Craig Zuhlke, Ph.D.

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Education

University of Nebraska-Lincoln (UNL):

Ph. D., Electrical Engineering, December 2012
Dissertation: "Control and understanding of the formation of micro/nanostructured metal surfaces using femtosecond laser pulses." December 2012.
Advisor: Professor Dennis Alexander

Bachelor of Science, Electrical Engineering, May 2007
Undergraduate Cumulative GPA: 3.965

Research Experience

Since obtaining my Ph.D., I have been a critical Co-PI within a large, highly interdisciplinary group (the Center for Electro-Optics and Functionalized Surfaces (CEFS)) that conducts research on femtosecond laser/materials interactions and on applications of metallic surfaces functionalized with a femtosecond laser. CEFS conducts fundamental research to show the potential of the laser processed surfaces to enhance heat transfer, to reduce drag, and to provide anti-icing and anti-bacterial properties. The group involves faculty from different departments at UNL, and UNK (ECE, MME and Chemistry) as well as faculty from UNMC. The group has been funded from both external and internal sources such as ONR, NASA, Boeing and NRI. This interdisciplinary research has been a natural outgrowth from four papers that were the basis of my doctoral dissertation (papers numbered 4-7 in the list of my journal publications).

UNL, Center for Electro-Optics and Functionalized Surfaces (CEFS)

2016 – Present

Research Assistant Professor (Graduate Faculty Associate): Conducted research based on applications of femtosecond pulse interaction with materials

- **Researched:**
  - Functionalizing metallic surfaces through femtosecond laser surface processing (FLSP) with applications in enhancing heat transfer, drag reduction, anti-icing and anti-microbial surfaces
  - Application of superhydrophobic, anti-microbial FLSP surfaces for the next generation condensing heat exchangers for the International Space Station
  - Understanding the physics behind the formation of FLSP surfaces, including experimental and numerical aspects
  - Precision machining using femtosecond lasers for biomedical devices including drilling precision holes (>30 μm diameter) in heart catheters for controlled drug delivery, as well as cutting components and assembling a device for stitching arteries together (collaboration with UNMC)
  - Extensive experience with lasers, optics and optical systems
- **Managed:** multiple femtosecond lasers including repair of these lasers; *including a 10 mJ system that is wavelength tunable from 800 nm – 15 μm purchased in 2016 with DURIP funds ($488,684)*; research equipment including a scanning electron microscope (SEM); extensive experience with LabVIEW programming for laser setup control systems and data capture
- **Advised:** graduate and undergraduate students on a number of research projects; trained students on the use and upkeep of multiple lasers and optical systems

- **Proposal preparation:** Experience with all aspects of proposal preparation, including: writing proposals and white papers, interacting with program managers and preparing budgets

2015 – present

Equipment Manager for NERCF

- Managed a Coherent, Astrella 6 mJ femtosecond laser
  - Completed work for groups from the ECE, MME, Chemistry and Chemical Engineering departments at UNL, as well as groups from UNMC, and GaTech
- Assistant manager of a Keyence 3D laser scanning confocal microscope

2013 – 2016

Postdoctoral Research Associate: Conducted research based on applications of femtosecond pulse interaction with materials

- **Researched:**
  - Functionalizing metallic surfaces through femtosecond laser surface processing (FLSP) with applications in enhancing heat transfer, drag reduction, anti-icing, and anti-microbial surfaces
  - Use of Archimedes laser in the Extreme Light Core Facility (ELCF) at UNL for functionalizing copper using extreme intensities and fabricating new phases of materials
  - Ultrafast pump-probe for battle damage assessment of optical sensors with experience in the experimental and numerical aspects of ultra-fast electron dynamics

Aug. 2007 – Dec. 2012

Graduate Research Assistant: Conducted research on understanding the self-organized micro/nanoscale surface modification processes from femtosecond laser ablation

- **Researched:** high surface area ultracapacitor electrodes; enhanced electrolysis electrodes through controlled bubble release; use of femtosecond lasers to create long-period and Bragg gratings in fiber optic waveguides for use in sensor applications

Aug. 2005 – Aug. 2007

Undergraduate Research: Conducted research in all optical communications using nanoparticles

- **Researched:** use of quantum dots to enable all optical switching
- Work resulted in a journal paper, which was reprinted in an MRS Bulletin and Virtual Journal of Nanoscale Science & Technology, a conference proceeding and a patent on an all optical (U. S. Patent #**7868302)**
- Funded for two years through the Undergraduate Creative Activity and Research (UCARE) program at UNL

Teaching Experience

In teaching, I utilize Blackboard, PowerPoints, Applets, in class demonstrations and whiteboard supported lectures; used in a combination that helps capture student attention to efficiently enhance learning

UNL, Department of Electrical and Computer Engineering

Lecturer

Fall 2016 — **ELEC215 (Electronics and Circuits I)**

Fall 2013 — **ELEC306 (Electromagnetic Field Theory)**

Spring 2013, Fall 2014, Spring 2014 — **ELEC211 (Elements of Electrical Engineering I)**

- Electrical engineering for non-Electrical Engineers
- Taught 328 students over three semesters

- In collaboration with the department chair, restructured the course objectives and syllabus for ELEC211, to better match the learning needs of the students.

ELEC231 (Electrical Engineering Laboratory)

- Electrical engineering lab for non-Electrical Engineers
- Directed two Lab TAs and two Lab assistants

Lab Teaching Assistant
Spring 2011

ELEC486/886 (Applied Photonics)

- Taught accompanying lab for Applied Photonics class
- In collaboration with class instructor, designed and implemented labs on topics related to applied photonics, on topics such as: Snell's Law, total internal reflection, polarization, optical time domain reflectometry, etc.

Funded and Pending Proposals/Funded Research Projects

Funding Agency	Role	Title	Award Period	Award Amount
Funded				
ONR	**PI**	Functionalized Metallic Surfaces for Enhanced Heat Transfer, Drag Reduction, and Novel Power Sources	9/26/2017 – 9/26/2019	$874,884
DURIP	Co-PI	Instrumentation for Understanding and Controlling Surface Chemistry During Femtosecond Laser Surface Processing (FLSP)	6/1/2017 – 7/14/2018	$961,830
NASA, JSC	Co-PI	Femtosecond Laser Condensing Heat Exchanger	1/1/2016 – 12/31/2018	$65,000 yr. 1 $150,000 yr. 2 $350,000 yr. 3
NASA-EPSCoR	**PI**	Femtosecond Laser Functionalized Needles to Control Release of Picoliter-Size Droplets for NASA's ISS Combustion Experiments	11/1/2017 – 6/30/2018	$7,500
NASA-EPSCoR	Co-PI	Highly Permanent Biomimetic Micro/Nanostructured Surfaces by Femtosecond Laser Surface Processing for Thermal Management Systems	8/1/2014 – 7/31/2018	$563,131
UTCRS	Co-PI	Anti-Icing LED Light Covers for Railroad Safety	9/1/2016 – 3/1/2018	$100,000
NASA Nebraska Space Grant	**PI**	UNO-NASA Space Grant: Atomic Layer Deposition of Silver on Metal Surfaces Functionalized Using Femtosecond Laser Surface Processing	8/1/2017 – 2/28/2018	$10,000
ONR	Co-PI	Functionalized Metallic Surfaces for Enhanced Heat Transfer, Drag Reduction, and Novel Power Sources	5/19/2016 - 11/17/2017	$609,992
Past awards				
NASA Nebraska Space Grant	**PI**	Femtosecond laser direct writing for advanced functionalization of silver and stainless steel for condensing heat exchanger applications	8/1/2016 – 4/30/2017	$9,998

ONR	Post-Doc	Functionalized Metallic Surfaces for Enhanced Heat Transfer, Drag Reduction, and Novel Power Sources	3/26/2015 – 3/26/2016	$289,616
NASA Nebraska Space Grant	**PI**	Dual pulse femtosecond laser surface processing for advanced functionalization of silver for condensing heat exchanger applications	2/1/2016 – 11/30/2016	$20,000
Boeing	Research Prof.	Femtosecond Laser Surface Processing of Aluminum Aircraft Alloys for Anti-Icing Properties	1/1/2016 – 12/31/2016	$150,178
NASA-EPSCoR	**PI**	Femtosecond Laser Functionalized Needles for Controlled Droplet Release	2/1/2015 – 9/30/2015	$10,000
DURIP	Research Prof.	Tunable Laser Source for Advanced Surface Functionalization	6/1/2016 – 5/31/2017	$480,616
NCESR	Post-Doc	Numerical Modeling of the Formation of Micro/nanostructures on Metals Using Femtosecond Laser Surface Processing	1/1/2014 – 12/31/2015	$201,000
NRI	Post-Doc	Preventing Biofilm Growth on Metal Alloys used for Medical Implants and Devices by Femtosecond Laser Surface Processing Techniques	7/1/2015 – 6/30/2017	$100,000
HEL-JTO	Post-Doc	Fundamental Studies of Femtosecond Pump Probe Techniques for Damaging and Assessment of Damage to Optical Components	5/1/2013 – 4/30/2015	$1.1 M
Pending				
ARO	Co-PI	Fundamental Studies on High Peak Power Femtosecond Laser-Driven Crystalline Phase Changes in Metals	1/1/2016 – 12/30/2019	$804,003
MURI – lead institution: CREOL	Co-PI	Fundamental Studies of LWIR Laser Radiation With Matter	10/15/2017	$5.7million

Student Co-Supervision

Type	Name	Time
Graduate	Alfred Tsubaki	Since 2015
Graduate	Ryan Bell	Since 2015
Graduate	Conner Thomas	Since 2015
Graduate	Chongji Huang	Since 2015
Graduate	Nick Roth	Since 2014
Graduate	Aaron Ediger	Since 2017
Undergraduate	Brenden Gatzemeyer	Since 2017
Undergraduate	Zvonimir Pusnki	Since 2017

As a key member of the Center for Electro-Optics and Functionalized Surfaces (CEFS) at UNL (Directed by Dr. Alexander) I have also aided in advising students on collaborative research projects who are under the supervision of Dr. Jeffery Shield and Dr. George Gogos in the MME department at UNL.

Honors/Awards

- **2017 College of Engineering Research Celebration Honoree**
- **2016 Exceptional Post-Doctoral Researcher from NSRI**
- Presentation to the DARPA director, Dr. Arati Prabhakar, for an invited faculty meeting on March 22, 2016
- Undergraduate Creative Activity and Research (UCARE) – 2 years
- Graduate Assistance in Areas of National Need (GANN) grant recipient
- Second place 2012 EE Graduate Research Poster Competition
- Outstanding Senior – Electrical Engineering
- Graduated with distinction
- Dean's List-all semesters
- First place as co-author in the 2007 Region 4 Student Paper Competition
- Eagle Scout
- Phi Eta Sigma Freshman Honorary
- Recipient of over $32,000 in scholarships/fellowships
    - J. A. Woollam Graduate Fellowship (4 years)
    - Milton E. Mohr Graduate Fellowship
    - David West Hawksworth Scholarship recipient
    - Glen Z. Fiebig, Jr. Memorial Scholarship recipient
    - William Darlington Scholarship recipient- five years
    - Walter Carlson Scholarship recipient
    - Irene & George Holling Scholarship recipient
    - Holling Memorial Scholarship recipient
    - Milton E. Mohr Research Scholarship recipient
    - Elec. Engineering Faculty Scholarship recipient
    - Engineering & Tech Scholarship recipient
    - James Canfield Scholarship recipient

Activities and Memberships

- Reviewer for Optics Express, Chinese Optics Letters, International Journal of Heat and Mass Transfer, and Surface and Coatings Technology
- Optical Society of America (Spring 2007 – 2015)
    - **Staff Advisor** (Fall 2013 – present)
- Institute of Electrical and Electronics Engineers (IEEE) (Fall 2003 – 2009)
    - **President** (Fall 2005 and Fall 2007 – Spring 2008)
- Eta Kappa Nu (HKN) (Fall 2004 – present)
    - **Secretary** (Spring 2007)
- Tau Beta Pi (Fall 2004 – present)
- UNL Christian Grads leadership team (Fall 2007-present)
    - **Staff Advisor** (Spring 2013 – present)
    - **President** (Fall 2008 – Fall 2012)
- Campus Crusade for Christ (Fall 2003 – Spring 2009)
    - Hurricane Katrina Recovery Volunteer (Spring 2006)
    - Men's Summer Project Executive Team member
    - Shepherding team (Spring 2007-present)
- Golden Key International Honor Society (Fall 2005 – present)
- National Society of Collegiate Scholars (NSCS) (Fall 2002 – present)

Professional development

- Attended a one day seminar on "Write Winning Grant Proposals" at UNL, March 2016
- Attended a one day seminar on "Write Winning Grant Proposals" at UNL, March 2014
- Attended the 2017 Directed Energy and Next Generation Munitions conference

Research interests

- Functionalizing surfaces using femtosecond laser surface processing (FLSP) and applications
- Superhydrophobic surfaces through FLSP for drag reduction in marine applications
- Enhanced heat transfer using surfaces modified through FLSP
- Studying the physics behind the formation of FLSP surfaces, including experimental and numerical aspects
- Use of Archimedes laser in the Extreme Light Core Facility (ELCF) at UNL for conducting research on light matter interactions at extreme intensities and inducing new phases of materials
- **Biomedical:** antibacterial surfaces through FLSP with controlled wetting properties of metals (superhydrophobic and superhydrophilic surfaces) and controlled surface chemistry changes
- Use for femtosecond laser for precision machining of biomedical device components
- Ultrafast pump-probe for battle damage assessment of optical sensors and remote detection of biological warfare agents including both experimental and numerical aspects of ultra-fast electron dynamics
- Studying light-matter interactions with lasers ranging from nanosecond to *attosecond* (use of attosecond lasers is a long term research interest)
- **Future manufacturing research:** Use of ultrashort pulsed lasers in 3D metal printing

Teaching interests

- Optics
- Ultrafast laser design and applications
- LabVIEW programming
- Capable of teaching any course offered within Electrical and Computer Engineering including, electromagnetics, circuits, signals and systems, probability theory, and MATLAB
- Future teaching interest: non-linear optics and devices

Refereed Publications

19. Huang, C., Bell, R., Tsubaki, A., Zuhlke, C. A., Alexander, D. R., "Condensation and Subsequent Freezing Delays as a Result of Using Femtosecond Laser Functionalized Surfaces," Accepted for publication in Journal of Laser Applications.

18. Yingxiao, S., Tsubaki, A., **Zuhlke, C.**, Rezaei, E., Gogos, G., Alexander, D. R., and Shield, J. E., "Effect of Topology and Material Properties on the Imprint Quality of the Femtosecond-Laser-Induced Surface Structure" *Journal of Materials Science,* Accepted for publication, 2017.

17. Tsubaki, A., Koten, M., Lucis, M., **Zuhlke, C.**, Ianno, N., Shield, J., Alexander, D. "Formation of aggregated nanoparticle spheres through femtosecond laser surface processing." *Applied Surface Science,* Volume 419, 15 October 2017, Pages 778–787

16. Peng, E., Bell, R., **Zuhlke, C. A.**, Wang, M., Alexander, D. R., Gogos, G. and Shield, J. E., "Growth Mechanisms of Multiscale, Mound-Like Surface Structures on Titanium by Femtosecond Laser Processing," *Journal of Applied Physics*, 122, 133108 (2017); doi: http://dx.doi.org/10.1063/1.4990709.

15. Peng, E., Tsubaki, A., **Zuhlke, C. A.**, Wang, M., Bell, R., Lucis, M. J., Anderson, T. P., Alexander, D. R., Gogos, G., Shield, J. E., "Micro/Nanostructures Formation by Femtosecond Laser Surface Processing on Amorphous and Polycrystalline Ni60Nb40," *Applied Surface Science*, 28, 1170-1176, 2017.

14. Kruse, C., Lucis, M., Shield, J., Anderson, T., **Zuhlke, C.**, Alexander, D., Gogos, G., and Ndao, S. "Effects of Femtosecond Laser Surface Processed Nanoparticle Layers on Pool Boiling Heat Transfer

Performance," *Journal of Thermal Science and Engineering Applications*, Accepted for publication, 2017.

13. Kruse, C., Tsubaki, A., **Zuhlke, C.**, Anderson, T., Alexander, D., Gogos, G., Ndao, S., "Secondary Pool Boiling Effects," *Applied Physics Letters*, 108, 051602, 2016. http://dx.doi.org/10.1063/1.4941081
12. Peng, E., Tsubaki, A., **Zuhlke, C. A.**, Wang, M., Bell, R., Lucis, M. J., Anderson, T. P., Alexander, D. R., Gogos, G., Shield, J. E., "Experimental Explanation of the Formation Mechanism of Surface-Mound Structures by Femtosecond Laser on Polycrystalline Ni60Nb40," Applied Physics Letters, 108, 031602, 2016. http://dx.doi.org/10.1063/1.4939983Tsubaki, A., Zuhlke, C. A., Anderson, T. P., Alexander, D. R., "Self-organized micro/nanostructures on silicon carbide produced through Femtosecond Laser Surface Processing," *Applied Physics Letters*, 108, 031602, 2016.
11. Hassebrook, A., Kruse, C., Wilson, C., Anderson, T., **Zuhlke, C.**, Alexander, D., Gogos, G., Ndao, S., "Effects of Droplet Diameter and Fluid Properties on the Leidenfrost Temperature of Polished and Micro/Nanostructured Surfaces," *Journal of Heat Transfer*, 138(5), 051501, 2016. doi: 10.1115/1.4032291.
10. Kruse, C. M., Anderson, T., Wilson, C., **Zuhlke, C.**, Alexander, D., Gogos, G., & Ndao, S. "Enhanced pool-boiling heat transfer and critical heat flux on femtosecond laser processed stainless steel surfaces." *International Journal of Heat and Mass Transfer*, 82, 109–116, 2015.
9. Kruse, C. M., Somanas, I., Anderson, T. P., Wilson, C., **Zuhlke, C. A.**, Alexander, D. R., Gogos, G., and Ndao, S., "Self-Propelled Droplets from Bioinspired Directional Microstructured Surfaces," *Microfluidics and Nanofluidics*, 18:1417, 2015. DOI 10.1007/s10404-014-1540-6.
8. **Zuhlke, C. A.**, Bruce III, J., Anderson, T. P., Alexander, D. R., Parigger, C. G.. "Fundamental understanding of the dependence of the LIBS signal strength on the complex focusing dynamics of femtosecond laser pulses either side of focus," *Applied Spectroscopy*, 68(9), PP. 1021-1029, September 2014.
7. **Zuhlke, C. A.**, Anderson, T. P., and Alexander, D. R., "Comparison of the structural and chemical composition of two unique micro/nanostructures produced by femtosecond laser interactions on nickel," *Applied Physics Letters*, 103(12), 121603, 2013.
6. **Zuhlke, C. A.**, Anderson, T. P., and Alexander, D. R., "Fundamentals of layered nanoparticle covered pyramidal structures formed on nickel during femtosecond laser surface interactions," *Applied Surface Science*, 21(7), 8460–73, 2013.
5. **Zuhlke, C. A.**, Anderson, T. P., and Alexander, D. R., "Formation of multiscale surface structures on nickel via above surface growth and below surface growth mechanisms using femtosecond laser pulses," *Optics Express*, Vol. 21, Issue 7, pp. 8460-8473, 2013.
4. **Zuhlke, C. A.**, Alexander, D. R., Bruce III, J. C., Ianno, N. J., Kamler, C. A., Yang, W., "Self assembled nanoparticle aggregates from line focused femtosecond laser ablation," *Optics Express*, Vol. 18 Issue 5, pp. 4329-4339, 2010.
3. Kruse, C., Anderson, T., Wilson, C., **Zuhlke, C.**, Alexander, D., Gogos, G., and Ndao, S. (2013). "Extraordinary shifts of the leidenfrost temperature from multiscale micro/nanostructured surfaces," Langmuir, 29 (31), pp 9798-9806, 2013.
2. Alexander, D., Bruce III, J., **Zuhlke, C.**, Koch, B., Rudebusch, R., Deogun, J., and Hamza, H., "Demonstration of a nanoparticle based optical-diode," *Optics Letters* 31, pgs. 1957-1959, 2006.
1. Veillère, A., Guillemet, T., Xie, Z. Q., **Zuhlke, C. A.**, Alexander, D. R., Silvain, J.-F., Heintz, J., Chandra, N., Lu, Y. F., "Influence of WC-Co substrate pretreatment on diamond film deposition by laser-assisted combustion synthesis." *ACS Applied Materials & Interfaces*, 3(4), 1134–9, 2011.

Publications under Peer Review

1. Zuhlke, C. A., Tsibidis, G. D., Anderson, T., Stratakis, E., Gogos, G., and Alexander, D. R., "Investigation of Femtosecond Laser Induced Ripple Formation on Copper for Varying Incident Angle," submitted to Applied Physics Letters.

Conference-Related Publications

13. Hansen, S., Wright, S., Wallace, S., Hamilton, T., Alexander, D., Zuhlke, C., Roth, N., Sanders, J., "Laser Processed Condensing Heat Exchanger Technology Development," 47th International Conference on Environmental Systems 16-20 July 2017, Charleston, South Carolina.
12. Hassebrook, A., Lucis, M. J., Shield, J. E., Zuhlke, C. A., Anderson, T. P., Alexander, D. R., Gogos, G., Ndao, S. (2015). "Thermal Stability of Rare Earth Oxide Coated Superhydrophobic Microstructured Metallic Surfaces." In Proceedings of the ASME 2015 International Technical Conference and Exhibition on Packaging and Integration of Electronic and Photonic Microsystems and ASME 2015 13th International Conference on Nanochannels, Microchnnels, and Minichannels (pp. 1–7).
11. Kruse, C., Anderson, T., Zuhlke, C., Alexander, D., Gogos, G., Ndao, S., "Pool Boiling Heat Transfer Enhancement with Metallic Femtosecond Laser Processed Surfaces: Study of Nanoparticle Effects," 9th International Conference on Boiling and Condensation Heat Transfer, Boulder, Colorado, April 2015
10. Anderson, T. P., Wilson, C., Zuhlke, C. A., Kruse, C. M., Gogos, G., Ndao, S., & Alexander, D. R. (2015). "Enhancing vapor generation at a liquid-solid interface using micro/nanoscale surface structures fabricated by femtosecond laser surface processing." Proc. SPIE 9351, Laser-based Micro- and Nanoprocessing IX, 93510D (12 March 2015); doi: 10.1117/12.2079828
9. Zuhlke, C. A., Anderson, T. P., Li, P., Lucis, M. J., Roth, N., Shield, J. E., Terry, B., Alexander, D. R. (2015). "Superhydrophobic metallic surfaces functionalized via femtosecond laser surface processing for long term air film retention when submerged in liquid." Proc. SPIE 9351, Laser-based Micro- and Nanoprocessing IX, 93510J (12 March 2015); doi: 10.1117/12.2079164
8. Kruse, C. M., Anderson, T. P., Wilson, C., Zuhlke, C. A., Alexander, D. R., Gogos, G., and Ndao, S., "Enhanced Pool-Boiling Heat Transfer and Critical Heat Flux Using Femtosecond Laser Surface Processing," ITHERM Conference Proceedings., 2014.
7. Hassebrook, A., Kruse, C., Wilson, C., Anderson, T., Zuhlke, C., Alexander, D., Gogos, G., and Ndao, S., "Effects of Droplet Diameter on the Leidenfrost Temperature of Laser Processed Multiscale Structured Surfaces," ITHERM Conference Proceedings, 2014.
6. Zuhlke, C. A., Anderson, T. P., and Alexander, D. R., "Understanding the formation of self-organized micro/nanostructures on metal surfaces from femtosecond laser ablation using stop-motion SEM imaging," Proc. SPIE 8968, Laser-based Micro- and Nanoprocessing VIII, 89680C, 6 March 2014.
5. Anderson, T. P., Wilson, C., Zuhlke, C. A., Kruse, C., Hassebrook, A., Somanas, I., Ndao, S., Gogos, G., and Alexander, D., "Tailoring liquid/solid interfacial energy transfer: fabrication and application of multiscale metallic surfaces with engineered heat transfer and electrolysis properties via femtosecond laser surface processing techniques," Proc. SPIE 8968, Laser-based Micro- and Nanoprocessing VIII, 89680R, 6 March 2014.
4. Anderson, T. P., Zuhlke, C. A., Wilson, C., Kruse, C., Ianno, N., Ndao, S., Gogos, G., Alexander, D. R., "Understanding the physical and material dynamics of multipulse femtosecond laser interactions with surfaces," Proc. SPIE, Laser-induced Damage in Optical Materials, pp. 888518, 2013.
3. Koester, L., Zuhlke, C., Alexander, D., Fuller, A., Wilson, B. M., Turner, J. A. "Near Race Ultrasonic Detection of Subsurface Defects in Bearing Rings," Bearing Steel Technology: Advances and State of the Art in Bearing Steel Quality Assurance, J. M. Beswick, Ed., ASTM International, Tampa, FL 2012.

2. Koester, L., Turner, J. A., Zuhlke, C., Alexander, D., Wilson, B., Tarawneh, C., Fuller, A. J., "Near-race Ultrasonic Inspection of Tapered Roller Bearing Components for Non-metallic Defects." Proceedings of the ASME 2012 Rail Transportation Division Fall Technical Conference. ASME, Omaha, NE, 2012.
1. Alexander, D., Deogun, J., Hamza, H., Bruce III, J., Zuhlke, C., Koch, B., Le, P., "Quantum Dots Based Technology for Multiple Wavelength Conversion" in *LEOS IEEE 18th annual meeting* (Institute of Electrical and Electronics Engineers, Sydney Australia), 2005.

Non-peer Reviewed Publications

2. Alexander, D., Bruce III, J., Zuhlke, C., Koch, B., Rudebusch, R., Deogun, J., and Hamza, H. (2006). "Optical diode based on core-shell quantum dots demonstrated," Materials Research Society Bulletin, Vol. 31, No. 8, August.
1. Alexander, D., Bruce III, J., Zuhlke, C., Koch, B., Rudebusch, R., Deogun, J. and Hamza, H. (2006). "Demonstration of a nanoparticle-based optical diode," Virtual Jounal of Nanoscale Science & Technology, Vol. 14, No. 4, July 24.

Awarded and Filed Patents

- U. S. Patent #**7868302**, **Nano-particle/quantum dot based optical diode**, issued January 11, 2011.
- Application #**61913979**, **High Resolution Dynamical Movies Made Using a Scanning Electron Microscope Sequence of Still Images**, filed December 10, 2013 by NUTech Ventures.
- Application #**62103328**, **Device and Process for Imaging through Blood,** filed January 14, 2015.
- There are also several patents that have been disclosed to NUTech Ventures (Nebraska Technology Transfer Office) that are in the process of being filed.

Conference Presentations

33. **Invited Keynote Presentation:** Zuhlke, C. A.; Anderson, T. P.; Wilson, C.; Kruse, C.; Alexander, D. R.; Gogos, G.; Ndao, S. "Understanding the Formation of Self-Organized Micro/Nanostructures from Femtosecond Laser Ablation used to Enhance Two-phase Heat Transfer," Invited Presentation to ASME International Conference on Nanochannels, Microchannels, and Minichannels (ICNMN), Chicago, IL August 2014.
32. Baker, C. H., Supowit, J. A., Miller, R., McHale, J. P., Pichardo, P., Alexander, D. R., Zuhlke, C. A., Roth, N., "Thermal Cycle Testing of Titanium Superhydrophobic Surfaces for a Spacecraft Jumping Droplet Thermal Diode," 12th AIAA/ASME Joint Thermophysics and Heat Transfer Conference, Atlanta, GA, June 25–29, 2018.
31. Hansen, S., Wright, S., Wallace, S., Hamilton, T., Alexander, D., Zuhlke, C., Roth, N., Sanders, J., "Laser Processed Condensing Heat Exchanger Technology Development," 47th International Conference on Environmental Systems 16-20 July 2017, Charleston, South Carolina.
30. Zuhlke, C., Alexander, D., Gogos, G., Shield, J., Ianno, N., Bayles, K., Exstrom, C., Darveau, S. and Hansen, S., "Functionalizing Metallic Surfaces Using Femtosecond Laser Surface Processing," CCMPP 2017, NASA Goddard Space Flight Center, Greenbelt, MD, July 18 - 20, 2017.
29. Kruse, C., Peng, E., Zuhlke, C., Shield, J., Alexander, D., Gogos, G., Ndao, S., "Role of Copper Oxide Layer on Pool Boiling Performance with Femtosecond Laser Processed Surfaces," Proceedings of the ASME 2017 International Conference on Nanochannels, Microchannels, and Minichannels, Cambridge, Massachusetts, August 27 - 31, 2017

28. **Invited Presentation** (presenter: D. R. Alexander): Alexander, D. R., Zuhlke, C. A., Gogos, G., Ndao, S., Ianno, N. and Shield, J., "Femtosecond Laser Technologies for Defending Against Emerging Threats Related Research," Presentation to Nebraska Congressional Delegates on October 4th 2016.
27. Alexander, D. R. and Zuhlke, C. A., "Femtosecond Laser Surface Processing (FLSP) of Metallic Surfaces and the Formation of New Phases of Matter", Australian National University, Canberra, Australia, September 16, 2016.
26. **Invited Presentation** (presenter: D. R. Alexander): Alexander, D. R., Zuhlke, C. A., "Functionalization of Metallic Surfaces and the Creation of New States of Matter Using Ultra-Fast Laser Technology." Southwest Ultrafast Conference, June 2016.
25. Peng, E., Tsubaki, A., Zuhlke, C. A., Bell, R., Wang, M., Anderson, T. P., Alexander, D. R., Gogos, G., Shield, J. E. "Below and Above Surface Growth Mechanisms of Multiscale Structures by Femtosecond Laser Surface Processing on Ni60Nb40." 2016 International High Power Laser Ablation and Directed Energy (HPLA), Santa Fe, NM.
24. **Invited Presentation** (presenter: D. R. Alexander): Alexander, D. R., Zuhlke, C. A., Anderson, T. P., "Functionalizing Metallic Surfaces, Creating New Phases of Metals, and Producing Coulomb Explosions Using Extreme Light." Lecture at the Army Research Laboratory, August 2015.
23. Zuhlke, C. A., Tsubaki, A., Kruse, C., Anderson, T. P., Wang, X., Tsai, H. E., Shaw, J., Downer, M. C., Gogos, G., Ndao, S., and Alexander, D. R., "Self-Organized Micro/Nanostructure Formation on Critical Heat Transfer Materials Using Femtosecond Laser Surface Processing," 2015 International Technical Conference and Exhibition on Packaging and Integration of Electronic and Photonic Microsystems and ASME 2015 13th International Conference on Nanochannels, Microchnnels, and Minichannels (ICNMM), San Francisco, CA, July 2015.
22. Hassebrook, A., Lucis, M. J., Shield, J. E., Zuhlke, C. A., Anderson, T. P., Alexander, D. R., Gogos, G., Ndao, S. (2015). "Thermal Stability of Rare Earth Oxide Coated Superhydrophobic Microstructured Metallic Surfaces." ASME International Conference on Nanochannels, Microchannels, and Minichannels (ICNMN), San Francisco, CA, July 2015.
21. Kruse, C., Anderson, T., Zuhlke, C., Alexander, D., Gogos, G., Ndao, S., "Pool Boiling Heat Transfer Enhancement with Metallic Femtosecond Laser Processed Surfaces: Study of Nanoparticle Effects," 9th International Conference on Boiling and Condensation Heat Transfer, Boulder, Colorado, April 2015.
20. Zuhlke, C. A., Anderson, T. P., Li, P., Lucis, M. J., Roth, N., Shield, J. E., Terry, B., Alexander, D. R. "Superhydrophobic metallic surfaces functionalized via femtosecond laser surface processing for long term air film retention when submerged in liquid." SPIE Photonics West, San Francisco, CA, February 2015.
19. Anderson, T. P., Wilson, C., Zuhlke, C. A., Kruse, C. M., Gogos, G., Ndao, S., & Alexander, D. R. "Enhancing vapor generation at a liquid-solid interface using micro/nanoscale surface structures fabricated by femtosecond laser surface processing." SPIE Photonics West, San Francisco, CA, February 2015.
18. Alexander, D. R., Anderson, T. P., Zuhlke, C. A., and Rowse, N., "Simultaneous Disabling and Real Time Damage Assessment of Optical Sensors", High Energy Laser-Joint Technology Office (HEL-JTO), Annual Contractors Review Presentation, Albuquerque, New Mexico, April 30, 2014.
17. Zuhlke, C. A., Bruce III, J, Anderson, T. P., Alexander, D. R., and Parigger, C., "Focusing Phenomena of Femtosecond Laser Radiation Interacting with Material", 22nd International Conference on Spectral Line Shapes, Tullahoma, Tennessee, April 21-26, 2014
16. Zuhlke, C. A., Anderson, T., Rowse, N., and Alexander, D., "Physics and Material Dynamics Resulting From Sequenced Multi-Pulse Femtosecond Laser Interactions with Metallic Surface", High Power Laser Ablation and Beamed Energy Propulsion (HPLA/BEP), Santa Fe, NM, April 21-25.

15. Zuhlke, Craig; Anderson, Troy; Alexander, Dennis. “Understanding the formation of self-organized micro/nanostructures on metal surfaces from femtosecond laser ablation using stop-motion SEM imaging.” SPIE Photonics West, San Francisco, CA, February 2014.
14. **Invited Presentation** (presenter: D. R. Alexander): Zuhlke, C. A., Bruce III, J., Anderson, T., Alexander, D. R., and Parigger, C., "Fundamental understanding of the dependence of the LIBS signal strength on the complex focusing dynamics o femtosecond laser pulses either side of focus," Invited presentation, Southeast Ultra Fast Laser Conference, Baton Rouge, LA, Jan. 8-9, 2014
13. Zuhlke, Craig; Bruce III, John; Anderson, Troy; Alexander, Dennis; Parigger, Christian. “Fundamental understanding of the dependence of the LIBS signal strength on the complex focusing dynamics of femtosecond laser pulses either side of focus.” Conference Presentation, 40th Federation of Analytical Chemistry and Spectroscopy Societies (FACSS) SCIX conference, Milwaukee, WI, October 2013.
12. Zuhlke, Craig; Alexander, Dennis R.; Bruce III, John. “Femtosecond Laser Production of Nanoparticles and Their Subsequent Layered Aggregate Growth Using a Line Focused Beam.” Conference Presentation, 18th International Conference on Composites or Nano Engineering, Anchorage, AK, July 2010.
11. Kruse, C.; Hassebrook, A.; Anderson, T.; Wilson, C.; Zuhlke, C.; Alexander, D. R.; Gogos, G.; Ndao, S. “Self-propelled droplets from bioinspired directional microstructured surfaces,” International Heat Transfer Conference, Kyoto, Japan, August 2014.
10. Kruse, C.; Hassebrook, A.; Anderson, T.; Wilson, C.; Zuhlke, C.; Alexander, D. R.; Gogos, G.; Ndao, S. “Self-propelled droplets from bioinspired directional microstructured surfaces”, Poster at ASME International Conference on Nanochannels, Microchannels, and Minichannels (ICNMN), Chicago, IL August 2014.
9. Kruse, C.; Anderson, T.; Wilson, C.; Zuhlke, C.; Alexander, D. R.; Gogos, G.; Ndao, S. “Enhanced Pool-boiling Heat Transfer and Critical Heat Flux using Femtosecond Laser Surface Processing,” Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITHERM), Orlando, FL, May 2014.
8. Hassebrook, A.; Kruse, C.; Anderson, T.; Wilson, C.; Zuhlke, C.; Alexander, D. R.; Gogos, G.; Ndao, S. “Effects of Droplet Diameter on the Leidenfrost Temperature of Laser Processed Multiscale Structured Surfaces,” Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITHERM), Orlando, FL, May 2014.
7. Anderson, T. P.; Zuhlke, C. A.; Kruse, C.; Wilson, C.; Hassebrook, A.; Somanas, I.; Ndao, S.; Gogos, G.; Alexander, D. R. “Tailoring Liquid/Solid Interfacial Energy Transfer: Fabrication and Application of Multiscale Metallic Surfaces With Engineered Heat Transfer and Electrolysis Properties Via Femtosecond Laser Surface Processing Techniques”, SPIE Photonics West, San Francisco, CA, February 2014.
6. Anderson, T. P.; Zuhlke, C. A.; Wilson, C.; Alexander, D. R. "Physics and material dynamics resulting from sequenced multipulse femtosecond laser interactions with metallic surface", High Power Laser Damage Conference, Santa Fe, New Mexico, April 14-17, 2014.
5. Kruse, C.; Anderson, T. P.; Wilson, C.; Zuhlke, C. A.; Alexander, D. R.; Gogos, G.; Ndao, S. “Controlling the Leidenfrost Temperature Through Laser-Assisted Surface Micro/Nano Texturing”, ASME Summer Heat Transfer Conference, Minneapolis, MN, July 18, 2013.
4. Anderson, Troy P.; Zuhlke, Craig A.; Bay, Kim; Wilson, Chris; and Alexander, Dennis R. “Growth Mechanisms for Multi-Scale Surface Features on Metals Fabricated Using Ultrashort Pulse Laser Irradiation,” presented at the Laser Micro and Nanostructuring: Fundamentals and Applications Conference. Palaiseau, France. December 10-12, 2012.

3. Anderson, T. P.; Zuhlke, C. A.; Bruce III, J.; Alexander, D. R.; Parigger, C. “Evidence of near-field filaments and how sample location affects femtosecond LIBS,” presented at the North American Symposium on Laser-Induced Breakdown Spectroscopy (NASLIBS), 2011.
2. Panel speaker at 2012 Nebraska Summit on Entrepreneurship, breakout session: "Studentpreneurs: Balancing Books and Business"
1. Panel speaker at 2012 Entrepreneurship Bootcamp hosted by NUtech Ventures, panel discussion: “From Student to Entrepreneur”

Conference Posters

5. Kruse, C., Hassebrook, A., Anderson, T., Zuhlke, C., Alexander, D., Gogos, G., Ndao, S., "Two-Phase Heat Transfer and Thermal Stability of Femtosecond Laser Fabricated Multiscale Hierarchical Metallic surfaces", Gordon Research Conference on Micro & Nanoscale Phase Change Heat Transfer, Galveston, Texas, January 2015.
4. Zuhlke, Craig; Anderson, Troy; Alexander, Dennis. “Understanding the formation of self-organized micro/nanostructures on metal surfaces from femtosecond laser ablation using stop motion SEM imaging” Poster Presentation, UNL Graduate Office Research Fair/EE Graduate Research Poster Competition, Lincoln, NE, April, 2013 (**honorable mention poster**).
3. Zuhlke, Craig; Alexander, Dennis; Lai, Rebecca; Anderson, Troy; Smith, Thomas. “Use of Femtosecond Laser Pulses to Modify Metal Surfaces for use as Pseudocapacitor Electrodes” Poster Presentation, UNL Graduate Office Research Fair/EE Graduate Research Poster Competition, Lincoln, NE, April, 2012 (**second place poster**).
2. Zuhlke, Craig; Alexander, Dennis; Lai, Rebecca; Anderson, Troy; Smith, Thomas. “Storage of Alternative Energy Using New Supercapacitors Utilizing Femtosecond Laser Surface Modification Technologies” Poster Presentation, UNL Graduate Student Poster Session/EE Graduate Research Poster Competition, Lincoln, NE, April, 2011.
1. Zuhlke, Craig; Alexander, Dennis; Lai, Rebecca; Anderson, Troy; Smith, Thomas “Storage of Alternative Energy Using New Supercapacitors Utilizing Femtosecond Laser Surface Modification Technologies.” Poster Presentation, Nebraska Research and Innovation Conference, Lincoln, NE, October, 2010.