A136 Reflectance Spectroscopy for Recognition and Age Determination of Blood Stains

Rolf Bremmer, MSc, Academic Medical Center, Meibergdreef 9, Amsterdam, 1105 AZ, NETHERLANDS*

After attending this presentation, attendees will understand the basic principles of reflectance spectroscopy and its applicability for recognition and age determination of blood stains. Non-contact reflectance spectroscopy can be used as a rapid, non-destructive identification test for

blood and can be used for the determination of hemoglobin derivatives in a blood stain, which are related to the time the blood stain was deposited at the crime scene.

This presentation will impact the forensic science community by introducing a new method for rapid, non-destructive identification, and interpretation of blood stains in the original context of the crime scene.

Blood detection and identification at crime scenes are crucial for harvesting forensic evidence. Unfortunately, most tests for the identification of blood are destructive and time consuming. A fast and non-destructive identification test for blood, using non-contact reflectance spectroscopy will be presented. Investigated in this experiment is whether blood can be discriminated from other body fluids and substances visually mimicking blood, based on the correlation coefficient between the reflectance spectrum and a blood-component fit. To test the sensitivity and specificity of this method, two sets of samples were analyzed: a set of 40 blood samples and a set of 35 red/brown colored substances and various body fluids. Discrimination is possible between blood and non-blood on white cotton with a specificity of 100% and a sensitivity of 98%. In addition, an example is given of a recent forensic case, in which non-contact blood identification was applied.

The age of blood stains can be crucial in reconstructing crime events; however, no reliable methods are currently available to establish the age of a blood stain on the crime scene. It will be shown that the fractions of three hemoglobin derivatives in a blood stain at various ages can be related to the age of the blood stain. Upon blood exiting the body, hemoglobin, the main chromophore in blood, transits from oxy- hemoglobin into met-hemoglobin and hemichrome. Analysis of the blood stains with light transport theory allows for determination of the amount of the three hemoglobin derivatives. Observations in twenty blood stains show that the chemical composition of the blood stain exhibits a distinct time-dependent behavior, with a unique combination of the three hemoglobin derivatives at all moments in time. The ageing of the blood stain does not depend on the size of the blood stain and no variation was found in ageing of blood stains among eight donors. Finally, the previously obtained hemoglobin reaction kinetics were employed inversely to assess the age of twenty other blood stains studied over a time period of 0-60 days and stored under laboratory circumstances. The precision of the age estimation depends on the age of the blood stain, e.g., a stain of two weeks old can be estimated correctly within an uncertainty margin of four days.

In conclusion, discrimination is possible between blood and non- blood on white cotton with non-contact reflectance spectroscopy. The high sensitivity and specificity indicate that this optical test is close to confirmative. The non-contact reflectance spectroscopy setup is portable, low-cost, non-invasive, and non-destructive, all favorable properties when measuring in a forensic setting. Additionally, determination of hemoglobin derivatives allows for age estimation of the blood stain and assists in reconstructing the time line of the crime scene.

Blood Stains, Spectroscopy, Age Determination

 ** Presenting Author*