The effectiveness of strong afterglow phosphor powder in the detection of finger marks

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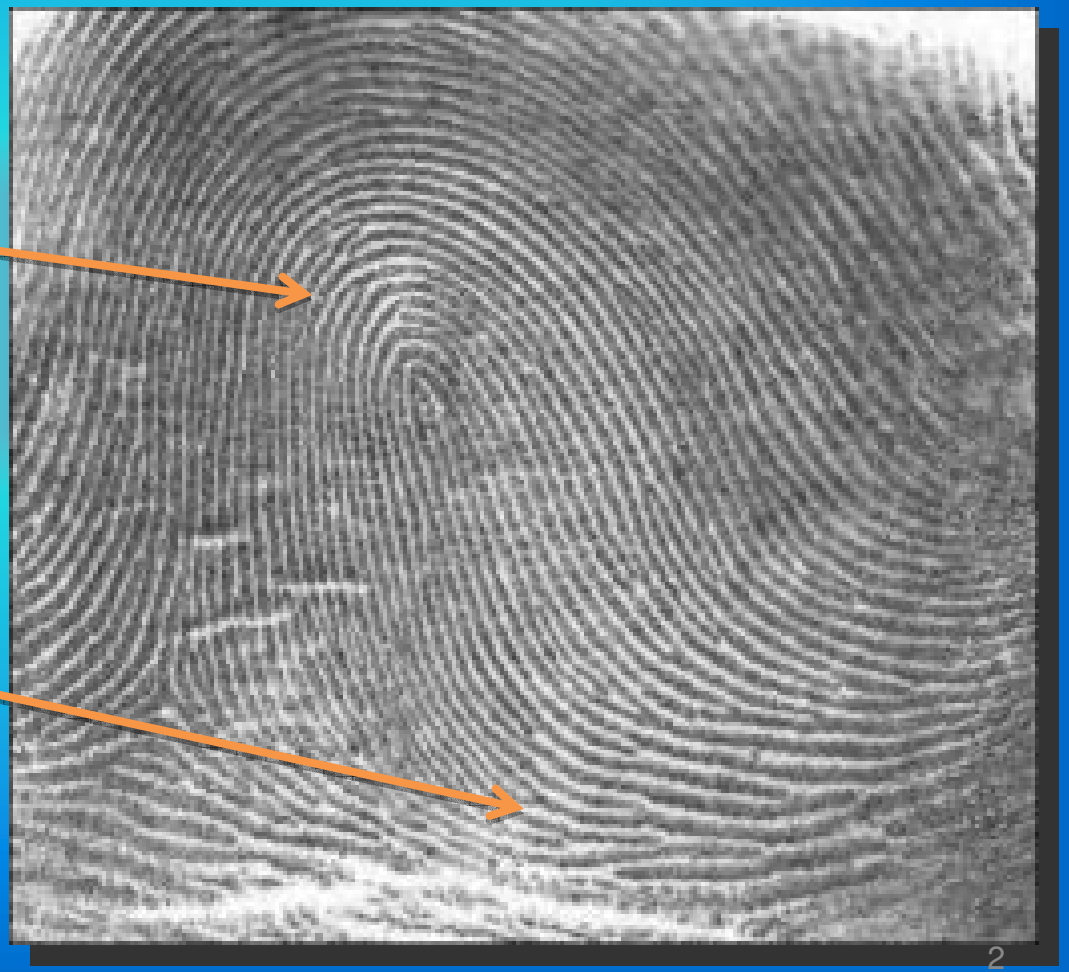
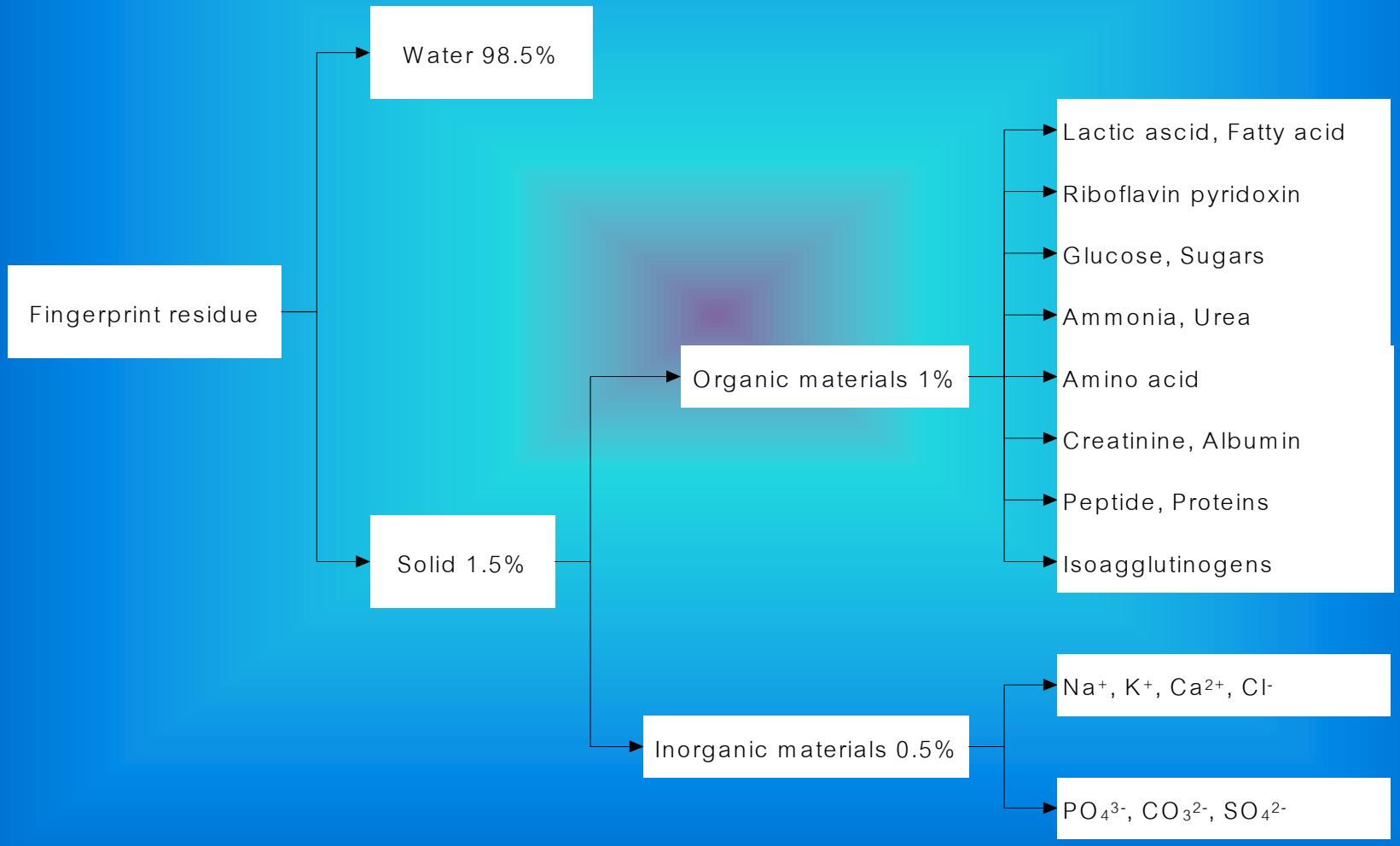
Fingerprint

Ridge

Furrow



Components of sweat



Fingerprints are divided into three main groups

Loop

Arch

Whorl

Minutiae point

Ridge ending

Ridge bifurcation

Enclosure or lake

Dot or island

Two types of fingerprints found are crime scene

1. visible fingerprint

2. latent fingerprint

Fluorescence are properties

Europium

strontium aluminate

Europium doped strontium aluminate (ESAs)

Materials and methods

1. Chemicals

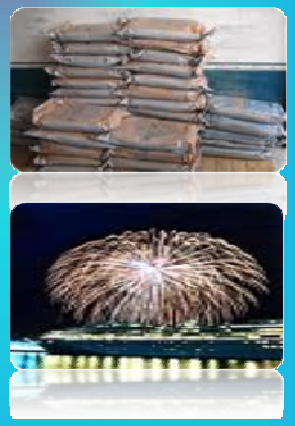
2. Preparation of phosphor powder

3. The detection of fingermarks using ESA powder

4. Spectroscopic measurements

Chemicals

- Aluminium oxide
- Strontium carbonate
- Barium carbonate
- Basic magnesium carbonate
- Magnesium borate
- Europium oxide



Preparation of phosphor powder

Hydrothermal Method

↓

Oxides and carbonates

↓

1300 ◦C For 2-4 h

↓

N_2 vapor containing 20% H_2

The detection of fingermarks using ESA powder

- Non-porous surfaces

Foil

Glass

Porcelain

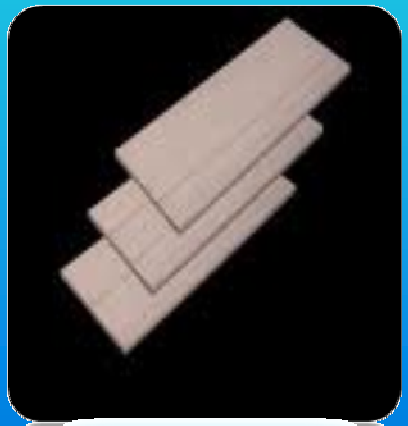
Plastic bag

The detection of fingermarks using ESA powder cont.

- Semi-porous surfaces
- Porous surfaces

Paper

Fabric



Wood

Leather

The detection of fingermarks using ESA powder cont.

- Aged fingermarks

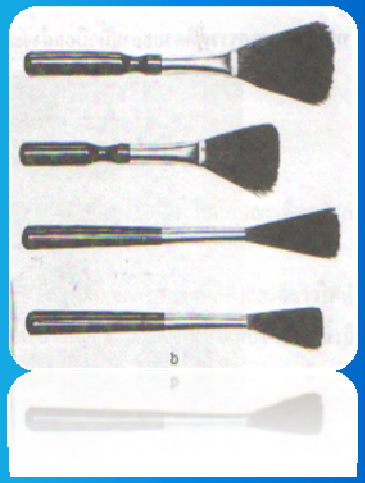
- Cyanoacrylate fumed fingermarks

The detection of fingermarks using ESA powder cont.

Squirrel hair brush to dust the fingermarks

Excited under UV400-1 (365 nm) 2 min and imaged 3 min

Imaged by 6.1 megapixel Kodak camera



Spectroscopic measurements

FLUOROLOG-2 luminescence spectrophotometer

Excitation wavelenght from 200-500 nm

Emission wavelenght between 400 and 700 nm

RESULTS

1. Luminescence excitation and emission spectra

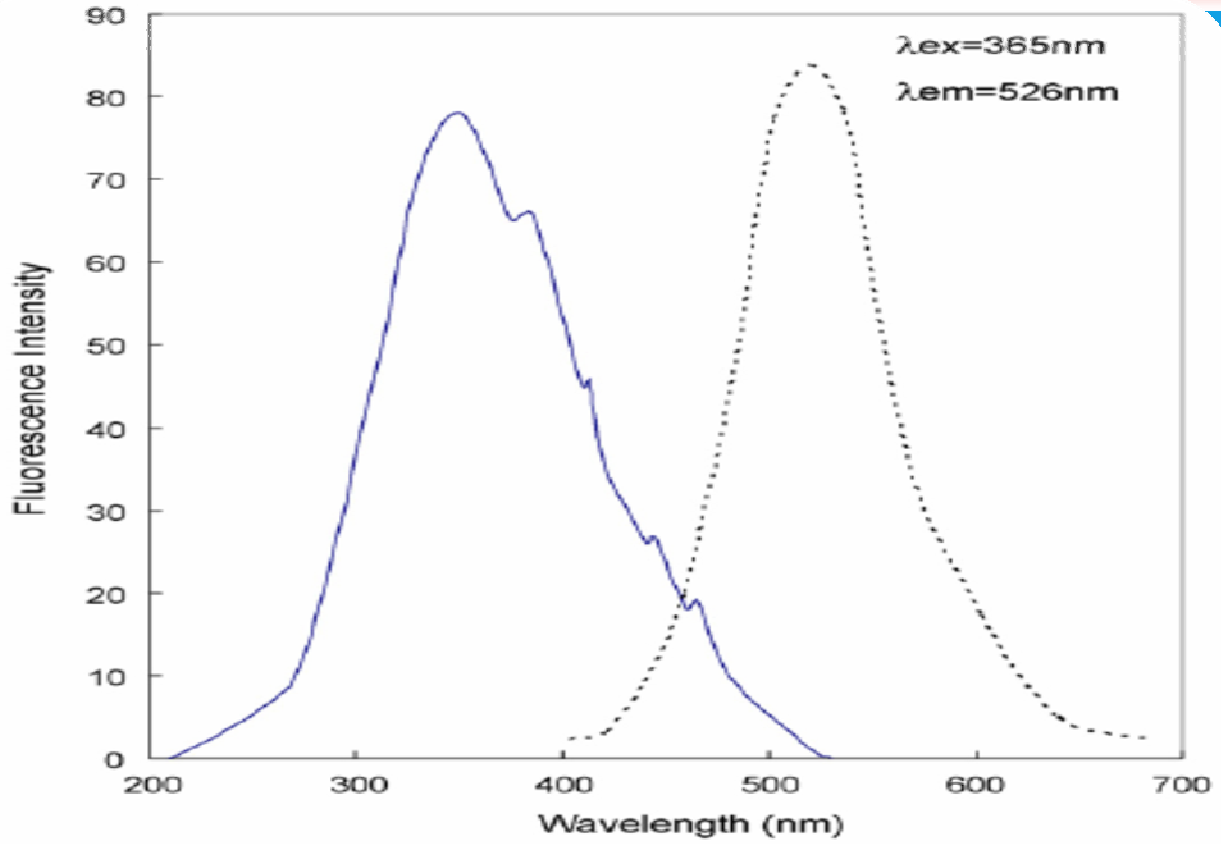


Fig. 1. Luminescence excitation and emission spectra of ESA.

2. A comparison of fingermark detection between phosphorescent powder and fluorescent powder

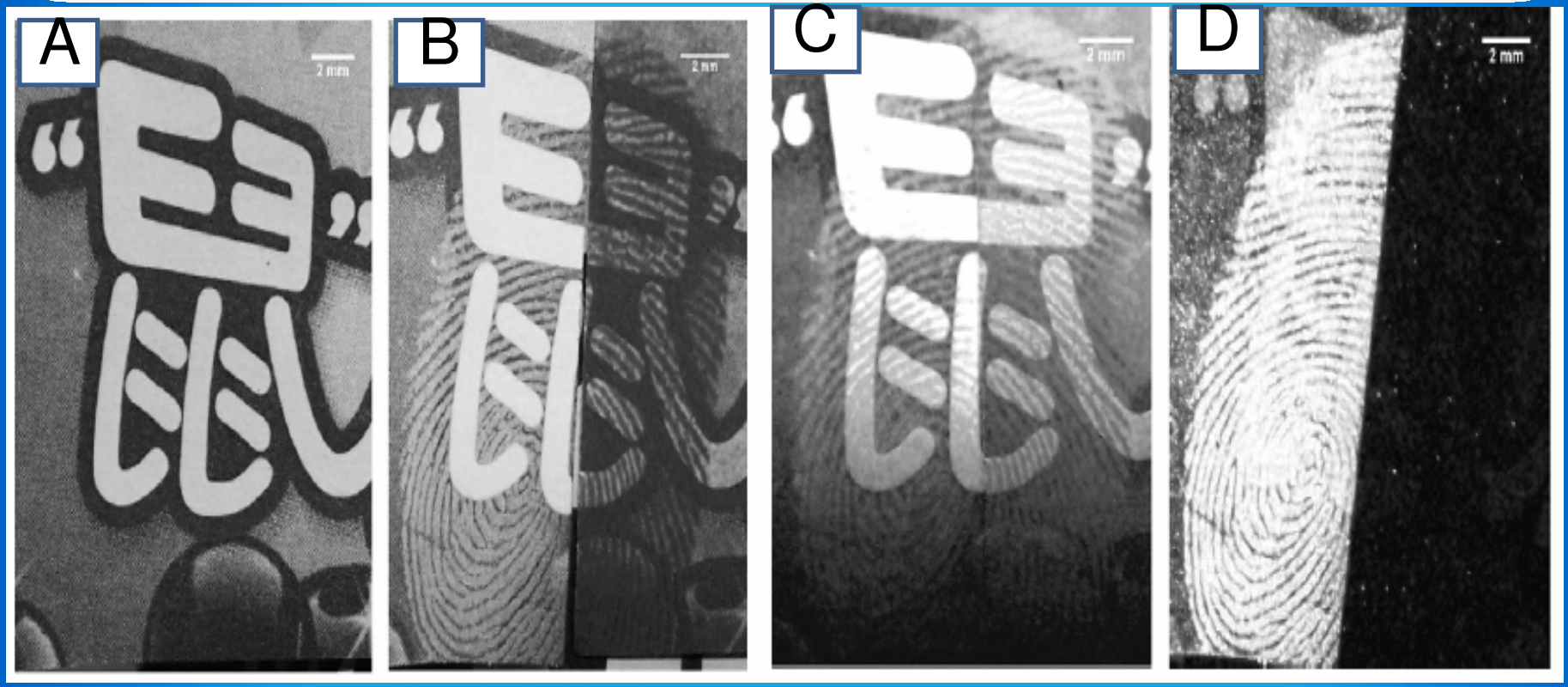


Fig. 2. Fingermark images detected using ESA powder and fluorescent powder on colored paper. The images of panels A and B were taken under white light; the image of panel C was taken under UV light; and the image of panel D was taken in the dark after a 2 min excitation under long UV light. All the images shown here appear as Figs. 3–5 which appear as 8-bit green-channel images of 24-bit-color images [24].

3. Detection of fingermarks on non-porous substrates by ESA powder

Fig. 3. Images of fingermarks detected by ESA powder on different non-porous substrates such as: foil (A); glass (B); porcelain (C); and a plastic bag (D). All of these experiments were performed using fresh fingermarks. All the images were taken in the dark after the labeled prints were excited under UV light for 2 min.

4. Detection of fingermarks on semi-porous or porous substrates by ESA powder

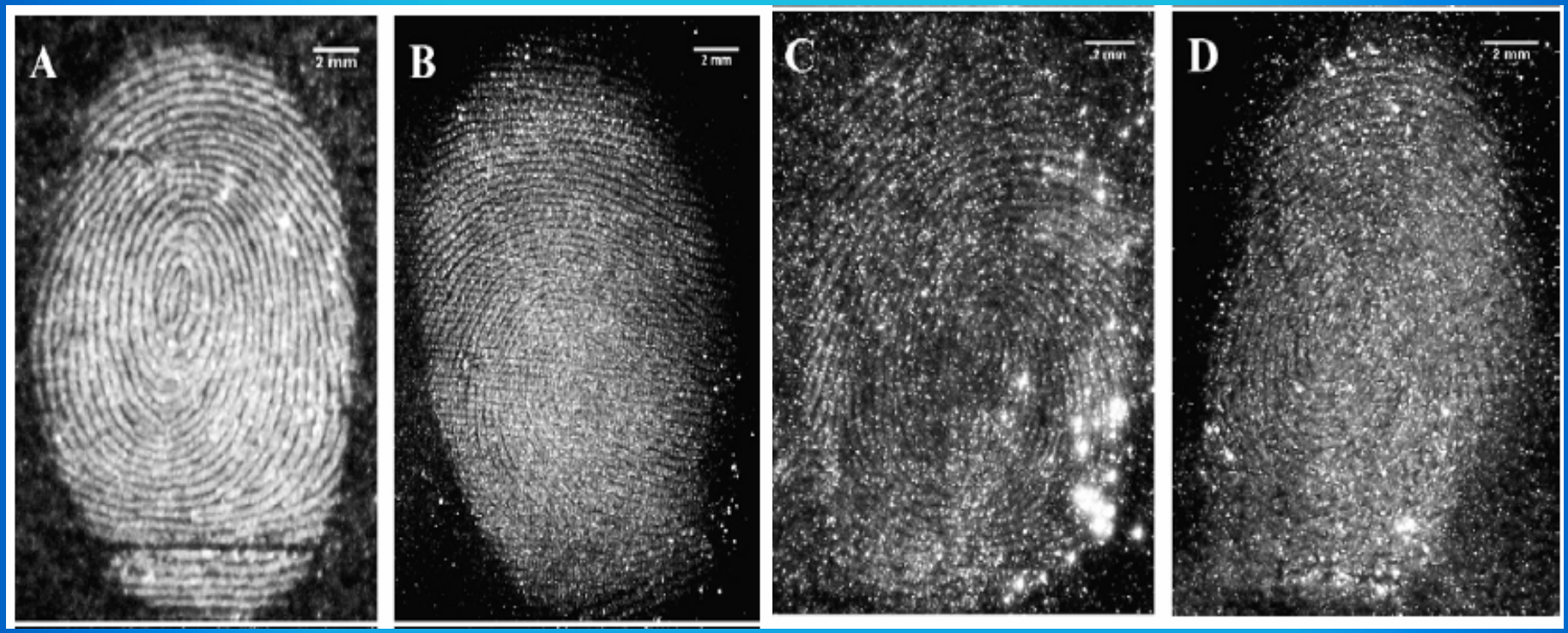


Fig. 4. Fingermark images detected by ESA powder on different semi-porous and porous substrates and the fingermarks images taken were of fingermarks placed on paper (A); fabric (B); wood (C); and leather (D). All of these experiments were performed using fresh fingermarks. All the images were taken in the dark after the labeled prints were excited 2 min under long UV light.

5. Effect of fingermark aging using ESA powder labeling

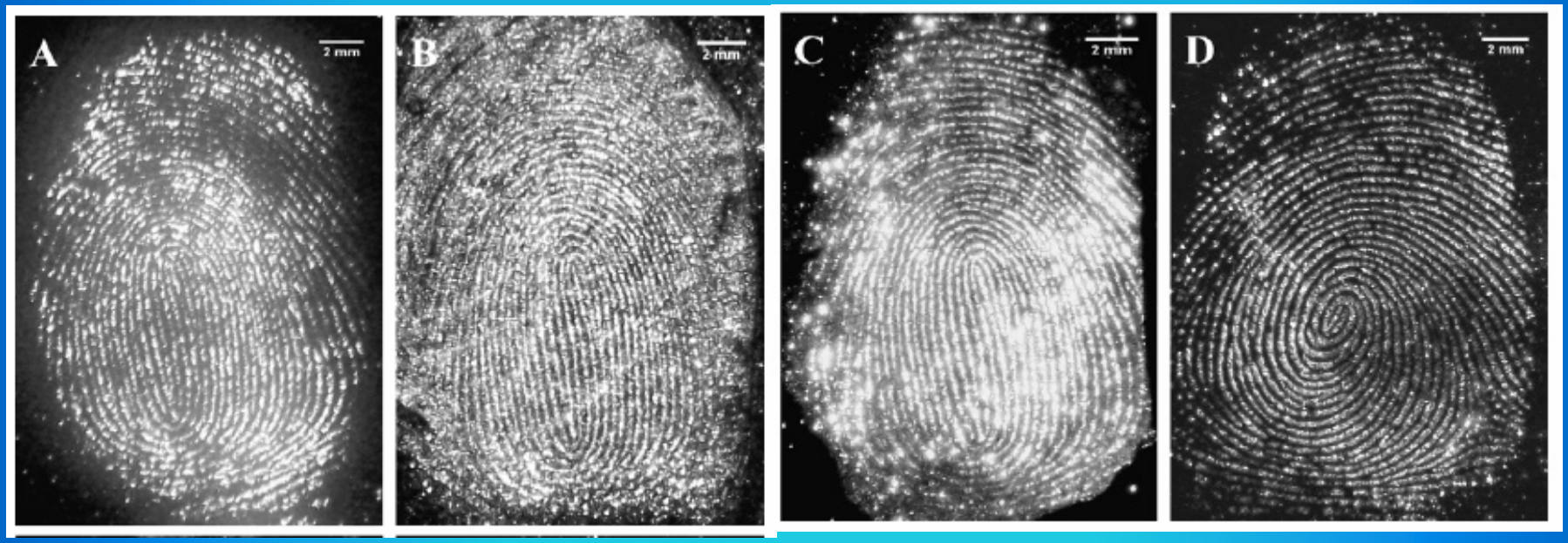


Fig. 5. 7-day-aged fingermark images detected using ESA powder. These 'aged fingermarks' were on: glass (A); a plastic bag (B); porcelain (C); and foil (D). All the images were taken in the dark after the labeled prints were excited under long UV light for 2 min.

6. Labeling as phosphorescent stain following cyanoacrylate fuming for the detection of fingermarks

Fig. 6. Comparison of unlabeled (A) and labeled (B) cyanoacrylate fumed fingermarks by cyanoacrylate placed on a plastic board.

7. Lifting of the fingermarks developed by ESA powder

Can be lifted by fingermark tape and preserved in the evidence bag.

Conclusions

ESA powder is a useful fingermark detection powder due to its strong afterglow effect and other phosphorescence properties.

It is an easy, efficient and effective powder dusting method that can eliminate background substrates.


Thank You for Your Attentions