B67 Development of a Portable Detection and Image-Processing System for Latent Fingerprints Using Time-Resolved Spectroscopy

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After attending this presentation, attendees will understand how a portable detection and image-processing system for latent fingerprints using time-resolved spectroscopy is developed and applied to a preprocessed fingerprint.

This presentation will impact the forensic science community by presenting a report of a first attempt to develop a portable detection and image-processing system for latent fingerprints using time-resolved spectroscopy. It is expected that this system can be used for on-site detection and investigation of latent fingerprints.

Detection of fluorescence from latent fingerprints using time-resolved spectroscopy is one of the effective methods for visualizing latent fingerprints.[1,2] When a latent fingerprint is excited by irradiating with light, it emits fluorescence with a certain lifetime. This fluorescence provides information on the shape and components of the latent fingerprint. Since the light interacts with substances in a non-contact manner, an excitation of latent fingerprints by a light with modest power neither contaminates nor destroys the material evidence.

Although not only latent fingerprints but also background substances will emit fluorescence, it is possible to detect the fluorescence from latent fingerprints exclusively by using time-resolved spectroscopy. Time-resolved spectroscopy enables a detection of the light of interest by making use of differences in fluorescence lifetimes, which depend on substances. This spectroscopy is conducted by using a pulsed light source and a Charge-Coupled Device (CCD) camera with accurate temporal controls. After the image of the latent fingerprint is obtained, in some circumstances, it will be helpful to process it by a computer. Practically, since these devices include an optical system and tend to be large in size, the application of time-resolved spectroscopy to latent fingerprints has been limited to laboratory use.

This presentation reports on the development of a portable detection and image processing system for latent fingerprints using time-resolved spectroscopy in order to conduct on-site detection and investigation of latent fingerprints. It is noted that applying this system requires a preprocessing of a latent fingerprint for a fluorescence lifetime of several hundreds of μsec because the accuracy of temporal control of the programmable Matrox Iris GT, GT300C* CCD camera used in this system is limited to an order of μsec. This system adopts a Laser Diode (LD) wavelength 375nm as a light source and the programmable CCD camera equipped with a Central Processing Unit (CPU) for on-site data processing, such as image accumulations, to enhance Signal-to-Noise (S/N) ratio. Three timings concerning the LD and the CCD camera have to be provided: (1) light-emitting time of the LD; (2) delay time for opening a shutter of the CCD camera after the LD begins to emit; and, (3) exposure time of the CCD camera. Times (1) and (2) were set by a Sapphire Plus Pulse Generator, MODEL 9214+ delay pulse generator and time (3) was controlled by a program in the CCD camera. Both the pulse delay generator and the CCD camera were controlled and/or programmed by a tablet personal computer, which is connected to a portable monitor to enable on-site settings for instrumental conditions and checks of image processing results. One can also use a head-mount display instead of the monitor. These components are electrically supplied by lithium batteries. Constituents of the system weigh nearly 3kg in total and are portable.

This portable system was applied to a fingerprint preprocessed by Tris-Thienyl-Europium Chelate (T.TEC). The fluorescence lifetime of the T.TEC is approximately 500μsec. The light-emitting time of the LD was set to 400μsec and the exposure time of the CCD camera was adjusted to 200μsec. For the delay time for the CCD camera of 550μsec (i.e., the shutter of the CCD camera opens 150μsec after the LD emission ends), a fluorescence image of the latent fingerprint without the fluorescence from backgrounds was successfully obtained and clarified after 1,000 image accumulations and a histogram adjustment.

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Reference(s):

1. Saitoh N., Akiba N. Ultraviolet fluorescence spectra of fingerprint. *Sci World J* 2005:5:355-66.
2. Akiba N., Saitoh N., Kuroki K. Fluorescence spectra and images of latent fingerprints excited with a tunable laser in the ultraviolet region. *J Forensic Sci* 2007:52:1103-6.

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