latent print on glass dusted with FMP 01/Nile blue and developed by red laser illumination.*

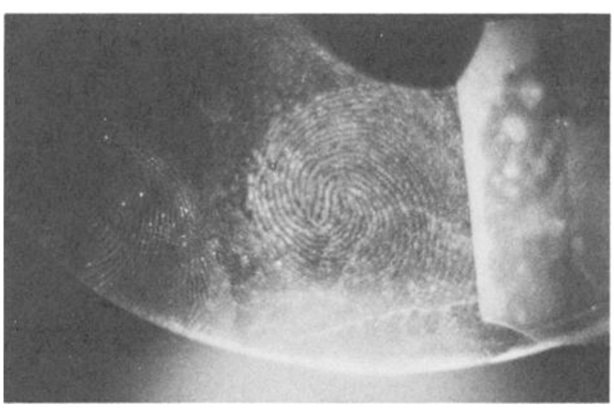

FIG. 3—*Latent prints on glass dusted with FMP 01/DODC and developed by red laser illumination. The left print was not discernible on inspection under laser light.*

dye solvent is not critical. Methanol was selected primarily because of high volatility and hence speed in powder preparation.

Dyes providing near-infrared fluorescence seem to be of little use since the dusted latent prints cannot be located by visual inspection. However, such prints can be readily located by spectroscopic means. We have measured the luminescence spectra of latent prints that were too weak to be seen by inspection under laser illumination, using a spectroscopic system comprising a 0.5-m McPherson double monochromator, a nine-stage photomultiplier tube of S-20 spectral response, and a photon counting system consisting of a Princeton Applied Research Model 1120 amplifier/discriminator and a Model 1112 photon counter/processor. In a practical detection system to locate latent prints illuminated by laser the monochromator can be replaced by suitable filters, and the photomultiplier signal is monitored while the exhibit is scanned. Infrared viewers may be of use as well. A spectroscopic detection system used with a helium-neon laser (with about 50 mW power) may bring laser detection of latent prints into the realm of portability (though not with the sensitivity permitted by powerful argon lasers), provided that 110 V (or 220 V) electrical power is available at the crime scene.

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