A10 Forensic Discrimination of Blood on Various Substrates by Diffuse Reflectance Infrared Spectroscopy (DRIFTS) and Visualization Using a Sensitized Thermal Detector

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The goal of thi presentation is to present studies establishing a scientific basis for the spectroscopic detection and discrimination of blood stains from other background materials that might be present at a crime scene. Attendees will learn about the development of a prototype camera for rapid and nondestructive visualization of blood at crime scenes.

This presentation will impact the forensic community by explaining the development and design of a novel detector for visualizing blood stains at crime scenes.

Developing techniques for the visualization of biological fluid stains on common surfaces has been a continuing goal for numerous forensic studies. The ideal device would be small, relatively inexpensive, and easy to operate and maintain portable; enhancement reagents would not be necessary; the method would be nondestructive; further, the device would detect trace levels of blood; and operate indoors or outdoors under ambient lighting.

A prototype imaging device is being developed that combines selective filters with a modified thermal array detector having a spectral response sensitized for blood detection. This goal will be achieved by modifying the detector with a metal mirror followed by the polymer film so that the film absorbances are responsible for most thermal conversion. By using polymers that mimic the spectral signatures of biological fluids of interest (e.g., blood, semen, saliva, and urine), the location of deposits of these fluids can be detected even in the presence of potential interferents that might be expected at crime scenes. The scientific basis and design characteristics of such a detector in systematic experiments using diffuse reflectance infrared spectroscopy (DRIFTS) have been developed. IR spectra of blood proteins such as hemoglobin and albumin exhibit distinctive IR absorbance due to the amide I and amide II bands in the 1650-1540 wavenumber range. In preliminary experiments, multiple substrates (textile and carpet polymers such as nylon, acrylic, cotton, oflefin, and polyester) have been tested, before and after doping with various concentrations of blood.

Multivariate statistical analyses were employed to determine the optimal spectral region for discrimination between neat and blood-doped substrates, and to measure false positive/negative error rates. Classification accuracies ranged between 96-100% comparing neat and bloodstained substrates, with little to no false negative misclassifications. With no alterations to a Merlin un-cooled microbolometer camera system, differences between infrared images taken with and without blood stains were seen as well as being able to distinguish the stains. Both experimental results and simulations will also be shown to validate the design parameters of our imaging instrument. Ongoing research on combinatorial optimization of detector design parameters will be discussed, along with practical evaluation tests.

Blood Stains, Diffuse Reflectance Infrared Spectroscopy, Thermal Detector

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