C17 Forensic Distance Determination by TXRF After Firearm Use

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After attending this presentation, attendees will be introduced to TXRF as a non-destructive technique for gun shot residue analysis with a bench-top system. This paper will demonstrate the suitability of TXRF (Total reflection X-ray fluorescence analysis) for distance determination after firearm use. In contrast to chemical tests, TXRF enables the distance determination for all types of ammunition. In addition, TXRF provides much higher accuracy then the widely used gunshot pattern testing.

TXRF can be applied to different sample types, like solids in form of micro fragments, powders, suspensions, thin films or liquids. The required sample amount is in the low µg or µl range, respectively. In TXRF the samples are prepared as thin film or layer, thus matrix effects are negligible. Quantification is possible by means of the known concentration of an internal standard element.

This paper will impact the forensic science community by introducing TXRF as a versatile and accurate technology, which may replace traditional technologies in most forensic laboratories.

Distance determination after firearm use is an important task during crime scene investigations. This requires trace element analysis of gunshot residue in the area surrounding the bullet hole. The major sources of gunshot residue are the ammunition's primer, which contain lead styphnate, barium nitrate and antimony sulfide compounds. However, some new primers do not contain lead, but can be characterized by other elements (e.g., Cu and Zn). In this presentation the determination of shooting distances for plumbiferrous and unleaded ammunition by TXRF is described.

All measurements were performed using the bench top TXRF spectrometer S2 PICOFOX. Shooting experiments were performed on white scrim. After shooting of textile samples, an area around the bullet hole was cut out. The textile samples were treated with aqua regia prior to the analysis.

A correlation of the element concentrations and the shooting distance for leaded and unleaded ammunition was shown up to a distance of about 45 and 60 inches, respectively.

The results of the presented measurements clearly indicate the suitability of a TXRF spectrometer for distance determination after firearm shooting. In contrast to other analytical methods like atomic spectroscopy, no external calibration is necessary. The simultaneous determination of all detectable elements by TXRF is possible also in case of unknown ammunition or element concentrations. Therefore, TXRF offers the flexibility to handle future changes of primer compositions. Finally, the presentation will give an outlook about further forensic applications, which will be covered by TXRF in the future. A semi- quantitative element analysis of minute amounts of glass splints or pigment samples followed by correspondence analysis will provide an unambiguous fingerprint of each sample. This will lead to a doubtless identification of the source or manufacturer of such a sample. Forensic scientists will receive the evidentiary value within a minimum of time required for sample preparation, measurement and quantification.

Shooting Distance, Gun Shot Residue, Elemental Analysis

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