Development of Latent Fingermarks from Difficult Surfaces by Laser Light Sources

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History

- Argon Ion Laser (1976)
- YAG Laser (1980)
- LED (1980)
- Semiconductor Laser (2006)
- Suzhou PD (2007)
Lasearcher Laser

- Purple Laser 400 nm
- Blue Laser 447 nm
- Green Laser 532 nm
- Red Laser 635 nm

Standard cutoff viewing filters
Photography

The first criminal fingerprint detected by laser

Detected, photographed and identified by Brian Dalrymple.
Photography
Photography

◆ Laser should not be held too close to articles since the article itself or the fingermark may be destroyed.

◆ Once a fingerprint is seen by its fluorescence, it should not be further illuminated until one is ready to photography it.

◆ Requiring careful scrutiny during the detection stage.
Experimental Design

◆ Sample Collection
  Fingerprints were collected on a range of surfaces: Rocks, Stones, Wood, Fibers, Leather, Train Tickets

◆ Chemistry
  Modified Indanedione Stock

◆ Lasers
“The stone which the builders rejected is become the chief corner-stone”
Crime Scene - Bricks
Bricks
Untreated Fingerprints on Brick

Green Laser 532 nm
Untreated Fingerprints on Brick

Blue Laser 447 nm
Laser + IND

(a) No IND  (b) 3 hours  (c) 3 days  (d) 30 days
Untreated Fingerprints

Green Laser 532 nm
Laser + IND

Green Laser 532 nm
Laser + IND

(a) No IND        (b) 3 hours        (c) 3 days      (d) 30 days
Fingerprint on stone
Laser + IND

Green Laser 532 nm
Fingerprint on wood
Laser + IND

Green Laser 532 nm
Fingerprint on leather
Train Tickets
Train Tickets

Dr. Meng Wang, Department of Trace Examination, National Police University of China.
Train Tickets

NaYF₄:Yb Nanoparticles
NIR-induced highly sensitive detection of latent fingerprints by NaYF$_4$:Yb,Er upconversion nanoparticles in a dry powder state

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ABSTRACT
The most commonly found fingerprints at crime scenes are latent and, thus, an efficient method for detecting latent fingerprints is very important. However, traditional developing techniques have drawbacks such as low detection sensitivity, high background interference, complicated operation, and high toxicity. To tackle this challenge, we employed fluorescent NaYF$_4$:Yb,Er upconversion nanoparticles (UCNPs), which can fluoresce visible light when excited by 980 nm human-safe near-infrared light, to stain the latent fingerprints on various substrate surfaces. The UCNPs were successfully used as a novel fluorescent label for the detection of latent fingerprints with high sensitivity, low background, high efficiency, and low toxicity on various substrates including non-infiltrating materials (glass, marble, aluminum alloy sheets, stainless steel sheets, aluminum foils, and plastic cards), semi-infiltrating materials (floor leathers, ceramic tiles, wood floor, and painted wood), and infiltrating materials such as various types of papers. This work shows that UCNPs are a versatile fluorescent label for the facile detection of fingerprints on virtually any material, enabling their practical applications in forensic sciences.

1 Introduction
A fingerprint is one of the most powerful traces that can be exploited as evidence for the identity of individuals since it represents the unique ridge skin pattern of an individual's finger. The most commonly found fingerprints at crime scenes are typically latent. Namely, they are normally invisible or less visible to

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Fingerprint on cotton
Laser + IND

Green Laser 532 nm
Quality
Quality

Web-based Software (PiAnoS)
Case # 1 – Homicide (06/01/2015)

- Cardboard found near the crime scene
- Laser examination – negative
- IND
- Two fingerprints located
- Identified as suspect
Case # 1 – Homicide  (06/01/2015)
Case #2 – Homicide (2009)

- Varnished drawer surface
- Examined by LED – negative
- Examined by Laser – fingerprint found
- Examined by powder – negative
- Not identified as suspect
Case #2 – Homicide (2009)
Case #3  Serial Burglary Case (2013)

- Impressions located
- Examined by Laser
- Ridge detail detected
- Identified as accused
Case #3  Serial Burglary Case (2013)
Case #4  Homicide (2015)
Health and Safety Issues

- Always wear goggles when operating the laser.
- Never exposure of the skin to the laser beam.
- Always follow laser manuals.
Semiconductor Laser

- Robust
- Very portable
- Wide range
- No speckle
- More cheaper
- More powerful

Always worth a try!
Thank you for listening
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