A159 The Application of Cathodoluminescence to the Analysis and Comparison of Concrete Block Samples

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After attending this presentation, attendees will understand the nature and components of concrete and how it is manufactured, the characteristics of minerals that allow them to become luminescent when bombarded with electrons, and how cathodoluminescence can be used with digital imaging to differentiate concrete samples.

This presentation will impact the forensic community by providing a semi-automated method for the collection and interpretation of cathodoluminescence and digital imaging of concrete materials. The purpose of this project is to develop a method using cold cathodoluminescence (CL) in conjunction with reflected light (RL) microscopy and image processing to discriminate among various sources of concrete (e.g., manufacturer, location, production batch).

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Concrete is a mixture of cement, water, and aggregates, where the aggregates are typically the major component of the mixture. Concrete is reported to be the most ubiquitous manmade substance on Earth and, as such, it is often found in connection with criminal activity. The components of concrete – cement, water, and aggregates – contain certain kinds of minerals, such as quartzes, carbonates, and feldspars. Many of these minerals contain impurities known as luminescence activators and lattice defects that allow the crystal to undergo both intrinsic and extrinsic luminescence when excited by an electron source. This luminescence is due to not only the mineral itself but also the presence of sensitizers and/or quenchers in its surroundings. This visible luminescence can be recorded via a digital camera or a UV-Vis-NIR spectrometer, both of which can be attached to the trinocular head of a microscope.

In this project, reflected light (RL) and cold cathodoluminescence (CL) image collection is combined to differentiate concrete samples that are difficult to distinguish with the naked eye. RL microscopy allows for both low- and high-magnification images to be collected and processed for color gates using image processing software. Processing CL images for color gates adds an extra investigative tool to differentiate samples that appear similar through RL analysis. Using a combination of image processing and statistical methods, the RL and CL data can be interpreted in numerical and graphical form to provide an objective basis for differentiation of concrete materials.

Concrete, Cathodoluminescence, Minerals

 ** Presenting Author*