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joint meeting
KALAHARI RESORTS



Trace/Arson & Explosives Session

Location: Kilimanjaro Ballroom Suite 5

NEAFS

Roberta Westerman, Trace/Arson Session Chair

MAAFS

Jackson Dimalanta, Physical Evidence Section Chair

Ashley Stein, Physical Evidence Section Chair-Elect

Thursday, October 8

- 9:00 am** **Leveraging Flies as Sentinels for the Detection & Identification of Illicit Chemicals by Portable Mass Spectrometry and Ion Mobility Spectrometry**
Brooke W. Kammrath, PhD^{1,2}, Lauryn Cammarata, B.S.¹, Hadleigh J. Sargent¹, Kalyna Karpishka, B.S.¹, Hailey Ruddock, B.S.¹, Pauline E. Leary, PhD³, Samantha J. Sawyer, PhD¹ - ¹University of New Haven ²Henry C. Lee Institute of Forensic Science ³Noble
- 9:15 am** **Pairwise Comparisons versus Regression Statistics to Determine Processed Sample Stability**
Matthew J. Keller, Emily Halpern, McKenzie Pochiro, Riley McCullough, Roman Karas, Christopher A. Tipple, Colby E. Ott - FBI/ORISE
- 9:30 am** **Analysis of Product Removal from Hair Shafts for Forensic Applications**
Lauren Lozano - University of the Incarnate Word
- 9:45 am** **Differentiation of 3 cm Single-Hair Fragments by 9 Selected Amino Acid Ratios**
Mara Hann, Robert Powers, PhD, Alyssa Marsico, PhD - University of New Haven
- 10:00 am** **Break**
- 10:45 am** **Real Time Detection of Organic Gun Shot Residue using a Novel Dielectric Barrier Discharge Ionization Source**
Charlotte Fletcherova, M.S., Adam Hall, PhD, Ciara Conway, Jan-Christoph Wolf, PhD - Boston University
- 11:00 am** **Application of Image Analysis Tools To The Differentiation of Packaging Tape Samples Examined By Polarized Light Microscopy**
Walter F. Rowe, PhD - The George Washington University
- 11:15 am** **Detection of Energetic Materials and Smokeless Powder Additives for Explosives Residue Analysis**
Matthew J. Keller, Christopher A. Tipple, Colby E. Ott - FBI



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- 11:30 am** **A First-Principles Investigation of Shock Sensitivity in Triacetone Triperoxide**
Grace E. Patzer, BS, Taylor M. Davis, BS, Matthew T Kieber-Emmons, PhD - Cedar Crest College
- 11:45 am** **Analysis of Extraction Methods for Explosives in Soil Matrixes Characterized by Total Organic Content and Separation for Identification and Quantification Utilizing Gas-Chromatography Mass-Spectroscopy and High-Performance Liquid-Chromatography**
Taylor Geist, MPS¹, William Campbell, PhD¹, Jason Herrington, PhD², Michael Kuslusi, MFS¹ - ¹Pennsylvania State University, ²Restek
- 12:00 pm** **Lunch**
- 2:30 pm** **O–O Bond Cleavage Selectivity in Copper-Mediated Hydroperoxide Decomposition: Mechanistic Insights for the Forensic Interpretation of Peroxide Explosive Decomposition**
Alexis R. Kline , Matthew Kieber-Emmons, Ghazanfar Ali, Marianna Mancuso - Cedar Crest College
- 2:45 pm** **Target practice or executions?**
Pete Diaczuk, Nick Petraco - John Jay College
- 3:00 pm** **Visual and Elemental Analysis of Fraudulent Pet Cremations**
Rhys Williams - Loyola University Maryland
- 3:30 pm** **Break**
- 4:00 pm** **What to Expect When You Are Assessing: A Beginner's Guide to Forensic Assessments**
David Greene - ANAB
- 4:15 pm** **Wrongful Convictions Related to Forensic Procedures: A Comparative Analysis of Legal Frameworks and Practice in the United States and Europe**
Dariusz Wilk - Jagiellonian University in Kraków
- 4:30 pm** **ABC Update 2026**
Heather L Harris - Arcadia University



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Leveraging Flies as Sentinels for the Detection & Identification of Illicit Chemicals by Portable Mass Spectrometry and Ion Mobility Spectrometry

Brooke W. Kammrath, Ph.D.^{1,2}, Lauryn Cammarata, B.S.¹, Hadleigh J. Sargent¹, Kalyna Karpishka, B.S.¹, Hailey Ruddock, B.S.¹, Pauline E. Leary, Ph.D.³, Samantha J. Sawyer, Ph.D.¹ - ¹University of New Haven ²Henry C. Lee Institute of Forensic Science ³Noble

Clandestine production sites for illicit drugs and explosives pose significant health and safety risks to first responders and surrounding communities, and current detection methods often require direct site entry or costly laboratory-based sampling. This study evaluated the use of necrophagous flies as passive chemical sentinels for cocaine, fentanyl, and the explosive TNT, leveraging their natural tendency to contact diverse substrates and passively acquire trace residues. Flies were inoculated with each target analyte, processed using dry swabbing, a methanol cuticle wash, or homogenization, and analyzed with two portable mass spectrometers (1st Detect Tracer 1000, 908 Devices MX908) and a portable ion mobility spectrometer (Smiths Detection IONSCAN 600). All three analytes were detected across preparation methods and instruments, with the methanol cuticle wash yielding the most consistent recovery (100% detection for all three analytes), and target analytes remained detectable within the flies for multiple hours post-exposure. These findings support blow flies as a low-cost, field-deployable complement to canine detection and laboratory testing for surveillance of clandestine drug and explosives production sites.

Pairwise Comparisons versus Regression Statistics to Determine Processed Sample Stability

Matthew J. Keller, Emily Halpern, McKenzie Pochiro, Riley McCullough, Roman Karas, Christopher A. Tipple, Colby E. Ott - FBI/ORISE

Processed sample stability is an important metric for many analytical methods, especially in forensic contexts. The most commonly employed approach is to compare the average analyte response at defined time points to its average starting response. Through extensive simulation and empirical analyses, we evaluated the accuracy of this approach and compared it to the use of regression (linear and quadratic). Regression methods were found to be more accurate than pairwise comparisons



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across multiple data types and techniques, while requiring fewer samples to be tested. Based on the results, adoption of regression models for stability studies is encouraged for consideration and to provide higher confidence.

Analysis of Product Removal from Hair Shafts for Forensic Applications

Lauren Lozano - University of the Incarnate Word

Hair fibers are an important part of trace evidence in criminal investigations due to their ease of transference and their ability to link suspects and locations to victims, often through DNA analysis. With the exception of microscopic comparison and mitochondrial DNA analysis, the hair shaft itself has limited use in forensic examinations which could be overlooking valuable information the shaft might contain. Styling fiber products are resinous agents used for thickening and texture and are commonly applied to the entirety of the hair strand, which could increase the probative value of the hair evidence by adding an additional defining factor. We are using GC-MS to study this potential, aiming to find if the presence of different brands of styling fiber products can be detected within a recovered hair strand.

Differentiation of 3 cm Single-Hair Fragments by 9 Selected Amino Acid Ratios

Mara Hann, Robert Powers, PhD, Alyssa Marsico, PhD - University of New Haven

A previously developed method using eleven amino acid ratios obtained through gas chromatography-mass spectrometry (GC-MS) successfully differentiated morphologically similar hair samples using 3.0 mg of hair (~50 cm) with an 84% differentiation rate within color grouping. Using five individual 3 cm (~0.015 mg) hair fragments from each of the five different donors, amino acid profiles were generated and evaluated for differentiation between samples. Samples were analyzed using a Shimadzu liquid chromatography-tandem mass spectrometry (LC-MS/MS) system equipped with a hydrophilic interaction liquid chromatography (HILIC) column, amino acids were identified using multiple reaction monitoring (MRM) transitions, and peaks areas were integrated to calculate amino acid ratios. The percent differences between amino acid ratios among donors were calculated to assess hair sample differentiation, and preliminary results demonstrated successful differentiation of all five donors. Across the nine amino acid ratios tested, each donor pair contained at least five ratios with greater than a 10% difference, and when applying a 15% difference threshold, all ten donor comparisons contained at least three ratios above the cutoff, with the majority containing four and six ratios.



Real Time Detection of Organic Gun Shot Residue using a Novel Dielectric Barrier Discharge Ionization Source

Charlotte Fletcherova, M.S., Adam Hall, Ph.D., Ciara Conway, Jan-Christoph Wolf, Ph.D. - Boston University

Organic gun shot residue was detected through the use of a JetDesorber with a dielectric barrier discharge ionization source connected directly to a mass spectrometer. Samples tested over a period of time allowed target peaks to be identified, along with the respective degradation products. Key, target components to help identify the organic gun shot residue included ethyl centralite, diphenyl amine, dibutyl phthalate, and more. Real time detection of the ignition of smokeless powders allowed for quantitative comparisons of target and degradative analytes in pre-ignition, post-ignition, and one month following ignition. This study resulted in reliable identification of degradative peaks consistent with organic gun shot residue as well as a nondestructive technique to detect organic gun shot residue off of carbon stubs.

Application of Image Analysis Tools To The Differentiation of Packaging Tape Samples Examined By Polarized Light Microscopy

Walter F. Rowe, PhD - The George Washington University

Packaging tapes (bi-axially oriented polypropylene or BOPP tapes) examined between crossed polarizing filters with a polarizing microscope show complex cross-hatched patterns when the tapes are oriented close to extinction. These patterns result from the stretching of the polypropylene tape backing both laterally and in the extrusion direction during the manufacturing process. The cross-hatched patterns can be recorded by photographically and the resulting photomicrographs can be analyzed by a number of image analysis tools, including fractal dimension determination and two-dimensional digital Fourier transforms. The cross-hatched patterns of samples of a number of different brands of BOPP tapes were analyzed. Both fractal dimensions and Fourier transforms were found to be useful in differentiating different brands of tape.

Detection of Energetic Materials and Smokeless Powder Additives for Explosives Residue Analysis

Matthew J. Keller, Christopher A. Tipple, Colby E. Ott - FBI

Protocols for differentiating smokeless powders often rely on multiple methods and instruments. Additionally, the detection of nitroguanidine (an important component of some smokeless powders) from residues is especially challenging due to its high hydrophilicity. We have developed a liquid chromatography-tandem mass spectrometry method for the detection of energetic materials and smokeless powder additives from post-blast samples. This method serves as a powerful approach for screening or confirmation of explosives residue-related investigations.



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A First-Principles Investigation of Shock Sensitivity in Triacetone Triperoxide

Grace E. Patzer, BS, Taylor M. Davis, BS, Matthew T Kieber-Emmons, PhD - Cedar Crest College

Triacetone triperoxide (TATP) is a highly shock-sensitive explosive, and because it can be prepared from readily available household precursors, it has become a growing concern in forensic and counterterrorism contexts. TATP is sensitive to both thermal and mechanical stimuli, yet whether a common electronic origin underlies its shock and thermal decomposition remains unclear. The initiating chemical event is believed to be homolytic cleavage of a peroxide bond within the nine-membered ring, yet this step carries a substantial activation barrier (36 kcal/mol)¹. Because of the magnitude of this barrier, a purely thermal initiation struggles to account for TATP's extreme shock sensitivity. To overcome this challenge, various models including hotspots, doorway modes, and mechanical distortion have been conceived in which deposited energy lowers or bypasses the barrier. While these models differ in how energy reaches the initiating bond, each ultimately depends on how the electronic structure responds to distortion, which has not been characterized from first-principles for a peroxide. We investigated this bond-breaking event through density functional theory and multireference ab initio calculations. The breaking peroxide bond was observed to develop open-shell character progressing from near equilibrium geometries, motivating a complete active space treatment of the critical region of homolysis. The converged active space is composed of sigma and sigma-star orbitals of the dissociating O-O bond as well as oxygen lone-pair orbitals, with no carbon-centered orbitals selected, indicating carbon is uninvolved along this reaction coordinate. Along the O-O stretch itself, a relaxed one-dimensional potential energy scan proceeds without an electronic barrier and rises to 43 kcal/mol, comparable to modern dialkyl peroxide bond strengths². The singlet-triplet gap collapses from 25.6 to < 1 kcal/mol between 2.05 and 2.85 Å, identifying the geometric window over which biradical character becomes fully developed. Ongoing work connects these molecular results with the crystalline lattice. Current results and their implications for TATP sensitivity will be presented.

Analysis of Extraction Methods for Explosives in Soil Matrixes Characterized by Total Organic Content and Separation for Identification and Quantification Utilizing Gas-Chromatography Mass-Spectroscopy and High-Performance Liquid-Chromatography

*Taylor Geist, MPS¹, William Campbell, PhD¹, Jason Herrington, PhD², Michael Kuslusi, MFS¹ -
¹Pennsylvania State University, ²Restek*

Explosives residues can be recovered from soil and characterized using gas chromatography–mass spectrometry (GC MS) and high performance liquid chromatography (HPLC), but elevated soil organic content can reduce extraction efficiency through binding and degradation of nitrogen containing analytes. This study evaluated and compared the performance of solid phase extraction (SPE), solid phase microextraction (SPME), and solid phase microextraction arrow (SPME Arrow) for the recovery of nitroaromatic and nitroamine explosives from soils classified as low, medium, and high total organic content. The SPME Arrow approach was investigated specifically for its increased sorbent surface area and potential to enhance extraction efficiency while reducing solvent consumption and overall analytical cost.

In parallel, HPLC separation strategies were developed to improve post blast identification of a broad panel of nitroaromatics and nitroamines by systematically varying and combining column chemistries,



including C18, phenyl, mixed C18/phenyl, C18 F5, C18 connected to phenyl, and C18 F5 connected to phenyl configurations. Particular attention was given to investigating 2,4 diaminoanisole, a primary breakdown product of 2,4 dinitroanisole, within complex post blast matrices. The optimized extraction and separation methods were applied to field-collected samples and demonstrated utility in a forensic case study, illustrating their applicability to real world investigations.

Because explosives are deployed across military, law enforcement, agricultural, mining, construction, and aerospace contexts, robust analytical approaches are needed to identify and quantify explosive formulations at post blast sites regardless of matrix complexity. The combined use of advanced solid phase extraction strategies and tailored HPLC column chemistries presented here addresses this need by improving the recovery and chromatographic resolution of explosive residues from organic rich soils, thereby strengthening forensic interpretations in explosive related incidents.

O–O Bond Cleavage Selectivity in Copper-Mediated Hydroperoxide Decomposition: Mechanistic Insights for the Forensic Interpretation of Peroxide Explosive Decomposition

Alexis R. Kline , Matthew Kieber-Emmons, Ghazanfar Ali, Marianna Mancuso - Cedar Crest College

Organic hydroperoxides are highly reactive compounds whose decomposition is initiated by O–O bond cleavage, yet the molecular factors governing whether this bond cleaves through homolytic or heterolytic pathways remain incompletely understood. Resolving these factors is important for understanding transition-metal-mediated oxidation chemistry and has significant forensic implications, as the branching between cleavage pathways dictates the decomposition products that can be used to detect and interpret peroxide-based explosives. This study investigates the mechanism of copper-mediated peroxide O–O bond cleavage using a Cu(I)–TMPA (tris(2-pyridylmethyl)amine) complex and the model alkyl hydroperoxide 2-methyl-1-phenyl-1-propyl hydroperoxide (MPPH), whose decomposition yields distinct products depending on whether cleavage occurs through homolytic or heterolytic pathways. Product distributions will be presented that provide mechanistic insight into these pathways. By establishing how proton activity governs the homolytic/heterolytic branching, this work develops a mechanistic framework for cleavage-pathway selectivity that may inform the interpretation of peroxide explosive decomposition.

Target practice or executions?

Pete Diaczuk, Nick Petraco - John Jay College

Some historians theorize that during World War II, while Fort Platte Saline was actually used as a fort for the military, it was used for executing people who were not following the orders of the occupying army. Other historians argue that the numerous bullet holes in the interior walls of the Fort were caused by soldiers conducting target practice, not engaging in the war crime of executing civilian or slave laborers.

The authors were asked to travel to the sites of possible executions on the British Channel Island of Alderney in search of trace evidence that might prove or disprove the execution hypothesis.



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Visual and Elemental Analysis of Fraudulent Pet Cremations

Rhys Williams - Loyola University Maryland

The distinction of bone in suspected cremations is a significant challenge to forensic practitioners, particularly when mixed with sediments and other unidentified material. This research explores the forensic analysis of 61 fraudulent cremated remains of pet animals in Baltimore, Maryland. A combination of visual identification of bone fragments, UV fluorescence, and elemental analysis with portable X-ray fluorescence (pXRF) were used. The majority of samples showed no visual or elemental composition of bone, and several samples contained foreign material, including scrap metal, building materials, coral, and human bone fragments. Overall, this research observed materials inconsistent with legitimate pet cremations throughout all the submitted samples.

What to Expect When You Are Assessing: A Beginner's Guide to Forensic Assessments

David Greene - ANAB

After learning about the assessment of forensic testing, inspection, and calibration, the next step—becoming an assessor—can feel intimidating. Taking that first step into forensic technical assessment often raises questions about what to expect and how to get started. This presentation will demystify the process of volunteering as a forensic technical assessor by outlining preparation before the assessment, walking through how an on-site assessment progresses, and highlighting the professional and organizational benefits of serving in this role. Attendees will gain practical insight into the assessor experience and a clearer understanding of how participation strengthens both individual expertise and the broader forensic community.

Wrongful Convictions Related to Forensic Procedures: A Comparative Analysis of Legal Frameworks and Practice in the United States and Europe

Dariusz Wilk - Jagiellonian University in Kraków

Wrongful judicial decisions, which may, for example, result in the conviction of an innocent person, arise from various causes, including, among others, errors made by law enforcement authorities in conducting forensic procedures. These include, in particular, mistaken identification by a witness, false confessions to committing a crime, and errors in forensic expert examinations. Some causes of wrongful convictions may be mitigated by introducing appropriate requirements concerning the procedures and conditions under which forensic activities are conducted. Therefore, for the purposes of the presentation, a comparative legal analysis of the regulations in force in EU Member States and selected U.S. states was conducted in order to determine the optimal conditions for carrying out such procedures. On this basis, several key issues were identified: requirements concerning the conduct of identification procedures; the prohibition of treating a suspect's confession as the sole source of evidence; and the possibility of having an expert opinion verified by another expert.