

STATE OF WISCONSIN : CIRCUIT COURT : MANITOWOC COUNTY

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STATE OF WISCONSIN,	)	
	)	
Plaintiff,	)	
	)	Case No. 05-CF-381
v.	)	
	)	Honorable Judge Angela Sutkiewicz,
STEVEN A. AVERY,	)	Judge Presiding
	)	
Defendant.	)	

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**AFFIDAVIT OF CHRISTOPHER PALENIK, Ph.D.**

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Now comes your affiant, Christopher Palenik, Ph.D., and under oath hereby states as follows:

1. I am of legal majority and can truthfully and competently testify to the matters contained herein based upon my personal knowledge and to a reasonable degree of scientific certainty. The factual statements herein are true and correct to the best of my knowledge, information, and belief.
2. Microtrace, LLC was founded in 1992 and specializes in the characterization and identification of minute amounts of unknown substances and single small particles through a combination of disciplines that span chemistry, geology, biology and materials science.
3. Microtrace staff have contributed to a variety of high profile cases including: the Unabomber, Swiss Air Crash, Narita Airport Bombing (Tokyo), Air India Bombing, Oklahoma City Bombing, the Green River Murders, Jon Benet Ramsey Case, Atlanta Child Murders, "Ivan the Terrible" war crimes trial (Jerusalem), and the kidnapping and



murder of DEA special agent "Kiki" Camerena in Mexico.

4. Microtrace staff have conducted analyses and reviews of scientific findings in numerous cases involving trace evidence and have testified for both the prosecution and defense. Our staff have, in addition, performed U.S. National Institute of Justice funded research and published articles and book chapters on various aspects of microscopic trace evidence.
5. The Microtrace laboratory conforms to the same international quality standard (ISO 17025) adhered to by forensic laboratories around the world.
6. Our laboratory, Microtrace LLC, has been retained by counsel for Steven Avery to perform microanalysis on certain items of evidence that were submitted at Mr. Avery's trial: State of Wisconsin vs. Steven Avery (Case No. 05 CF 381).
7. I have prepared this affidavit as a Senior Research Microscopist at Microtrace. I received my MS and PhD in Geology from the University of Michigan. I took a Post Doctoral Fellowship with the Federal Bureau of Investigation, Forensic Science Research Unit. I have published extensively in the field of research microscopy. My professional appointments have included:
  - a. Chemistry/Instrumental Analysis Scientific Area Committee's (SAC) Materials (Trace) Subcommittee within the Organization of Scientific Area Committees (OSAC) sponsored by the National Institute of Standards and Technology (NIST);
  - b. North Carolina Forensic Science Advisory Board Member, appointed by the Attorney General of North Carolina;
  - c. Scientific Working Group for the Analysis of Geological Materials (SWGCEO);
  - d. UNESCO International Union of Geological Sciences (IUGS) Initiative on Forensic Geology Geological (IoFG) Trace Evidence Advisor.

A copy of my CV is attached to this affidavit as **Exhibit A**.

### I. Scientific Findings – Hood Latch Swab

8. All opinions expressed herein as based upon a reasonable degree of scientific certainty in the fields of forensic geology and forensic microscopy.
9. A microscopical analysis of the hood latch swab fragment submitted to us (Item ID swab from hood latch / trial exhibit #205 / Independent Forensic Ex. 1) shows that it is composed largely of fine mineral grains and other particles of airborne dust (*e.g.*, pollen). This is qualitatively consistent with the size range and composition of debris collected from the hood latch of an exemplar 2012 Toyota Rav 4.
10. The quantity of debris on the hood latch swab is such that it is only visible through microscopical observation. Swabs collected from the hood latches of two exemplar vehicles (a 2012 Rav 4 and a 2007 Volvo S60) each showed a considerably heavier loading of debris. Whereas particles on the hood latch swab (item ID / trial exhibit #205) could only be seen with the aid of a microscope, a swab from each exemplar vehicle showed a heavy, dark streak of collected debris that is clearly visible to the unaided eye.


### II. Scientific Findings – Key

11. Two previously established facts suggest that the recovered key (Item C / trial exhibit #211) (*i.e.*, the questioned key) was not the primary key in use by the victim: 1) The key is a sub key, as seen by comparing the shape of the recovered key to illustrations in the 1999 Toyota RAV-4 manual (manual and trial exhibit 219 attached to this affidavit as **Group Exhibit B**) which provides limited access to the vehicle. 2) The key appears to be different from one seen with the victim in a photo (Trial exhibit 5, attached to this affidavit as **Exhibit C**).

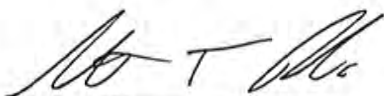
12. The questioned key and debris adhering to it were microscopically examined. Wear patterns on surfaces of the key that make contact with the locks/ignition show evidence that the key had been utilized since the deposition of the fine debris in the key grooves occurred. This is consistent with testimony that the key had been placed into the vehicle ignition and driver's door after collection by state crime laboratory analyst (Excerpt from testimony of State Crime Lab analyst Sherry Culhane, attached to this affidavit as **Exhibit D**).

13. Furthermore, the relative amount of debris in the key grooves was compared to five exemplar vehicle keys that are utilized on a daily basis (including one from a 2012 Toyota Rav 4). While the amount of debris on a key can vary due to a number of circumstances, the general quantity of debris on the recovered key (M05-2467C) is greater than any of the exemplar keys that were examined. This is consistent with the hypotheses that the key in question was not utilized on a regular basis and was not the primary vehicle key utilized by Ms. Halbach. This is also consistent with the previously established facts stated in paragraph 11.

**FURTHER AFFIANT SAYETH NAUGHT**

  
\_\_\_\_\_  
Christopher Palenik, PhD

Subscribed and sworn before me  
this 3<sup>rd</sup> day of May, 2017.

  
\_\_\_\_\_  
Notary Public



STATE OF WISCONSIN : CIRCUIT COURT : MANITOWOC COUNTY

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2. Microtrace, LLC was founded in 1992 and specializes in the characterization and identification of minute amounts of unknown substances and single small particles through a combination of disciplines that span chemistry, geology, biology and materials science.
3. Microtrace staff have contributed to a variety of high profile cases including: the Unabomber, Swiss Air Crash, Narita Airport Bombing (Tokyo), Air India Bombing, Oklahoma City Bombing, the Green River Murders, Jon Benet Ramsey Case, Atlanta Child Murders, "Ivan the Terrible" war crimes trial (Jerusalem), and the kidnapping and murder of DEA special agent "Kiki" Camerena in Mexico.



4. Microtrace staff have conducted analyses and reviews of scientific findings in numerous cases involving trace evidence and have testified for both the prosecution and defense. Our staff have, in addition, performed U.S. National Institute of Justice funded research and published articles and book chapters on various aspects of microscopic trace evidence.
5. The Microtrace laboratory conforms to the same international quality standard (ISO 17025) adhered to by forensic laboratories around the world.
6. Our laboratory, Microtrace LLC, has been retained by counsel for Steven Avery to perform microanalysis on certain items of evidence that were submitted at Mr. Avery's trial: State of Wisconsin vs. Steven Avery (Case No. 05 CF 381).
7. I have prepared this affidavit as a Senior Research Microscopist at Microtrace. I received my MS and PhD in Geology from the University of Michigan. I took a Post Doctoral Fellowship with the Federal Bureau of Investigation, Forensic Science Research Unit. I have published extensively in the field of research microscopy. My professional appointments have included:
  - a. Chemistry/Instrumental Analysis Scientific Area Committee's (SAC) Materials (Trace) Subcommittee within the Organization of Scientific Area Committees (OSAC) sponsored by the National Institute of Standards and Technology (NIST);
  - b. North Carolina Forensic Science Advisory Board Member, appointed by the Attorney General of North Carolina;
  - c. Scientific Working Group for the Analysis of Geological Materials (SWGCEO);
  - d. UNESCO International Union of Geological Sciences (IUGS) Initiative on Forensic Geology Geological (IoFG) Trace Evidence Advisor.

A copy of my CV is attached to this affidavit as **Exhibit A**.

## I. Scientific Findings – Bullet #FL

### Background and Approach

8. The purpose of this examination was to determine if evidence of bone could be detected on the surface of bullet #FL.
9. The following analytical approach was utilized:
  - a. Perform the first in depth photo-documentation and microscopical examination of the #FL bullet. This was conducted by a combination of stereomicroscopy and digital video microscopy, the latter of which was used to produce a map of the bullet surface and the debris adhering to it. The microscopes used were manufactured in 2016.
  - b. Characterization of the bullet by scanning electron microscopy and energy dispersive x-ray spectroscopy (SEM/EDS). Using the digital images of the bullet surface as a guide, specific areas were examined in detail and analyzed to determine their elemental composition. The inorganic portion of bone is composed almost entirely of calcium, phosphorous and oxygen, all of which are detectable by this approach. The SEM/EDS equipment used was produced in 2016.

### Exemplar Bullet Examination – Proof of Concept

10. In preparation for this examination, four exemplar bullets, fired through bone by L. Haag, were examined at our laboratory.
  - a. The exemplar bullets were initially examined and photo-documented by a combination of stereomicroscopy and digital video microscopy to assess the overall condition of the bullet. This initial examination showed the presence of white, translucent particles, consistent with the appearance of bone, on the surface of or embedded in each of the four exemplar bullets.
  - b. After the initial examination and documentation, the bullets were individually packaged and submitted to Independent Forensics for DNA extraction, to simulate the process to which the #FL bullet had been subjected. Independent Forensics Laboratory Supervisor Liz Kopitke placed each of the damaged bullets in separate test tubes and submerged them in buffer fluid. Ms. Kopitke then shook the test tubes in her hand.
  - c. The post-extraction exemplar bullets were again examined and photo-documented by a combination of stereomicroscopy and digital video microscopy. This examination showed that white, translucent particles, morphologically consistent

with bone, remained on and embedded in each of the four exemplar bullets. That is, the DNA extraction conducted by Independent Forensics, which was meant to simulate the the extraction process #FL was subjected to, did not cause the white, translucent particles consistent with bone to fall or become dislodged from the exemplar bullet

- d. SEM/EDS analysis of debris on two of the exemplar bullets showed, as expected, the co-occurrence of calcium, phosphorous and oxygen in areas identified by digital video microscopy as containing white, translucent particles that appeared to be fragments of bone.

11. This study of exemplar bullets demonstrates the following:

- a. Particles consistent with bone were detected on each of the four exemplar bullets that were studied.
- b. This approach using a combination of stereomicroscopy, digital video microscopy and scanning electron microscopy was shown to be suitable for the *in situ* documentation and identification of bone on a bullet. If indications of bone were detected by these methods, further analytical approaches could be applied to more specifically confirm its presence.
- c. Particles consistent with bone were detected on the exemplar bullets after they were subjected to a DNA extraction process meant to simulate the DNA extraction performed on #FL.

#### **Bullet #FL Analysis**

12. On 23 May 2017, a bullet (M05-2467 #FL) was hand carried to Microtrace by Special Agent Jeff Wisch of the Wisconsin Department of Justice.

13. The bullet remained in the custody of SA Wisch during the analysis performed at Microtrace.

14. The bullet was opened, photo-documented, and examined using a combination of stereomicroscopy and digital video microscopy.

15. This examination revealed that the bullet surface was covered in debris exhibiting the following characteristics:

- a. A waxy substance covers a significant portion (~40%) of the leading surface of the bullet. This material may be related to the waxes used by a firearms analysts



to orient and hold bullets during their analysis. Further analysis of the waxy material could clarify this point.

- b. Numerous, fine red flakes are on or embedded in the waxy substance.
- c. Numerous fibers are observed adhering to the waxy substance. Most of these are colorless; however, red and black fiber fragments were also noted. Other white fibers not associated with the waxy surface were observed in association with the bullet. These fibers could be more specifically identified after isolation and further analysis.
- d. Numerous wood fragments are present in, on and/or under the waxy substance. Further analysis could elucidate their specific relationship to the waxy substance. Other wood fragments appear to be directly adhering to or embedded in the lead of the bullet. This later observation suggests that at least some of the wood was deposited when the energized bullet encountered a wooden object. Some of the fragments observed are individual particles of wood. One particle appears to be an agglomeration of woody fragments, possibly originating from a manufactured wood product such as chip or particle board. Isolation and analysis of these particles would be required if their specific identity (e.g. species, type of wood product) is of interest.
- e. A rounded red droplet ( $\sim 0.073 \text{ mm}^2$ ) adjacent to a smaller red droplet ( $\sim 0.005 \text{ mm}^2$ ) is present on one side of the bullet. The identity of this dried liquid is presently unknown. Based upon its color and the fact that the bullet was previously extracted for DNA, it seems unlikely that this is blood. The color, texture, and shape of the deposit suggests that the material may be paint. Regardless of its identity, the texture of the bullet in the area where the droplets are observed strongly suggests that the droplet was deposited after the bullet was fired and came to rest. This material could be identified if subjected to further analysis.
- f. No particles consistent with bone were detected by an examination using stereomicroscopy or digital video microscopy.

16. Note that the criteria for classification each material described above is based upon *in situ* observations and are not necessarily inclusive of all particle types that may be present. A more thorough examination would require the physical isolation of the debris for a more detailed analysis.

17. The sample was examined without any further preparation in a JEOL 7100FT field emission scanning electron microscope with a 50 mm<sup>2</sup> Oxford SDD EDS detector.

- a. The base of the bullet was fixed upon a piece of conductive, double sided, carbon tape.
- b. An image of the bullet was obtained at 20 kV. The sample was examined by a combination of backscatter and secondary electron imaging at magnifications ranging from ~50x to 2000x.
- c. Elemental maps were collected from various areas on the leading surface of the bullet that showed surfaces with exposed lead (*i.e.*, away from the waxy deposit). The elemental maps were examined for areas with elevated levels of calcium and phosphorous. Each area analyzed was rotated toward the EDS detector to increase the number of x-rays detected.
- d. No areas with elevated levels of calcium and phosphorous were detected, indicating the absence of detectable bone.
- e. A few silicon-rich areas were noted, which may suggest the presence of silicate compounds (*e.g.*, minerals).
- f. No particles consistent with bone were detected by SEM/EDS analysis.

18. Following the analysis, the bullet was repackaged, sealed and retained by SA Wisch.

## Conclusions

19. Based upon the our analyses, there is no evidence to indicate that the bullet passed through bone. In fact, the particulate evidence that is present strongly suggests an alternate hypothesis, which is that the trajectory of the fired bullet took it into a wooden object, possibly a manufactured wood product. Furthermore, the presence of red droplets deposited on the bullet suggest that the bullet had picked up additional contamination from its environment at some point after coming to rest (*i.e.*, droplets of potential red paint or a red liquid).
20. Based upon these findings, it is our understanding that an investigator was sent by the Zellner Law Office to the Avery garage to review the area for possible sources of the particulate types described above. It is our understanding that the following possible sources were identified:

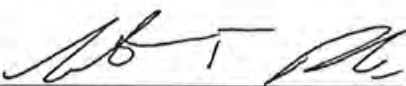
- a. Particle board in the garage with apparent bullet holes.
- b. Red painted surfaces including a ladder in the garage and a red painted ceiling.

21. Each of the above listed materials observed on the bullet could be identified specifically, if their actual identity, is of importance to the investigation. This may provide further constraints or refinement of the hypotheses I have advanced. To facilitate this, specimens would need to be isolated from the bullet and analyzed individually. Isolation and analyses could be conducted using only a small portion of the material available. The potential sources for the particulate matter that were recently collected from the Avery garage could be directly compared to materials on the bullet.

**FURTHER AFFIANT SAYETH NAUGHT**

  
\_\_\_\_\_  
Christopher Palenik, PhD

Subscribed and sworn before me  
this 31<sup>st</sup> day of May, 2017.

  
\_\_\_\_\_  
Notary Public



**Curriculum Vitae**

**of**

**Dr. Christopher Samuel Palenik**

(cpalenik@microtracellc.com)

**Current as of 1/5/2017**

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## Educational History

2002-2004	University of Michigan, Department of Geological Sciences Ph.D. Geology Dissertation Chair: Prof. Rodney C. Ewing Dissertation Committee: Prof. Eric J. Essene, Prof. Ronald Fleming, Prof. Lumin Wang, Prof. Lynn Walter DOE-OCRWM fellowship recipient Horace H. Rackham 2004 Distinguished Dissertation Award
1999-2001	University of Michigan, Department of Geological Sciences M.S. Geology Prof. Rodney C. Ewing, Advisor
1995-1999	University of Chicago B.S. Chemistry, B.S. Geology
1992-1995	Illinois Mathematics and Science Academy, Aurora, IL
1991-1992	Saint Edward's Catholic Central High School, Elgin, IL

## Employment

2005 - Present	Vice President and Senior Research Microscopist, Microtrace, a forensic laboratory specializing in small particle analysis using microchemistry and microscopy.
2004-2005	Federal Bureau of Investigation (ORISE sponsored) Post-Doctoral Fellow in the Counter Terrorism and Forensic Science Research Institute.
1999-2004	Graduate Student Research Assistant in the Electron Microbeam Analysis Laboratory, University of Michigan. Duties include training and assistance to university scientists in TEM, EMPA, XRD, and SEM/EDS.
1999-2000	Graduate Student Instructor for Determinative Methods (GS-455). Teaching responsibilities included XRD, SEM, Microprobe, Raman, FTIR.
1993-2004	Microscopist (consultant) at Microtrace, a forensic laboratory specializing in small particle analysis using microchemistry and microscopy.

## Appointments and Committees

- Chemistry/Instrumental Analysis Scientific Area Committee's (SAC's) Materials (Trace) Subcommittee within the Organization of Scientific Area Committees (OSAC), appointed by Mark Stolorow of the National Institute of Standards (NIST) (2014-present)
- North Carolina Forensic Science Advisory Board Member, Charter Member, Appointed by the Attorney General of the State of North Carolina. Acting as an advisor to the NC State Crime Laboratory to strengthen the laboratory system. (2012-present)
- ASTM International, Subcommittees: E30 - Forensic Sciences, E30.01 – Criminalistics, E30.11 - Interdisciplinary Forensic Science Standards, Participating Member (2014-present)

- Scientific Working Group for the analysis of Geological Materials (SWGCEO), charter member (2012-2014).
- Independent Review Board for Lawrence Livermore National Laboratory "U and Pu Impurities" Project (2013)
- UNESCO International Union of Geological Sciences (IUGS) Initiative on Forensic Geology Geological (IoFG) Trace Evidence Advisor. (2011-present)
- FermiLab Community Advisory Board Member (2010)
- Board of Directors, RQA Food Forensics LLC (2008-present)
- Alumni Board Member, University of Michigan Department of Geological Sciences (2005-2015)

### **Professional Affiliations**

- International Association of Geoanalysts (2016-present)
- American Society of Trace Evidence Examiners (ASTEE), Charter Member (2009-present)
- American Academy of Forensic Sciences, Fellow (2001-present)
- Midwestern Association of Forensic Scientists, Member (2007–present)
- Mineralogical Society of America (2000-present)
- Geological Society of America (2002-present)
- Sigma Xi – Scientific Research Society, Member (1998-2013)
- American Chemical Society (1998-present)
- State Microscopical Society of Illinois (1998-2000, 2007-2010)
- Materials Research Society (2002-2004)

### **Honors**

- Certificate of Recognition by the Midwestern Association of Forensic Scientists for appointment to the Materials (Trace) OSAC Committee, Board of Directors (2015)
- Horace H. Rackham Distinguished Dissertation Award (Highest honor given to dissertations produced under the auspices of the University), University of Michigan (2004)

- John Dorr Graduate Academic Achievement Award – Department of Geological Sciences, University of Michigan (2004)
- Geological Society of America, Travel Grant, (2004)
- Graduate Fellowship Recipient, Department of Energy - Office of Civilian Radioactive Waste Management, (2002-2004)
- Best Paper Award, C.S. Palenik and R.C. Ewing, "Microanalysis of Radiation Damage Across a Zoned Zircon Crystal" - Materials Research Society National Meeting (2001)
- Geological Society of America Travel Grant (2004)
- Scott Turner Research Grant in the Earth Sciences (2001, 2002)
- Member, Rackham Graduate Student Forum (2002)
- Co-President, University of Michigan Geology Club (2000-2002)
- Dean's List, University of Chicago (1995-96, 1997-98, 1998-99)

### **Expert Testimony and Deposition**

- List can be provided upon request.

### **Additional Training and Experience**

- Fluorescence Microscopy. Lectures and Workshop taught by Dr. Steve Ruzin, Director, College of Natural Resources Biological Imaging Facility. 1.5 days of laboratory and lecture (2016).
- $\mu$ -XRF of glass: A practical explanation of ASTM E2926. Lectures by Troy Ernst, Michigan State Police Forensic Laboratory and Ted Manasian, Ohio Bureau of Criminal Investigation. Presented by NIJ / RTI (2016).
- Forensic Hair Analysis. Lecture by Dick Bisbing, retired from McCrone Associates and Michigan State Police. 3 days of laboratory and lecture (2015).
- Introduction to Basic Human Body Tissues. Taught by Dr. Lynne Herold, retired from the Los Angeles County Sheriff's Department Scientific Services Bureau. 2 day workshop (2015).
- Pistol Training. Taught by Jerry Kau, NRA-IPA-IA-ISV-IVA-Certified instructor (2015).
- Blood Spatter and trace Evidence in the Sam Shepard Case. Lecture and discussion presented by Bart Epstein (retired Assistant Director of from the Minnesota Bureau of Criminal Apprehension) (2014).
- Asbestos Analysis by TEM - Instruction in the Standard Methods for the Analysis of Asbestos. Taught by James R. Millette, Ph.D. and Steven P. Compton, Ph.D. of MVA Scientific Consultants, Duluth, GA. 3 day workshop (2014).



- Thermal Field Emission SEM Operations Training Course. Taught by Natasha Erdman, Ph.D. and Tony Laudate of JEOL at JEOL USA, Peabody, MA. 2 day workshop (2014).
- Forensic Applications of Infrared and Raman Spectroscopy. Taught by Ed Suzuki, Ph.D. of the Washington State Police Forensic Laboratory at Microtrace, Elgin, IL. 4 day workshop (2013).
- Post Mortem Root Banding Hair Workshop. Taught by Stephen Shaw, Sandy Koch, and Karen Korsberg Lowe of the Federal Bureau of Investigation and Amy Michaud (of the Bureau of Alcohol, Tobacco, Firearms, and Explosives) at the Smithsonian Institute. 1 day workshop (2013).
- Nanotechnologies in Textiles Workshop. Taught by Prof. Seshadri Ramkumar (of Technical Textiles in the Department of Environmental Toxicology, Texas Tech University). Webinar (2013).
- Automotive and Industrial Paint Workshop. Taught by Tim Moczulewski and Jon Granberg of PPG Industries at the Oak Creek, WI Coatings Plant in conjunction with the Midwestern Association of Forensic Scientists Annual Meeting. ½ day workshop (2012).
- The Analysis of Low Explosives. Taught by Edward C. Bender, ATF Laboratory, Retired. Held at Midwestern Association of Forensic Scientists Annual Meeting, Milwaukee, IL. 1 day workshop (2012).
- Optical Mineralogy. Taught by Prof. Mickey Gunter of the University of Idaho. 1.5 day workshop held at Microtrace LLC.
- ISO 17025 Without Tears. Taught by Terry Mills of ANSI-ASQ-FQS, Tampa, FL. Three day workshop (2012).
- Geology of Volcano National Park. Taught by Phillip Ong, M.S. at Volcano National Park, Big Island, HI. One day session (2012).
- Natural Fiber Identification. Taught by Skip Palenik at McCrone Research Institute. One day training session (2011).
- Animal Hair Identification. Taught by Bonnie Yates of the U.S. Fish and Wildlife National Forensic Lab at the National Institute of Justice Trace Evidence Symposium. One Day Workshop (2011).
- Quartz Grain Surface Textures. Taught by Prof. Peter Bull of Oxford University at Microtrace LLC. One Day Workshop (2011).
- Forensic Paint Examinations and Comparisons. Taught by Scott Ryland of the Florida Department of Law Enforcement (2010).
- An Introduction to Glass Science and Technology workshop. Taught by J. Terry Fisk of JTF Microscopy Services (formerly of the Corning Glassworks Research Lab, New York) (2010)
- Wood Identification workshop, taught by Dr. Regis Miller of the Center of Wood Anatomy Research, Forest Products Laboratory (2009)
- Microspectrophotometry User Course. Workshop taught by Dr. Jim Throne of CRAIC instruments at Microtrace (2009)
- Airborne Fungus Spores. Workshop taught by Dr. John Haines of the New York State Museum and Science Services, Albany, NY at McCrone Research Institute (2009)

- Energy Dispersive X-ray Spectroscopy- Thermo Noran System 6. Workshop taught by Dr. Dave West, ThermoFisher Scientific at Microtrace (2009)
- Private workshop on SERS sample preparation and analysis with Dr. Marco Leona of the New York Metropolitan Museum of Art (2008)
- Fluorescence Microscopy Workshop, taught by Dr. Steve Ruzin of the University of California at Berkeley at McCrone Research Institute (2008)
- Cement and Concrete Microscopy, taught by Don Campbell of the Campbell Petrographic Services, Inc. Dodgeville, Wisconsin (2007)
- Heavy Mineral Identification, taught by Maria Mange of the University of California at Davis (2007)
- Forensic Paint Examination, taught by Scott Ryland of the Florida Department of Law Enforcement, Lansing, MI (2007)
- Hardwood Identification workshop, taught by Dr. Regis Miller of the Center of Wood Anatomy Research, Forest Products Laboratory (2007)
- Advances and Changes in Forensic Paint Examination Workshop, taught by Scott Ryland of the Florida Department of Law Enforcement at California Associate of Criminalists Semi-annual workshop (2006)
- Forensic Soil Examination Workshop, taught by Dr. Ray Murray, Dr. Robert Graham, Marianne Stam, Dr. Lynne Macdonald, Dr. George Sensabaugh, Skip Palenik and Chris Palenik, at California Associate of Criminalists Semi-annual workshop.
- Paper Fiber Identification Workshop, taught by Dr. Walter Rantanen of the Integrated Paper Service (2006)
- Wood Identification Workshop, taught by Dr. Walter Rantanen of the Integrated Paper Services (2006)
- Softwood Identification workshop, taught by Dr. Regis Miller of the Center of Wood Anatomy Research, Forest Products Laboratory (2006)
- Orientation Imaging Microscopy and Phase Identification EBSD workshop, taught by David Dingley and Matthew Nowell, TSL/EDAX, Draper, Utah, (2005)
- Forensic Analysis of Paint, taught by Ed Suzuki, Ed Bartick, FBI Academy, Quantico, VA (2004)
- FTIR Spectroscopy, taught by Edward Bartick, John Reffner, Edward Suzuki, FBI Academy, Quantico, VA (2004)
- Cathodoluminescence Microscopy Workshop, taught by V. Barbin, M. Schvoerer, K. Ramseyer, Florence, Italy (2004)
- Spent Nuclear Fuel workshop, Chicago, IL (2004)
- Lock and Security workshop, Folger-Adams Security, Lemont, IL (2004)
- Metal Working instruction workshop, taught by Julian Broad, Shop Supervisor, University of Michigan (2004)

- Scientific Glassblowing workshop, taught by Harald Eberhart, Master Glassblower, Ann Arbor, MI (2003)
- Secondary ionization mass spectroscopy (SIMS) of uraninite, under Prof. M. Fayek, Oak Ridge National Laboratory, TN (2003)
- Spindle Stage Methods workshop, Instructors: Prof. D. Bloss, Prof. M. Gunter, Dr. S. Su, McCrone Research Institute, Chicago, IL (July, 2003)
- Actinide Chemistry workshop, Institute for Transuranic Elements, Karlsruhe, Germany (June 2003)
- Micro-Raman spectroscopy research on radiation damage in zircon, under Prof. L. Nasdala, Universität Mainz, Germany (March 2002)
- Micro-XRF experimentation, Advanced Photon Source, Argonne, IL (2002)
- Engineering Mineralogy of Ceramic Materials workshop, University of Siena, Italy (June 2001)
- Forensic Fiber Examination, Instructor: S. Palenik, Department of Public Safety, Austin, TX (June, 2000)
- Synthesis of Hf-borosilicate glasses, under Prof. L.L. Davis, Pacific Northwest National Laboratory, Hanford, WA (February, 2000)
- Design and development of the "Microtrace Forensic Fiber Reference Collection", with S. Palenik, Microtrace, Elgin, IL (1998-1999)
- Study of automobile paint finish systems, under Dr. W. Stoecklein, Forensic Science Institute of the Bundeskriminalamt, Wiesbaden, Germany (Summer 1998)
- Study of inclusions in the Allende meteorite, Prof. L. Grossman and Dr. S. Simon, Department of Geophysical Sciences, University of Chicago (1996-1998)
- Mentorship study of Gel-based inks, under L. Olson, National Forensic Laboratory, Internal Revenue Service (1994-1995).
- Infrared Spectroscopy Interpretation, Bowdoin College, Maine, (June, 1996)
- Microchemical Methods, Instructor: S. Palenik, McCrone Research Institute, Chicago, IL (1996)
- Scanning Electron Microscopy, Instructor: Stevens, McCrone Research Institute, Chicago, IL (1994)
- NMR Spectroscopy use and interpretation, IMSA, Aurora, IL (1993-1995)
- Polarized Light Microscopy, Instructor: J. Delly, McCrone Research Institute, Chicago, IL (1992)

## Analytical Techniques

Include but are not limited to: Polarized light microscopy, thermal microscopy, scanning electron microscopy, electron microprobe, energy dispersive X-ray spectroscopy, high-resolution transmission electron microscopy, Raman microspectroscopy, infrared microspectroscopy, cathodoluminescence, UV/visible spectroscopy, scanning white light interferometry, UV/visible/near infrared microspectrophotometry, powder x-ray diffraction, micro-X-ray fluorescence, phase contrast microscopy,

differential interference contrast microscopy, fluorescence microscopy, gas chromatography-mass spectroscopy.

## Research Grants

Nanotrace: Applications of subvisible to nanoscale particles in trace evidence (National Institute of Justice, 2015-DN-BX-K0033) – Role: Principal Investigator

Advanced research in Microspectrophotometry of Fibers: Analysis and Interpretation (National Institute of Justice, 2012-DN-BX-K040) – Role: Principal Investigator

Development of a Turnkey Analytical System for the Forensic Comparison and Identification of Fiber Dyes on Casework-sized Fibers (National Institute of Justice, 2012-DN-BX-K42) – Role: Principal Investigator

Raman spectroscopy of automotive and architectural pigments: in situ identification and evidentiary Significance (National Institute of Justice, 2011-DN-BX-K557) – Role: Principal Investigator

Fundamentals of Forensic Pigment Identification by Raman microspectroscopy: A practical identification guide and spectral library (National Institute of Justice, 2010-DN-BX-K236) – Role: Principal Investigator

## GRADUATE COMMITTEES

Samuel Yatzkan (anticipated 2016) Detection and Persistence of Gunshot Residue (GSR) on Facial Features using SEM/EDX. Master of Science in Forensic and Investigative Science, West Virginia University. Additional committee members: Prof. Keith Morris (chair) and Prof. Susan Bell.

Barbara Fallon (2016) A Tale of two corchorus species: jute and its substitutes in commercial goods. Forensic Science – Master of Science, Michigan State University. Additional committee members: Prof. Ruth Smith (chair) and Prof. Jeremy Wilson.

Katelyn Hargrave (2013) A New Technique for the Identification of Dyes Extracted from Fibers. Master of Science in Forensic Science, University of Illinois at Chicago.

## Publications and Teaching

### Courses and Workshops Taught

Advanced Trace Evidence Analysis (2016). Topics included: dye and pigment identification, soil analysis, nanoparticle analysis – workshop taught by Palenik C. at the 8<sup>th</sup> Annual Asian Network of Forensic Sciences meeting, Bangkok, Thailand.

Petrographic identification of soil minerals (2015) - workshop taught by Palenik, S. and Palenik, C.S. at the National Institute of Justice Impression, Pattern and Trace Evidence Symposium (IPTES), San Antonio, TX.

Applications of Raman Spectroscopy for Trace Evidence Examinations (2014) – workshop taught by Buzzini, P, Suzuki, E.M., Palenik, C.S., Bowen, A.M. at the American Academy of Forensic Sciences Annual Meeting, Seattle, WA.

What did you just step in? (2011) – workshop taught with Mooney, K.E., Flohr, D.B., Bowen, A, Stoney, D, Bisbing, R., Hopen, T., Murray, R., Palenik, C.S., Palenik, S., Schneck, W.M., Stam, M. at the American Academy of Forensic Sciences Annual Meeting, Atlanta, GA.

Classification of Pigments by Raman Spectroscopy (2011) – workshop taught at the Midwestern Association of Forensic Sciences Ruby Jubilee Meeting, Lombard, IL.

Identification of Animal Hairs (2011) – workshop taught with Skip Palenik and Jason Beckert at the American Academy of Forensic Sciences Annual Meeting, Chicago, IL.

Advanced Hair and Fiber Microscopy – synthetic fiber section (2009) taught with Skip Palenik and Jason Beckert at McCrone Research Institute, Chicago, IL.

#Methods in Stereomicroscopy (2009) Customized Class. Rockville, MD.

#Forensic Pigment Analysis (2009) National Institute of Justice (NIJ) Trace Evidence Symposium, Clearwater Beach, FL.

Special topics in Forensic Science (2008) taught with Skip Palenik and Jason Beckert at McCrone Research Institute, Chicago, IL.

#Palenik, C.S (2005-2008) Trace evidence in forensic science. Seminar presented at Northwestern University Forensic Science Series, Chicago, IL (presented annually)

Introductory workshop to Forensic Microscopy (2007) taught with Skip Palenik at the Federal Bureau of Investigation (FBI) / National Institute of Justice (NIJ) Trace Evidence Symposium, Clearwater Beach, FL.

### **Book Chapters and Peer Reviewed Reports**

Palenik, C.S. (2015) Forensic Microscopy in Forensic Chemistry (ed. Jay Seigl) American Academy of Forensic Sciences under Wiley Publications.

Palenik, C.S., Palenik, S., Groves, E., Herb, J. (2013) Raman spectroscopy of automotive and architectural paints: in situ pigment identification and evidentiary significance. Submitted in completion of NIJ grant 2011-DN-BX-K557.

Palenik, C.S., Palenik, S., Herb, J., and Groves, E. (2011) Fundamentals of Forensic Pigment Identification by Raman Microspectroscopy: A practical identification guide and spectral library for forensic science laboratories. Submitted in completion of NIJ grant 2010-DN-BX-K236.

Palenik, C.S. and Buscaglia, J. (2007) Applications of cathodoluminescence in Forensic Science, in Forensic analysis on the Cutting Edge: new methods for trace evidence analysis, ed. R. Blackledge, Wiley.

Palenik, C.S. (2004) Isotopic and Neutronic Composition of the Okelobondo Natural Nuclear Reactor. Ph.D. Thesis, University of Michigan.

Palenik, S.J. and Palenik, C.S. (2004) Microscopy and microchemistry of physical evidence, in Forensic Science Handbook II, 2<sup>nd</sup> ed. Ed. R. Saferstien, Prentice Hall.

### **Journal Articles**

Carlton, R.A., Mistry, N., Yoest, L., Palenik, C.S., Buyuklimanli, T., (in preparation 2016) Characterization of Molded Vial Glass Corrosion (Delamination) with Flolan® Diluent (pH 12). PDA Journal of Pharmaceutical Science and Technology.

Groves, E.G., Palenik, S.J., and Palenik, C.S. (accepted 2016) A Survey of Extraction Solvents in the Forensic Analysis of Textile Dyes. *Forensic Science International*.

Groves, E.G. and Palenik, C.S. (accepted, 2014) Applications of Blue Light Curing Acrylic Resin to Forensic Sample Preparation and Microtomy. *Journal of Forensic Science*. March 2016, Vol. 61, No. 2 489-493.

Palenik, C.S. and Palenik, S. (2014) Seeing Color: Practical Methods in Pigment Microscopy. *The Microscope*, v62, 51-61.

Trejos, T., Koons, R., Becker, S., Berman, T., Buscaglia, J., Duecking, M., Eckert-Lumsdon, T., Ernst, T., Hanlon, C., Heydon, A., Mooney, K., Nelson, R., Olsson, K., Palenik, C., Pollock, E.C., Rudell, D., Ryland, S., Tarifa, T., Valadez, M., Weis, P., Almirall, J. (2013) Cross-validation and evaluation of the performance of methods for the elemental analysis of forensic glass by  $\mu$ -XRF, ICP-MS, and LA-ICP-MS. *Anal Bioanalytical Chemistry*, 405: 5393-5409 (DOI 10.1007/s00216-013-6978-y).

Jantzi, S.C., Trejos, T., Zdanowicz, V. Dalpe, C., Palenik, C.S., Koons, R. Becker, S., Pollock, E.C., Hanlon, C., Almirall, J.R. (submitted) Inter-laboratory comparison of laser ablation inductively-coupled plasma mass spectrometry (LA-ICP-MS), micro X-ray fluorescence ( $\mu$ XRF) and laser-induced breakdown spectroscopy (LIBS) methods for bulk soil analysis. *Forensic Science International*.

Palenik, C.S. and Diaczuk P. (2013) Plumbum microraptus: Microscopic indicators of a bullet hole in a synthetic fabric. *The Microscope Journal* and reprinted in the *Journal of the American Society of Trace Evidence Examiners* (Volume 4, Issue 2, August 2013).

Ernst, Troy, Berman, Ted, Buscaglia, JoAnn, Eckert-Lumsdon, Tiffany, Hanlon, Christopher, Olsson, E. Kristine, Palenik, Christopher, Ryland, Scott, Trejos, Tatiana, Valadez, Melissa, Almirall, Jose (submitted 2012) Chemistry Signal-to-noise ratios in forensic glass analysis by micro x-ray fluorescence spectrometry. *X-ray Spectrometry*. DOI 10.1002/xrs.2437

Trejos, T, Koons, R., Becker, S., Berman, T., Buscaglia, J., Duecking, M., Eckert-Lumsdon, T., Ernst, T. Hanlonh, C., Heydoni, A., Mooney, K., Nelson, R., Olssonk, K., Palenik, C., Pollock, E.C., Rudelli, D. Ryland, S., Tarifaa, A., Valadez, M., Weisc, P. Almirall, J. (2) Forensic analysis of glass by  $\mu$ -XRF, SN-ICP-MS, LA-ICP-MS and LAICP-OES: Evaluation of the performance of different criteria for comparing elemental composition. *Journal of Analytical Atomic Spectrometry*, 38, 1270-1282. DOI: 10.1039/c0xx00000x.

Trejos, T, Koons, R., Becker, S., Berman, T., Buscaglia, J., Duecking, M., Eckert-Lumsdon, T., Ernst, T. Hanlonh, C., Heydoni, A., Mooney, K., Nelson, R., Olssonk, K., Palenik, C., Pollock, E.C., Rudelli, D. Ryland, S., Tarifaa, A., Valadez, M., Weisc, P. Almirall, J. (accepted) Forensic analysis of glass by  $\mu$ -XRF, ICP-MS, LA-ICP-MS and LA-ICP-OES - Part I: Method Standardization

Egan, J.M.; Mooney, K.; Palenik, C.S.; Mueller, K.T., and Golombeck, R. (2006) Synthesis, Isolation, and Characterization of Chlorinated Products of Bleached 1-(methylamino)anthraquinone. *Journal of Forensic Sciences*.

Reich, M., Kesler, S.E., Utsunomiya, S., Palenik, C.S., Chryssoulis, S.L., and Ewing, R.C. (2005) Solubility of gold in arsenian pyrite. *Geochimica et Cosmochimica Acta*, 69, 2781-2796.

Palenik, C.S. and Palenik, S.J. (2004) Forensic Science and Academic Science, Comment on Forensic Science: Oxymoron? *Science*, 303, 1136.

Utsunomiya, S., Palenik, C.S., Valley, J.W., Cavosi, A.J., Wilde, S.A. and Ewing, R.C. (2004) Nanoscale behavior of Pb in an Archean zircon. *Geochimica et Cosmochimica Acta*, 68, 4679-4686.

Ewing, R.C., Palenik, C.S. and Konikow, L. (2004) Comment on: "Probabilistic Risk Analysis for a High-Level Radioactive Waste Repository" by B. L. Cohen in Risk Analysis, vol. 23, 909-915, Risk Analysis, in press.

Palenik, C.S., Utsunomiya, S., Reich, M., Kesler, S.E. and Ewing, R.C. (2004) Invisible Gold Revealed: Direct imaging of gold nanoparticles from a Carlin-type deposit. American Mineralogist, 89, 1359-1366.

Davis, L.L., Darab, J.G., Qian, M., Zhao, D., Palenik, C.S., Li, H., Strachan, D.M. and Li, L. (2003) Hafnium in peralkaline and peraluminous boro-aluminosilicate glass and glass sub-components: a solubility study. Journal of Non-Crystalline Solids, 328, 101-122.

Palenik, C.S., Nasdala, L. and Ewing, R.C. (2003) Radiation damage in a zircon. American Mineralogist, 88, 770-781.

Jensen, K.A., Palenik, C.S. and Ewing, R.C. (2002) U<sup>6+</sup>-phases in the weathering zone of the Bangombe U-deposit: Observed and predicted mineralogy. Radiochimica Acta, 90, 1-9.

Palenik, C.S. (2000) The role of the forensic scientist in the new millennium. Academy News (American Academy of Forensic Sciences), 23-24.

Palenik, C.S. (1989) The microscopical differentiation of dog and cat hairs, The Microscope, 38(4), 415-421.

### **Conference Proceedings**

Palenik, C.S., Jensen, K.A. and Ewing, R.C. (2004) The impact of uncertainties in geochemical modeling on performance assessments: Lessons from natural analogues. Materials Research Society Spring Meeting, San Francisco, CA.

Palenik, C.S. and Ewing, R.C. (2002) Microanalysis of radiation damage across a zoned zircon crystal. Proceedings of the Materials Research Society, 713, JJ8.8.1-JJ8.8.6.

Zhao, D., Davis, L.L., Li, L., Palenik, C.S., Wang, L.M., Strachan, D.M. and Ewing, R.C. (2000) Gadolinium and hafnium aluminoborosilicate glasses: Gd and Hf solubilities. Proceedings of the Materials Research Society, vol. 608, 683-689.

### **Other Publications**

Palenik, C.S. and Jackson, G. (2016) Forensic Myths and Methods. The Analytical Scientist, March 2016 #38, 24-32.

Palenik, C.S., Palenik, S.J., and Groves, E.G. (2014) Forensic Microscopy, In: Reedijk, J. (Ed.) Elsevier Reference Module in Chemistry, Molecular Sciences and Chemical Engineering. Waltham, MA: Elsevier. 07-Aug-14 doi: 10.1016/B978-0-12-409547-2.11426-X.

Palenik, C. and Nytes, B. (2014) Mercury Wings, (ed.) Bethany Halford in Chemical and Engineering News, Newsprints. Volume 92 Issue 22, p40, June 2, 2014.

Palenik, C. (2013) Consumer Complaint Sample Analyses: Considerations for Outsourcing Sample Analysis, Submitted to Society of Consumer Affairs Professionals – Customer Relationship Management CRM Magazine. Summer 2013.

Palenik, C. (2011) A Better Fate For Mercury?, Letter to the Editor, Chemical and Engineering News, 18 April 2011, 89(16), p6.

Palenik, C. (2005) Big "I" in Owens. Letter to the Editor, New York Times, November 13.

Utsunomiya, S., Palenik, C.S., and Ewing, R.C. (2004) Nano- to Atomic Scale Imaging of Heavy Trace Metals Utilizing Advanced Microscopy Techniques in The Dekker Encyclopedia of Nanoscience and Nanotechnology. Marcel Dekker Pub., NY

Palenik, C.S. and Palenik, S.J. (2004) Forensic Microscopy, in Encyclopedia of Analytical Sciences, 2nd Ed., eds. Worsfold, P., Townshend, A and Poole, C. Elsevier, NY.

Palenik, C.S. and Palenik, S.J. (1999) Forensic Fiber Reference Collection Manual. Microtrace: Elgin, IL 46p.

Palenik, S.J. and Palenik, C.S. (1999) Forensic Fiber Identification Course Guide. Microtrace: Elgin, IL, 32p.

### **Abstracts and Talks**

\*Keynote or Plenary address; #Invited talk; ^Session chair

#Palenik, C.S. (2017) Scientific Foundations Session 1, National Commission on Forensic Science. National Institute of Justice, Washington, DC.

#Palenik, C.S. (2016) Counterfeit materials and their relation to forensic science. Interpol Forensic Science Managers Symposium, Lyon France.

#Palenik, C.S. (2016) The invaluable role of a technician in forensic science. Fall Annual Meeting of the Midland Section of the American Chemical Society, Midland Michigan.

\*Palenik, C.S. (2016) Forensic microscopy and the lost art of observation. Fall Annual Meeting of the Midland Section of the American Chemical Society, Midland Michigan.

#Palenik, C.S. (2016) Advanced trace evidence analysis: from micro to nano. Asian Forensic Sciences Network Annual Meeting 2016, Bangkok, Thailand.

#Palenik, S.J. and Palenik, C.S. (2016) The Utilization of Microscopy in Developing Investigative Leads from the Examination of Microscopic Trace Evidence in Forensic Investigations. Microscopy and Microanalysis 2016 Meeting, Dayton, OH.

Hargrave, K.H., Nytes, B.N., Hopen, T., Palenik, C.S. (2016) Applications of Glass Microspheres as Forensic Trace Evidence. Presentation at Inter/Micro 2016, Chicago, IL.

Groves, E.G. and Palenik, C.S. (2016) A practical approach to forensic dye identification: method and validation. Presentation at Inter/Micro 2016, Chicago, IL.

Palenik, C.S., Groves, E.G., and Palenik, C.S. (2016) Dye Identification in Casework: How far can you go? Presentation at Inter/Micro 2016, Chicago, IL.

Scott, K.R., Palenik, C.S., Palenik, S., Morgan, R.M. (2016) A multidisciplinary approach to the collection and analysis of aquatic trace evidence from clothing exhibits. Australian and New Zealand Forensic Science Society International Symposium. Auckland, New Zealand.

Scott, K., Morgan, R., Palenik, C.S. and Palenik, S.J. (2015) Developing the techniques available for the collection and analysis of forensic evidence in freshwater crime scene environments. National Institute of Justice Impression, Pattern and Trace Evidence Symposium (IPTES), San Antonio, TX.



Fallon, B.L., Palenik, C.S. and Palenik, S.J. (2015) Jute and its Substitutes in Common Goods. National Institute of Justice Impression, Pattern and Trace Evidence Symposium (IPTES), San Antonio, TX.

Palenik, C.S. (2015) Decreasing the Scale and Increasing the Scope of Trace Evidence. National Institute of Justice Impression, Pattern and Trace Evidence Symposium (IPTES), San Antonio, TX.

^Palenik, C.S. (2015) Surrounded by Spheres: Microspheres and nanospheres in the world around us. Inter/Micro 2015. Chicago, IL.

Nytes, B.N., Palenik, C.S., Palenik, S.J. (2015) Microchemistry: Not such a small thing. Inter/Micro 2015. Chicago, IL.

Hargrave, K., Palenik, S.J., Beckert, J., Palenik, C.S. (2015) Characterization of Extracted Dyes by Capillary Microspectrophotometry: Proof of Concept. Inter/Micro 2015. Chicago, IL.

Fallon, B.L., Palenik, C.S., and Palenik, S. (2015) A Tale of Two Corchorus Species: Jute and Its Substitutes in Common Goods. Inter/Micro 2015. Chicago, IL.

^#Palenik, C.S. (2015) Keynote Address. Microscopy and the lost art of observation. SCIX 2015, Providence Rhode Island.

#Palenik, C.S. (2015) Microscopy: My Professional Hobby. State Microscopical Society of Illinois monthly speaker series. Chicago, IL.

Palenik, C.S. and Palenik, S.J. (2015) Microtrace to Nanotrace: Extracting information at increasingly smaller length scales. American Academy of Forensic Sciences Annual Meeting, Orlando, FL.

^,#Palenik, C.S. (2014) Identification and Significance of Colorants in Forensic Casework. World Forensic Festival (IAFS 2014, AFSN 2014, APMLA 2014), Seoul, Korea.

Palenik, C.S. and Palenik, S.J. (2014) Seeing Color: Practical Methods in Pigment Microscopy. Inter/Micro 2014, Chicago, IL.

Hargrave, K., Beckert, J., Palenik, C.S., White, K., Sigman, M. (2014) The Comparison of Similarly Colored Fabrics and Yarns Using Comparison Microscopy and Microspectrophotometry. Inter/Micro 2014, Chicago, IL.

Nytes, B., White, K.M., and Palenik, C.S. (2014) You Found WHAT in Your Pizza?: Characterization of a condom allegedly baked into a pizza. Inter/Micro 2014, Chicago, IL.

White, K.M., Palenik, C.S., Beckert, J.B., and Hargrave, K. (2014) Evaluating Different Methods of Comparison for Fibers with Subtle Variations in Dye Concentration. Inter/Micro 2014, Chicago, IL.

#Palenik, C.S. (2014) Food Forensics: Key Considerations for Consumer Complaint Sample Analysis. Food Labs Conference at PittCon, Chicago, IL.

#Palenik, C.S. (2013) Applications of colorant identification in forensic science. SCIX 2013 Annual Meeting, Milwaukee, WI.

Groves, E. and Palenik, C.S. (2013) The use of blue light curing resins in forensic sample preparation, Inter/Micro 2013, Chicago, IL.

Palenik, C. and Beckert, J. (2013) Between the fringes: overlooked topics in microspectrophotometry, Inter/Micro 2013, Chicago, IL. (abstract accepted, talk not given due to illness)

Groves, E. and Palenik, C.S. (2013) Colorant basics: chemical organization of a dye and pigment database, Inter/Micro 2013, Chicago, IL.

Palenik, S. and Palenik, C.S. (2013) Development of a systematic approach to forensic dye identification, Inter/Micro 2013, Chicago, IL.

Nytes, B., Palenik, S.J. and Palenik, C.S. (2013) Fitting the Mold: An Exploration into Sourcing of Glass Fragments, Inter/Micro 2013, Chicago, IL.

Palenik, C.S. (2013) Microanalytical methods of materials characterization in forensic science. International Cement Microscopy Association Annual Meeting, Rosemont IL.

#Palenik, C.S. and Palenik, S.J. (2013) Applications of Forensic Microanalytical Methods to the Identification and Sourcing of Particulate Matter in Pharmaceutical Products, Microscopy & Microanalysis 2013 sponsored by the Microscopy Society of America, Indianapolis, IN.

Palenik, C.S. (2013) Systematic in situ Identification of Pigments in Paint by Raman Microspectroscopy, AAFS, American Academy of Forensic Sciences National Meeting, Washington, DC.

Palenik, C.S. and Beckert, J.B. (2012) The Forensic Analysis of Paint Evidence Using Micro-Raman Spectroscopy, MAFS 2012, Milwaukee, WI.

Groves, E.G., Herb, J., Palenik, C.S. (2012) Benefits of Using Cross-Sectioning in Forensic Analysis of Automotive Paints, Inter/Micro 2012, Chicago, IL.

Palenik, C.S., Buzzini, P., Herb, J., Groves, E. (2012) The Forensic Analysis of Paint Evidence Using Micro-Raman Spectroscopy Part I: Development of Libraries and Application Methods, Inter/Micro 2012, Chicago, IL.

Buzzini, P., Palenik, C.S., and Massonnet, G. (2012) The Forensic Analysis of Paint Evidence Using Micro-Raman Spectroscopy Part II: Case Examples, Inter/Micro 2012, Chicago, IL

Sliwa, S., Groves, E., Palenik, M.C. (2012) Mapping Elemental and Refractive Index Variation in Container Glass, Inter/Micro 2012, Chicago, IL.

Herb, J., Palenik, C.S., and Palenik, S.J. (2012) Four Score and Seven Years Ago" or Was It? : Authenticating President Abraham Lincoln's Signature, Inter/Micro 2012, Chicago, IL.

Palenik, C.S. and Palenik, S. (2012) Development of a Pigment Classification Scheme by Raman Spectroscopy. American Academy of Forensic Sciences National Meeting. Atlanta, GA.

#Palenik, C. (2011) Forensic Soil Examination at the NIJ Sponsored Elemental Analysis Working Group Meeting Miami, Florida – October 12-13, 2011.

Buscaglia, J., Palenik, C.S., Brokus, S.A., Silletti, D.K., Cooper, D.E., Purcell, D.K., Peaslee, G.F. (2011) Applications of Cathodoluminescence (CL) Microscopy and Spectroscopy to Forensic Evidence. Presented at Cathodoluminescence (CL 2011), a topical conference (TC) of the Microbeam Analysis Society (MAS), co-sponsored by the Australian Microbeam Analysis Society (AMAS) held at the National Institute of Standards and Technology (NIST), Gaithersburg, MD, USA on October 24-28, 2011.

#Palenik, CS. Beyond Comparison: Developing Investigative Leads from Trace Evidence. Eastern Analytical Symposium. Somerset, New Jersey.

Palenik, CS, Palenik, S., Herb, J., Beckert, J., Nytes, B. Chemical Classification of Pigments by Raman Spectroscopy for Forensic Applications. NIJ Trace Evidence Symposium, Kansas City, MO (2011).

Palenik, CS, Palenik, S., Beckert, J., Nytes, B., Groves, E. (2011) Improvements in analytical precision in the forensic analysis of glass through the use of metal filters in  $\mu$ -XRF analysis. NIJ Trace Evidence Symposium, Kansas City, MO.

Jantzi, S.C., Trejos, T., Zdanowicz, V., Dalpe, C., Palenik, C.S., Koons, R., Wong, D., Hanlon, C., Pollock, E., Becker, S., Almirall, J. (2011) Inter-Laboratory Comparison of LA-ICP-MS,  $\mu$ XRF and LIBS methods for Bulk Soil Analysis

Ernst, T., Trejos, T. Valadez, M., Koons, R., Buscaglia, J., Olsson, K., Ryland, S. Berman, T., Eckert-Lumsdon, T. Hanlon, C., Palenik, C., Almirall, J. (2011) When is a peak, a peak? Calculating detection and quantification limits for micro X-ray fluorescence spectrometry of glass samples.

Herb, J.N. and Palenik, C.S. (2011) Use of surface enhanced Raman spectroscopy (SERS) applied to the study of fluorescing pigments and dyes. American Academy of Forensic Sciences National Meeting, Chicago, IL.

Nytes, B.N, Beckert, J., Palenik, C.S., and Palenik, S. (2011) Obtaining investigative forensic information from the analysis of rodents in food products. American Academy of Forensic Sciences National Meeting, Chicago, IL.

Palenik, CS, Wilke, B. (2010) Raman spectroscopy of organic pigments. American Academy of Forensic Sciences National Meeting, Seattle, WA.

Palenik, CS, Nytes, B.N., Beckert, J., Bonta, H, and Palenik, S (2009) Raman spectroscopy of Forensic Evidence. Trace Evidence Symposium (National Institute of Justice (NIJ), Clearwater Beach, FL.

Buscaglia, J., Palenik, C.S., and Peaslee, G. (2009) Trace evidence applications of cathodoluminescence (CL) microspectrophotometry. Trace Evidence Symposium (National Institute of Justice (NIJ), Clearwater Beach, FL.

Wilke, B. and Palenik, C.S. (2009) Organic Pigments: Analytical characterization and classification by Raman spectroscopy. Inter/Micro 09, Chicago, IL.

Palenik, CS, Bonta, H, and Palenik, S (2009) Microanalysis of Architectural Tinting Pigments. American Academy of Forensic Sciences National Meeting. Denver, CO.

#Palenik, CS (2008) Food Forensics: Applications of microscopy and microchemistry to contamination issues in the food industry. Presented to the Griffith Laboratory Global Summit Meeting, Lombard, IL.

#Palenik, CS (2008) Big Picture Clues from Microscopic Particles: Applications of Geology to Forensic Science. Colgate University, NY.

Peaslee, GF, Buscaglia, J, Palenik, CS (2008) Cathodoluminescence as a Forensic Tool. 2008 Joint Meeting of The Geological Society of America, Soil Science Society of America, American Society of Agronomy, Crop Science Society of America, Gulf Coast Association of Geological Societies with the Gulf Coast Section of SEPM. Houston, TX.

Bales, H. and Palenik, CS (2008) Planar Section of Multilayer Paint Chips. Inter/Micro 2008, Chicago, IL.

Palenik, S. and Palenik, CS (2008) A Practical Technique for the Recognition of Modern Sculptures Proffered as Ancient Works of Art. Inter/Micro 2008, Chicago, IL.

Palenik, CS and Bonta, H. (2008) Microanalytical Characterization of Architectural Paint Pigments. Inter/Micro 2008, Chicago, IL.

#Palenik, CS (2008) Workshop on Raman Spectroscopy of Forensic Evidence. International Association of Forensic Sciences Conference Proceedings. New Orleans, LA.

Peaslee, GF, Palenik, CS, and Buscaglia, J (2008) Application of Cathodoluminescence Microspectrophotometry for Forensic Comparison of Concrete Samples. International Association of Forensic Sciences Conference Proceedings.

Palenik, CS, Palenik, S., and Nytes, B. (2008) An introduction to the *in situ* identification of pigments in automobile and architectural paints by Raman microspectroscopy. Proceedings of the American Academy of Forensic Sciences National Meeting, Washington DC.

Palenik, CS and Nytes B (2007) The *in situ* identification of pigments in CMYK printing inks. Inter/Micro 2007, Chicago, IL.

Palenik, CS and Palenik, SJ (2007) Ensuring the Continued Role of Science in the Forensic Examination of Trace Evidence. Proceedings of the 2007 American Academy of Forensic Sciences National Meeting, San Antonio, TX.

Palenik, SJ and Palenik, CS (2007) Developing Investigative Leads through Trace Evidence. Proceedings of the 2007 American Academy of Forensic Sciences National Meeting, San Antonio, TX.

#Palenik, CS (2007) Forensic Trace Evidence: Big Picture Clues from Microscopic Particles. Saturday Science Fun Lecture Series, Freedom Hall, Park Forest, IL.

#Palenik, CS (2006) Trace Evidence for the Public Defender. Missouri State Public Defender Winter Workshop, St. Louis, MO.

#Palenik, CS (2006) Forensic Microscopy of Fibers. Presentation at Philadelphia University seminar series.

#Palenik, CS (2006) Cathodoluminescence in Forensic Science. Presentation Soil Analysis workshop at California Association of Criminalists Fall Seminar.

Palenik, S.J. and Palenik, C.S. (2006) Developing Forensic Investigative Leads through the Microscopical Examination of Trace Evidence. Geological Society of America National Meeting, Philadelphia, PA. GSA Abstracts with Programs 38 (7).

Palenik, C.S. (2006) Novel applications of cathodoluminescence microscopy. Inter/Micro-06, Chicago, IL.

Palenik, C.S. and Buscaglia, J. (2006) Cathodoluminescence in Forensic Science. American Academy of Forensic Sciences National Meeting, Seattle, WA.

Mooney, K.E., Koons, R.D., Buscaglia, J. and Palenik, C.S. (2006) Discrimination of Automobile Side Windows by Micro-XRF. American Academy of Forensic Sciences National Meeting, Seattle, WA.

Palenik, C.S. (2006) From PhD to Professional: Bridging the Gap. 3<sup>rd</sup> Annual Northwestern University PLU Career Forum.

#Palenik, C.S. (2005) Applications of microscopy and microchemistry in forensic science. Talk given at Chemistry Dept. seminar, University of Wisconsin Platteville.

Egan, J.M., Mooney, K.E., Palenik, C.S., Rickenback, M.P., Golombeck, R.A. and Mueller, K.T. (2005) Synthesis, Isolation, and Characterization of Chlorinated Products of Bank Security Dye Packs Upon Bleaching, Pittcon - 2005, August, 2005.

Palenik, C.S. and Buscaglia, J. (2005) Cathodoluminescence microscopy in forensic science. 2006 Annual meeting of the American Academy of Forensic Sciences. Seattle, WA.

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