B42 Development of a Portable X-Ray Fluorescence Instrument for Forensic Applications

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After attending this presentation, participants will understand the critical design features and operational parameters of a new, portable xray instrument for assisting in the recognition of trace evidence for crime scene and laboratory applications.

This presentation will impact the forensic community by: 1) describing the development of a portable x-ray fluorescence instrument; 2) demonstrating the operational performance of the instrument for trace residua of forensic importance, including primer residue, blood, and semen; and 3) discussing the future use of this instrument at crime scenes or in the laboratory to develop investigative leads by assisting in the recognition and recovery of such trace evidence.

A ruggedized x-ray fluorescence instrument has been designed to investigate trace element content at crime scenes. The initial focus is to identify possible materials of interest such as gunshot residue (GSR) and bodily fluids. The instrument has been designed to be part of a system to aid crime scene investigation and transmit the data to locations requiring it. This portable instrument was designed to meet the obvious constraints of weight, battery operation, and ruggedness. A number of special design features, however, were needed to allow for the detection of microgram quantities of the trace elements of interest. The instrument makes use of a custom-designed x-ray generator and a new type of Shottky-barrier cadmium telluride x-ray detector.

This instrument is part of a teleforensics program jointly funded by NIJ and NASA. This collaboration seeks to develop cost-effective instrumentation based on technology developed for the space program to benefit crime scene investigation, and to develop advanced instrumentation for planetary missions for NASA. A critical factor at crime scenes is the collection of evidence for analysis at forensic laboratories. The friable nature of evidence requires rapid recognition, to avoid losing the probative information contained therein. Some evidence is invisible to normal investigation techniques, either because it involves trace quantities not visible to any investigation technique, or because it is covered or hidden from view. Many types of potential evidence can be indicated by crime scene detection through in situ trace element analysis.

We show data that supports possible use of an x-ray fluorescence instrument through detection of gunshot residue, blood (through the detection of the iron in hemoglobin) and semen (through the detection of zinc protoporphorin). To detect the low levels of trace element concentrations, advanced technology has been incorporated including the unique x-ray generator and a recently developed Shottky cadmium telluride x-ray detector. The design of the internal structure of the instrument minimizes the background due to coherent scattering. It was also necessary to select the x-ray tube anode material to ensure that the tube's x-ray line production does not interfere with the detection of elements of forensic interest.

Results of experiments to date realistically characterize the expected performance of the instrument for detecting trace element concentrations that are useful for investigating crime scenes and in laboratory applications.

X-Ray, Trace Evidence, Criminalistics

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