

# Trevor G. Aguirre, Ph.D.

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## **CAREER OBJECTIVE AND PROFILE**

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To develop the next-generation of additively manufactured ultra-high temperature ceramics and ceramics composites with enhanced thermal, mechanical, and oxidation performance.

Early career research development materials engineer with experience in identifying and solving complex problems within the ceramics field. Leverages advanced research and academic background combined with experience gained working within industry-leading organizations to conduct applied research and develop procedures and processes to resolve technical challenges. Driven, self-starter, and quick learner with excellent written and verbal communication.

## **EDUCATION**

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- 2020** **Colorado State University (CSU)** – Fort Collins, Colorado  
Doctor of Philosophy: Mech. Engr., Advisor: Dr. Seth W. Donahue, GPA: 3.57/4.00  
Dissertation: *Bio-inspired Design for Engineering Applications - Empirical and Finite Element Studies of Mechanically Adapted Bone Architectures*
- 2017** Master of Science: Mech. Engr., Advisor: Dr. Troy B. Holland, GPA: 3.57/4.00  
Thesis: *Effects of the addition of boron-nitride nanoplatelets to hydroxyapatite: processing, testing, and characterization*
- 2014** Bachelor of Science: Mech. Engr. GPA: 3.17/4.00
- 2010** **Western Nebraska Community College (WNCC)** – Scottsbluff, Nebraska  
Associate of Science: Engineering, GPA: 3.19/4.00  
Associate of Science: Mathematics, GPA: 3.19/4.00

## **TECHNICAL PROFILE**

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- Experimental** Ceramic powder processing, reaction processing (solid-solid reaction gas-solid reaction, nitriding), densification/sintering, microstructural characterization, processing-microstructure-property relationships of ceramics, mechanical and thermophysical properties of ceramics up to ultra-high temperatures, ultra-high-temperature ceramics (Borides, Carbides, Nitrides), finite-element modeling of environmental barrier coatings, design of Experiments (DOE),
- Equipment** Debinding ovens, Sintering furnaces (vacuum, graphite, SiC, MoSi<sub>2</sub>), hot-presses, spark-plasma sintering press, hydraulic compaction presses, Hydraulic and servo-mechanical testing frames, load cells, strain gauges, LVDTs, PLC/PID and computer-controlled processing and data collection systems, gas delivery systems, mass flow controllers, vacuum systems, thermocouples, optical pyrometers, binder jet additive manufacturing. Basic proficiency with extrusion, lithography, and electron and laser beam printers.
- Analytical** SEM/EDS/EBSD, powder XRD systems, optical microscopy, TGA, strength (compression, flexural, tension), fracture toughness (indentation, CN, SENB, SEVNB), hardness (Vickers, Knoop), Elastic Moduli (stress-strain response)
- Computer** MS Office, Adobe Acrobat, Minitab, MATLAB, LABVIEW, ImageJ, Solidworks, ABAQUS,

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## RESEARCH BASED EMPLOYMENT

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### **Current Alvin M. Weinberg Distinguished Staff Fellow**

Oak Ridge National Laboratory, Supervisor: Dr. Vlastimil Kunc and Dr. James W. Klett *Oct. 2020–*

- Developing additive manufacturing (AM) strategies for 1) refractory and ultra-high temperature ceramics and ceramics composites and 2) ceramic-metallic heterogenous material composites
- Developed novel bio-inspired SiC-W composite that was tested as a thermal protection system on a sounding rocket as part of the Sandia National Labs H4H campaign in October 2021
- Developed novel method for processing of net-shape porous silicon nitride
- Finite element modeling of environmental barrier coatings to determine effect of thermal cycling to prevent spalling of the coating during heating

### **2020 Graduate Research Assistant, Ph.D.**

Colorado State University, Advisor: Dr. Seth W. Donahue

*Aug. 2017–July 2020*

- Studied unique porous bone architectures adapted for extreme loading conditions
- Collected trabecular bone cores from dinosaur tibiae and femora to study bone adaption
- Studied and bio mimicked the velar architecture in Rocky Mountain bighorn sheep to generate novel energy absorbing structures for low velocity impact applications (helmets/shoes/vehicles)
- Mechanical testing and finite element analysis of unique trabecular bone architectures to determine structure-based strength differences

### **2019 ASTRO Scholar and Additive Manufacturing Intern**

Oak Ridge National Laboratory, Supervisor: Dr. Amy M. Elliott

*May 2019–Aug. 2019*

- Development, testing, and manufacture of ceramic heat exchangers using binder jet additive manufacturing, polymer infiltration and pyrolysis, and reactive melt infiltration
- Fabrication, characterization, and testing of ultra-high temperature ceramic composites for high temperature applications

### **2017 Graduate Research Assistant, M.S.**

Colorado State University, Advisor: Dr. Troy B. Holland

*Aug. 2014–May 2017*

- Statistical experimental design to determine optimal parameters for sintering experiments
- Designed and manufactured specialty tooling and mechanical testing fixtures
- Mechanical property quantification via hardness, fracture toughness, and flexural strength testing

### **2014 Product Technology Intern**

EVRAZ Rocky Mountain Steel Mill, Supervisor: Mr. Greg Garcia

*May 2014–Aug. 2014*

- Developed contact mechanics models to visualize subsurface stress distribution during wheel and rail contact to better understand rolling contact fatigue
- Developed a graphical tool for tracking metallurgical defect occurrences in rail
- Tensile testing and data analysis for mechanical property quantification of novel steel alloys
- Gained experience in non-destructive testing processes

### **2013 Engineering Services Intern**

Transportation Technology Center (now MxV Rail)

Supervisor: Mr. Greg Garcia

*May 2011–May 2013*

- Metallographic sample preparation for grain size analysis and non-destructive analyses.

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- Gained experience in non-destructive testing processes such as ultrasonic, dye penetrant, and magnetic particle testing to determine flaw size and location in rails
- Analyzed experimental data to create a wear-growth curve for trafficked railroad track

## PROJECTS

1. Additive manufacturing of ceramics for harsh environments. DOE, ORNL LDRD, Project ID: DE-EE0010216.0000. Role: Principal Investigator.
2. Additive Manufacturing of High Resolution SiC Fiber Composite Components for Utilization in Energy Systems. DOE, Office of Energy Efficiency & Renewable Energy. Program Manger Stephen Sikirica, Project No. DE-EE0010216.0000. Collaboration between GE Additive, GE Energy, & ORNL. Role: Principal Investigator at ORNL
3. Next Generation Environmental Barrier Coatings, DOE, Office of Fossil Energy and Carbon Management, Program Managers Richard Dennis and Rin Burke, Work Proposal #: FEAA149. Role: Supporting researcher
4. Materials and Manufacturing Research for Future Air Force Assets Operating in Extreme Environments, Air Force Research Laboratory, DOE Project No. 2243-Z423-21, Role: Supporting Researcher

## AWARDED FUNDING

1. \$500,000 – Additive manufacturing of ceramics for harsh environments

## REFEREED PUBLICATIONS (Reverse Chronological Order)

1. C.L. Cramer, E. Ionescu, M. Graczyk-Zajac, A.T. Nelson, Y. Katoh, J.J. Haslam, L. Wondraczek, **T.G. Aguirre**, S. LeBlanc, H. Wang, M. Masoudi, E. Tegeler, R. Riedel, P. Colombo, M. Minary-Jolandan, “Additive Manufacturing of Ceramic Materials for Energy Applications: Road Map and Opportunities”, Online: <https://doi.org/10.1016/j.jeurceramsoc.2022.01.058>
2. **T.G. Aguirre**, B. Lamm, C.L. Cramer, D.J. Mitchell, “Zirconium-diboride silicon-carbide composites: A review”, Online: <https://doi.org/10.1016/j.ceramint.2021.11.314>
3. **T.G. Aguirre**, C.L. Cramer, D.J. Mitchell, “Review of additive manufacturing and densification techniques for the net- and near net-shaping of geometrically complex silicon nitride components”, Online: <https://doi.org/10.1016/j.jeurceramsoc.2021.11.001>
4. **T.G. Aguirre**, C.L. Cramer, E. Cakmak, R.A. Lowden, “Reaction bonded ZrB<sub>2</sub>-SiC Composites: In situ formation and mechanical properties”, Online: <https://doi.org/10.1016/j.rinma.2021.100217>
5. A. Ingrole, **T.G. Aguirre**, L. Fuller, S.W. Donahue, “Bioinspired energy absorbing material designs using additive manufacturing”, Online: <https://doi.org/10.1016/j.jmbbm.2021.104518>
6. **T.G. Aguirre**, L. Fuller, A. Ingrole, T.W. Seek, B.D. Steineman, B.B. Wheatley, T.L. Haut-Donahue, S.W. Donahue, “Bioinspired material architectures from bighorn sheep horncore velar bone for impact loading applications”, Online: <https://doi.org/10.1038/s41598-020-76021-5>
7. **T.G. Aguirre**, A. Ingrole, L. Fuller, T.W. Seek, A.R. Fiorillo, J.J.W. Sertich, S.W. Donahue, “Differing trabecular bone architecture in dinosaurs and mammals contribute to stiffness and limits on bone strain”, Online: <https://doi.org/10.1371/journal.pone.0237042>
8. C.L. Cramer, **T.G. Aguirre**, N.R. Wieber, R.A. Lowden, A. Trofimov, H. Wang, J. Yan, M.P. Paranthaman, A.M. Elliot, “Binder jet printed WC infiltrated with pre-made melt of WC and Co,” Online: <https://doi.org/10.1016/j.ijrmhm.2019.105137>

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9. C.L. Cramer, N.R. Wieber, **T.G. Aguirre**, R.A. Lowden, A.M. Elliot, "Shape retention and infiltration height in complex WC-Co parts made via binder jet of WC with subsequent Co melt infiltration," Online: <https://doi.org/10.1016/j.addma.2019.100828>
10. **T.G. Aguirre**, C.L. Cramer, V.P. Torres, T.J. Hammann, T.B. Holland, K.Ma, "Effects on the Mechanical Properties and Weibull Distribution of Boron Nitride Nanoplate Reinforced Hydroxyapatite Composites Prepared by Spark Plasma Sintering," Online: <https://doi.org/10.1016/j.jmbbm.2019.01.021>
11. T.J. Hensen, **T.G. Aguirre**, C.L. Cramer, A.S. Wand, K. Ma, D. Prawel, J.D. Williams, T.B. Holland, "Additive Manufacturing of Ceramic Nanopowder by Direct Coagulation Printing," Online: <https://doi.org/10.1016/j.addma.2018.07.010>
12. C.L. Cramer, **T.G. Aguirre**, K. Ma, T.B. Holland, "Prediction of Porosity Gradients in Ceramics using ZnO as a model material," Online: <https://doi.org/10.1111/jace.15872>

## **PRESENTATIONS (Reverse Chronological Order)**

1. *Additive Manufacturing Enabling W-SiC and W-ZrB<sub>2</sub>-SiC Heterogeneous Materials*. Ultra-High Temperature Ceramics: Materials For Extreme Environment Applications V, Snowbird Utah, USA, June 2022, D. Mitchell, C. Cramer, **T. Aguirre**, A. Schumacher, M. Kirka, C. Ledford, V. Kunc
2. *Cyclic Steam Oxidation of Environmental Barrier Coatings Deposited without a Silicon Bond Coat*. 48th International Conference on Metallurgical Coatings and Thin Films. May 2022. San Diego, CA. M. Ridley, K. Kane, C. Parker, M. Lance, **T. Aguirre**, E. Garcia, B. Pint.
3. *Raman Spectroscopic Characterization of Yttrium/Ytterbium Silicates and Thermally-Grown SiO<sub>2</sub> Phases in Environmental Barrier Coatings*. 48th International Conference on Metallurgical Coatings and Thin Films. May 2022. San Diego, California, USA. M.J. Lance, M.J. Ridley, K.A. Kane, **T.G. Aguirre**, and B.A. Pint.
4. *Processing of polymer-derived ceramics (PDCs) for fibers, monoliths, and ceramics matrix composites (CMCs)*. 14th Pacific Rim Conference on Ceramic and Glass Technology (PACRIM 14), Vancouver, British Columbia, CA, December 2021, C.L. Cramer, S. Bullock, T. Aguirre, D. Mitchell, V. Kunc
5. *Additive Manufacturing of Silicon Nitride Using a Slurry Approach*. Materials Science & Technology Technical Meeting & Exposition Columbus Ohio, USA, October 2021. B.L. Armstrong, C.L. Cramer, B. Lamm, **T.G. Aguirre**, and D.J. Mitchell
6. *Fabrication and shaping of ZrB<sub>2</sub>-SiC composites by reaction bonding with various precursors and consolidation techniques*. International Conference and Expo on Advanced Ceramics and Composites, Daytona Beach, Florida January 2020, **T.G. Aguirre**, C.L. Cramer, R.A. Lowden, E. Eyeran.
7. *The effect of the addition of white graphene to hydroxyapatite: Processing, Testing, and Characterization*. International Conference and Expo on Advanced Ceramics and Composites, Daytona Beach, Florida, USA January 2017, **T. G. Aguirre**, T.B. Holland.

## **MEDIA RELEASES (Reverse Chronological Order)**

1. Cable News Network (CNN), August 19<sup>th</sup>, 2020.  
<https://www.cnn.com/2020/08/19/world/dinosaur-bones-study-scni/index.html>
2. University of Wyoming, Laramie, WY, March 27<sup>th</sup>, 2019.  
<https://www.facebook.com/uwgeologyandgeophysics/videos/378267269433887/>
3. Wyoming Dinosaur Center, Thermopolis, WY, March 1<sup>st</sup>, 2019.

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<https://www.facebook.com/WyomingDinosaurCenter/videos/2052931628161428/>

4. Washakie Museum and Cultural Center, Worland WY, March 1<sup>st</sup>, 2019  
<https://www.facebook.com/washakiemuseum/videos/1998197320474263/>

## **PATENTS**

1. Mobile stone/bone coring device (US Utility Patent Expired)  
<https://csuventures.org/project/precise-coring-methods-and-device-for-bone-and-stone/>
2. Additively Manufactured Refractory Metal-Ceramic Matrix Composites (Patent to be filed)  
ORNL Patent ID: 81934755

## **AWARDS AND HONORS**

- Distinguished Staff Fellow, Oak Ridge National Laboratory, 2020-2023
- ASTRO Program Scholar, Oak Ridge National Laboratory, Summer 2019
- Bob and Bonnie Walker Scholarship Recipient, CSU, 2012-2014
- Scholarships for Information Technology and Engineering Recipient, WNCC, 2008–2010

## **ACTIVITIES**

- 2018** CSU – Society of Hispanic Professional Engineers (SHPE) *Jan. 2011–May 2018*
- Served as Treasurer, Vice-President, President, and Recruitment and Retention Chairperson
  - Developed new practices/policies to maintain and improve student involvement and retention
- 2018** National Graduate Representative – SHPE National *July 2017–July 2018*
- Remotely managed two different teams of seven members across the US to develop and implement programs to increase graduate student value from SHPE involvement
  - Helped develop and plan graduate workshops at the SHPE National Conference
- 2017** Regional Graduate Representative – SHPE National *July 2016–July 2017*
- Managed Graduate Ambassadors at 15+ universities to promote graduate school awareness and success to Hispanic graduate and undergraduate students
  - Helped develop and plan graduate workshops at the SHPE National Conference

## **VOLUNTEERING AND OUTREACH**

### **Academic Research Collaboration Mentor**

- Mentored 10+ SHPE undergraduates in the Advanced Materials Processing and Testing Lab through hands-on training and application of classroom concepts in a lab environment
- Helped students develop analytical and safety skills needed for working in a lab environment

### **EnPower Mentor**

- Volunteered to help pilot a mentoring program designed to increase the success and retention of Native American and Hispanic engineering students in the CSU College of Engineering
- Helped students find the resources they needed for success in school, mental/medical health, and volunteering opportunities

### **Multicultural Undergraduate Research, Arts, and Leadership Symposium**

- Served as mentor to help evaluate undergraduates' abstracts, posters, and oral presentations
- Served as lead graduate student. Coordinated 60+ graduate students across the university to evaluate undergraduate abstracts and provide feedback on student presentations

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## **TEACHING AND EDUCATION EXPERIENCE**

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MECH331: Intro. to Materials Science – Graduate Teaching Asst.	<i>Summer 2020</i>
MECH307: Mechatronics and Measurement Systems – Graduate Teaching Asst.	<i>Spring 2020</i>
MECH331: Intro. to Materials Science – Graduate Teaching Asst.	<i>Fall 2019</i>
MECH201: Engineering Design I – Graduate Teaching Fellow	<i>AY 2018–19</i>
MECH231: Engineering Experimentation – Graduate Teaching Asst.	<i>2014-2017</i>
Mathematics and Physics Tutor	<i>Spring 2009 – Fall 2010</i>

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## REFERENCES

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**Dr. James W. Klett**

*Group Leader: Extreme Environment Materials Processing Group and R&D Staff, Oak Ridge National Laboratory (ORNL), Oak Ridge, TN*

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**Dr. Vlastimil Kunc**

*Section Head: Composites Science Technology and R&D Staff, Oak Ridge National Laboratory (ORNL), Oak Ridge, TN*

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**Dr. Corson L. Cramer**

*R&D Associate Staff, ORNL, Oak Ridge, TN*

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**Dr. Thomas R. Muth**

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**Dr. David J. Mitchell**

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**Dr. Amy M. Elliot**

*Group Leader: Robotics & Intelligent Systems and R&D Staff, ORNL, Oak Ridge, TN*

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**Mr. Richard A. Lowden**

*R&D Staff, ORNL, Oak Ridge, TN*

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**Dr. Seth W. Donahue**

*Professor, Department of Biomedical Engineering, University of Massachusetts Amherst*

Email: [swdonahue@umass.edu](mailto:swdonahue@umass.edu)

**Mr. Greg Garcia**

*NDT Level III Engineer, Program Coordinator, EVRAZ Rocky Mountain Steel Mill, Pueblo, CO*

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