Reed A. Ayers

Address and Telephone Numbers:

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Home Phone: (303) 880-5383

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email: reed.ayers@cuanschutz.edu

Education:

Ph.D. *Aerospace Engineering Sciences*, University of Colorado (December 1999)

“Interaction between bone and porous biomaterials in human and rabbit craniomaxillofacial bone”: Drs. Steven Simske and Robert Norrdin, advisors

M.S. *Aerospace Engineering Sciences*, University of Colorado (December 1995)

B.S. *Aerospace Engineering Sciences*, University of Colorado (May 1987)

Professional Experience:

2013-Present *Research Assistant Professor*, Orthopedics, University of Colorado, Denver, School of Medicine

2012-Present *Founder and Chief Technology Officer*, Verkko Biomedical, LLC.

2009-Present *Consultant* with Humatec, Kansas City, KS

2016-2020 *Advisor, Scientific and Clinical Advisory Board*, PorOsteon Spine, Inc.

2014-2018 *Chair: Scientific Advisory Board*, Tridens Medical

2006-2013 *Assistant Professor*, Department of Metallurgical and Materials Engineering, Colorado School of Mines

2000-2006 *Research Assistant Professor*, Center for Commercial Applications of Combustion in Space, Colorado School of Mines

2002-2005 *Research Associate*, BioServe Space Technologies, Department of Aerospace Engineering Sciences, University of Colorado

2004-2005 *Instructor*, Mechanical Engineering, Colorado State University

1999-2000 *Postdoctoral Fellow*, Center for Commercial Applications of Combustion in Space, Colorado School of Mines

1994-1999 *Graduate Research Assistant*, BioServe Space Technologies, Department of Aerospace Engineering, University of Colorado

1997-1998 *Engineer*, Laboratory Automation Research and Development, Amgen Biopharma, Inc.

1996-1997 *Research and Development Engineer*, Outlast Technologies Inc.

1987-1994 *Mass Properties Engineer*, Systems Integration and Mission Operations, Martin Marietta, Space Launch Systems

Patents

1. US8,545,786 Manufacture of Porous Net-Shaped Materials Comprising of Alpha or Beta Tricalcium Phosphate or mixtures thereof, **Ayers** RA, Simske SJ, Moore JJ, Castillo M, Gottoli G. June, 2003.
2. US10,118,827 Combustion Synthesis of Calcium Phosphate Constructs and Powders Doped with Atoms, Molecules, Ions or Compounds. Reed A. **Ayers** and Nina L. Vollmer. November 6, 2018.
3. US10,662,513 Dynamic, non-homogenous shape memory alloys. Reed A. **Ayers**. May 2020

Research Interests:

• Failure analysis of medical devices and materials including microbial influenced corrosion of orthopedic biomedical alloys as well and fracture and loosening

* Powder metallurgy and ceramic manufacture of materials for bone engineering including, shape memory alloys, multiphasic calcium phosphate ceramics, bioabsorbable materials.

• Synthesis (FAST, SPS, Combustion) processing and characterization of light alloys (titanium, magnesium and CoCr alloys).

• Reactive Materials Structures (RMS) synthesis using SPS/Field Affected Sintering.

#### Grants and Awards

Society of Biomaterials, Oral and Craniofacial Special Interest Group, Best Poster, Combustion Synthesis of Calcium Phosphate Blocks Doped with Silver for Treatment of Large Scale Battlefield Injuries, N. Vollmer and R. **Ayers**, Annual meeting, October 4-7, 2012.

American society of Dermatopathology, Physician in Training Award Oral Abstract, Unusual response to ear piercing: granulomatous response to titanium alloy? High WA, **Ayers** RA, Chang A, Fitzpatrick JE. 42nd Annual Meeting, Seattle Washington, October 20-23, 2005.

Funded research:

**NIH - 1R21AR080873-01A1** In-vivo Polymicrobial Biofilms Resulting in Implant Corrosion and Metallosis – Reed Ayers, sole PI ($205,260). 12/19/22-11/30/24.

University of Colorado, School of Medicine, Department of Orthopedics Pilot Research Grants, Biomechanical Evaluation of Band Clamp Systems as a Method to Decrease Proximal Junctional Level Load in Thoracolumbar Instrumentation, Reed Ayers sole PI ($10,000). June 2015-April 2016.

State of Colorado Biomedical Economic Development Grant, Tricalcium phosphate manufacture for biomedical applications, Reed Ayers sole PI ($35,000). September 2011-August 2012. Completed.

University of Colorado, ($5,000) Calcium Phosphate/Collagen scaffold intervertebral spacer. Reed Ayers PI, Summer 2011. Completed.

**NIH - 1R15 AR060011-01** The Anelastic Strain Response of Spine Rods in a Biologic Environment – Reed Ayers, sole PI ($287,000). September 2010-August 2013.

Sub contract to DE Technologies under **DARPA Program (BAA 08-23)** – Spark Plasma Sintering of Novel Reactive Materials – Reed A. Ayers, sole PI ($235,000). January 2009-September 2010. Completed. Program terminated due to budget cuts.

Industry Funded Research:

Sinaptic, Inc. Assessment of bacterial adhesion to silicon nitride in suspension culture. $8,753, 03/2023 – 02/2024

CTLAmedica. $4,000. Antimicrobial potential of SiN ceramics. Ongoing – January 2020.

Lanx Spine Inc. $16,000 materials grant. Lanx supplies spinal instrumentation for the NIH R15 program.

Cerapedics, Inc. – Enhanced Incorporation of P-15 to Calcium Phosphate Materials – Reed A. Ayers 50% PI ($55,000) – September 2008-May 2010. Completed.

Sulzer Medica, Bone Morphogenic Protein Drug Delivery Systems, $15,000. 2004, Completed

Colorado Institute for Research in Biotechnology, Novel Porous Metal Implant Materials Impregnated with Bone Growth Factors for Application in Bone Repair and Replacements, 1998. $125,000, Completed.

## Legal Consulting

Focused on materials failure in medical and commercial applications. Work is done through Verkko Biomedical, LLC. and Humatec, Inc.

## Teaching experience and Academic Service

• Created, developed and teach a senior/first year graduate level course, *Introduction to Biocompatability*, MTGN/MLGN 570, 2000-2013. This class is a required class in the Ph.D./M.S. Biomaterials emphasis in Materials Science as well as for the Bioengineering and Life Sciences Undergraduate Minor in Materials Sciences.

• Taught the fundamental materials science class for the Colorado School of Mines, MTGN 202, Engineered Materials Systems, Fall and Spring semesters since 2006.

• Materials Science Senior Design class project advisor, every year since 2006.

• Developed a 6 course undergraduate minor curriculum for a Bioengineering and Life Sciences Undergraduate Minor in the MME Department as well as a 4 course emphasis in Biomaterials in CSM's Bioengineering and Life Sciences degree program. Recently created the 4 course Biomaterials Area of Special Interest (ASI) within the MME Department (published in 2011-2012 Mines Undergraduate Bulletin).

• Instructor for undergraduate course, *Introduction to Engineering Materials*, ME331, Colorado State University, 2004-2005.

• Member of the Metallurgy and Materials Science Department’s Undergraduate Affairs Committee; lead in developing Colorado School of Mines’ Biomaterials Ph.D./Master's focus area curriculum, 2002 and Area of Special Interest certification for undergraduates in 2010.

• Member of committee to establish Bioengineering and Life Sciences Program/Department at the Colorado School of Mines, 2002.

NSF BMAT proposal review panels.

NIH R15 Review Panel, Bioengineering Sciences and Technologies Initial Review Group.

Professional Memberships:

ASTM F42.07 Committee on Additive Manufacturing and F04.02 Committee on Medical and Surgical Materials and Devices. Voting member on both.

American Academy of Orthopedic Surgeons

ASM Medical Materials Strategic Analysis Committee, member 2012-2015

Publications:

***Book Chapters:***

**Reed A. Ayers,** Evalina Levina Burger, Christopher J. Kleck, Vikas Patel, Metallurgy of Spinal Instrumentation in “Advances in Metallic Biomaterials Technology” Mitsuo Niinomi, Takayuki Narushima, Masaki nakai (eds.). Springer Series in Biomaterials Science and Engineering, Springer-Verlag Gmbh Heidelberg (June, 2015).

**Reed Ayers**, Core Sciences: Biomaterials. In: Jay R. Lieberman, MD, (ed) AAOS Comprehensive Review, 2020.

**Ayers** RA, Bateman TA, Simske SJ, Porous NiTi as a material for bone engineering. In: LH Yahia (ed) Shape Memory Implants, Springer-Verlag, Berlin, 2000, pp. 73-88.

Simske SJ, **Ayers** RA, Bateman TA, Porous materials for bone engineering. In: Liu, D.-M., Dixit, V. (eds.) Materials Science Forum, vol. 250: Porous Materials for Tissue Engineering, Transtech, Enfield, NH, 1997, pp 151-182.

***Journal Articles:***

**2022:**

**Ayers**, Reed PhD; Noschenko, Andriy PhD; Ou-Yang, David MD; Burger, Evalina MD; Patel, Vikas MD; Kleck, Christopher J. MD. Laser Marking of Spine Rods Is Strongly Associated With Risk of Clinical Rod Failure. Journal of the American Academy of Orthopaedic Surgeons: January 15, 2022 - Volume 30 - Issue 2 - p e252-e263 doi: 10.5435/JAAOS-D-20-00866

Trevor Pier, Kenneth Milligan, Zachary Wuthrich, R. Dana Carpenter, Reed **Ayers**, Mary Jesse, Christopher Kleck & Vikas Patel (2022) Morphometric analysis of the sacrum using statistical shape modelling, Computer Methods in Biomechanics and Biomedical Engineering: Imaging & Visualization, 10:1, 76-84, DOI: 10.1080/21681163.2021.1977716

**2020:**

Reed **Ayers**, Vikas Patel, M.D., Evalina Burger, M.D., Christopher Cain, M.D., David Ou-Yang, M.D., Nolan Wessell, M.D., Christopher Kleck, M.D. Corrosion of titanium spinal explants is similar to that observed in oil field line pipe steel: Evidence of microbial influenced corrosion (MIC) in-vivo. Spine 1;43(1):62-67, 2020.

**2018:**

Reed **Ayers**, Mackenzie Miller, Jeffery Schowinsky, CJ Kleck, Evalina Burger, Vikas Patel. Three Cases of Significant Metallosis in the Spine. J Mater Sci: Mater Med (2018) 29: 3.

**2017:**

Reed **Ayers**, Mathew Hayne, Evalina Burger, Spinal Instrumentation Failure as the Result of Spine Rod Straightening, J Mater Sci Mater Med. 2017 Aug;28(8):123.

Reed **Ayers**, Christopher Kleck, Mackenzie Miller, Evalina Burger. Bacterial Infection of Spine Instrumentation and Microbial Influenced Corrosion (MIC): Chicken or Egg. Biomed J Sci & Tech Res 1(6)- 2017.

**2016:**

NL Vollmer, JR Spear, RA **Ayers**, Antimicrobial activity and biologic potential of silver-substituted calcium phosphate constructs produced with self-propagating high-temperature synthesis. Journal of Materials Science: Materials in Medicine 27 (6), 1-12.

**2015:**

N Vollmer, KB King, R **Ayers**, Biologic potential of calcium phosphate biopowders produced via decomposition combustion synthesis. Ceramics International 41 (6), 7735-7744.

**2013:**

Reed **Ayers**, Matt Hayne, David Jann, Julian Stock, Cosan Unuvar, Spark Plasma Sintering (SPS) of Hf/Al Reactive Metal Structures. Propellants, Explosives, and Pyrotechnics. Accepted.

**2011:**

Reed **Ayers**, Nolan Hannigan, Nina Vollmer, Cosan Unuvar, Combustion Synthesis of Multiphase Calcium Phosphate Biomaterials from CaO and P2O5 Precursors, International Journal of Self-Propagating High Temperature Synthesis. 2011, Vol. 20, No. 1, pp. 6–14.

M. A. Karsh and R. A. **Ayers**, Self-Propagating High Temperature Synthesis to Produce CoCrMoC from Elemental Powders. International Journal of Self-Propagating High Temperature Synthesis, 2011, Vol. 20, No. 3, pp. 141–147.

Andriy Noshchenko, Yao Xianfeng, Grant Alan Armour, Todd Baldini, Vikas V. Patel, Reed **Ayers**, Evalina Burger, Evaluation of spinal instrumentation rod bending characteristics for *in-situ* contouring, J. Biomed Mater. Res.[Volume 98B, Issue 1,](http://onlinelibrary.wiley.com/doi/10.1002/jbm.b.v98b.1/issuetoc) pp. 192–200, July 2011

Fouad Zhim, Reed A. **Ayers**, John J. Moore, Richard Moufarrège, L’Hocine Yahia, Personalized implant for high tibial opening wedge: combination of solid freeform fabrication with combustion synthesis process. J. Biomaterials Applications. Available online, July, 2011.

Rahul Bhola, Shaily M Bhola, Brajendra Mishra, Reed Ayers, David L Olson, and Timothy Ohno, Cellular Response of Titanium and Its Alloys as Implants. Journal of Oral Implantology: August 2011, Vol. 37, No. 4, pp. 387-399. 2011

**2007:**

Reed **Ayers**, Virginia Ferguson, Denise Belk, John Moore, Self-propagating high temperature synthesis of porous nickel titanium, Materials Science Forum Vols. 561-565, pp 1643-1648, 2007.

High, Whitney A, **Ayers**, Reed A, Cowper, Shawn E , [Gadolinium is quantifiable within the tissue of patients with nephrogenic systemic fibrosis.](http://www.scirus.com/srsapp/sciruslink?src=mdl&url=http%3A%2F%2Fwww.ncbi.nlm.nih.gov%2Fentrez%2Fquery.fcgi%3Fcmd%3DRetrieve%26db%3Dpubmed%26dopt%3DAbstract%26list_uids%3D17289213) Journal of the American Academy of Dermatology, 56 (4), p.710-712, Apr 2007.

**Ayers**, Reed A, Burkes, Douglas E, Gottoli, Guglielmo, Yi, Hu-Chun, Zhim, Fouad, Yahia, L'hocine, Moore, John J, Combustion synthesis of porous biomaterials. Journal of Biomedical Materials Research. Part A, 81 (3), p.634-643, Jun 2007

High, Whitney A, **Ayers**, Reed A, Chandler, John, Zito, Gary, Cowper, Shawn E, [Gadolinium is detectable within the tissue of patients with nephrogenic systemic fibrosis.](http://www.scirus.com/srsapp/sciruslink?src=mdl&url=http%3A%2F%2Fwww.ncbi.nlm.nih.gov%2Fentrez%2Fquery.fcgi%3Fcmd%3DRetrieve%26db%3Dpubmed%26dopt%3DAbstract%26list_uids%3D17097388) Journal of the American Academy of Dermatology, 56 (1), p.21-26, Jan 2007.

**Ayers**, R.; [Burkes, D.](http://www.engineeringvillage2.org/controller/servlet/Controller?CID=quickSearchCitationFormat&searchWord1=%7bBurkes%2C+D.%7d&section1=AU&database=2&yearselect=yearrange&sort=yr); [Gottoli, G.](http://www.engineeringvillage2.org/controller/servlet/Controller?CID=quickSearchCitationFormat&searchWord1=%7bGottoli%2C+G.%7d&section1=AU&database=2&yearselect=yearrange&sort=yr); [Yi, H.C.](http://www.engineeringvillage2.org/controller/servlet/Controller?CID=quickSearchCitationFormat&searchWord1=%7bYi%2C+H.C.%7d&section1=AU&database=2&yearselect=yearrange&sort=yr); [Moore, J.J.](http://www.engineeringvillage2.org/controller/servlet/Controller?CID=quickSearchCitationFormat&searchWord1=%7bMoore%2C+J.J.%7d&section1=AU&database=2&yearselect=yearrange&sort=yr), The application of self-propagating high-temperature synthesis of engineered porous composite biomedical materials. Materials and Manufacturing Processes, v 22, n 3-4, 2007, p 481-8.

**2006:**

**Ayers**, RA, Neilsen-Priess S, Ferguson V, Gotolli G, Moore JJ, Kleebe HJ, Multiphasic calcium phosphate induced mineralization in SaOS-2 osteoblast-like cells. Mat Sci and Eng C 2006;26:1333-1337.

High WA, **Ayers** RA, Chang A, Fitzpatrick JE. Unusual response to ear piercing: granulomatous response to titanium alloy. J Am Acad Dermatol. 2006 Oct;55(4):716-20.

High WA, **Ayers** RA, Chang A, Fitzpatrick JE. Gadolinium is detectable within tissue of patients with nephrogenic fibrosing dermopathy. J Am Acad Dermatol Nov 2006 E-pub ahead of print.

R. **Ayers**,D. Burkes, G. Gottoli, H.C. Yi, J.Y. Guigné, J.J. Moore, The Application of Energetic SHS Reactions in the Synthesis of Multi-functional Bone Tissue Engineering and Drug Delivery Systems. In Multifunctional Energetic Materials, (N.N. Thadhani, R.W. Armstrong, A.E. Gash, W.H. Wilson. Eds.) Mat Res Soc. Symposium Proceedings, Vol. 896, 2006.

J. Zhou, I. T. Martin, **R. Ayers**, E. Adams, D. Liu, and E. R. Fisher, Investigation of Inductively Coupled Ar and CH4/Ar Plasmas and the Effect of Ion Energy on DLC Film Properties, *Plasma Sources Sci. Technol.* **15,** 714-726, 2006.

**2005:**

Reed A. **Ayers,** Martin Castillo Guglielmo Gottoli, John J. Moore, Steven J. Simske, Combustion synthesis of Ca3(PO4)2 Net-Shape Surgical Implants, NASA Tech Briefs, September 21, 2005.

Douglas E. Burkes, John J. Moore, Hu Chun Yi, Guglielmo Gottoli and Reed A. **Ayers** Effects of Environmental Gas on the Combustion Synthesis and Microstructure of Ni3Ti – TiCx Composites. International Journal of SHS Vol.14, No 4, 2005.

**2004:**

Burkes, DE, Gottoli, G, Moore, JJ, Yi, HC, **Ayers**, RA Combustion synthesis of NiTi-TiC composites with controlled porosity for biomedical applications. Mat Res Soc Symp Proc. Vol. 800, 2004.

**2003:**

Virginia Ferguson, Reed **Ayers**, Ted Bateman, Steven Simske, bone development and age related bone loss in male C57BL/6J mice. Bone. 33:387-398, 2003.

M. Castillo, J.J.Moore, F.D. Schowengerdt, R.A. Ayers, X. Zhang, M. Umakoshi, ILC. YI, J.Y. Guigne, Effects of Gravity on Combustion Synthesis of Functionally Graded Materials. Adv. Space Res. 32:265-270, 2003.

**2002:**

Ferguson VL, Simske SJ, **Ayers** RA, Bateman TA, Wang HT, Bendele A, Rich B, Collins D, Scherrer J, Sennello R, Colagiovani DB, Effect of MPC-11 myeloma and MPC-11+IL-1 receptor antagonist treatment on mouse bone properties. Bone 30:109-116, 2002.

**2001:**

Castillo M, **Ayers** RA, Zhang X, Schowengerdt F, Moore JJ, Combustion synthesis of porous glasses and ceramics for bone repair. Biomed. Sci. Instrum 37:469-474; 2001.

Bateman, TA Dunstan, CR, **Ayers**, RA, Lacey, DL, Ferguson, VL, Simske, SJ Osteoprotegerin ameliorates sciatic nerve crush induced bone loss. J. Orthop Res 19(4);518-23, 2001.

Zhang X, **Ayers** RA, Thorne K, Moore JJ, Schowengerdt F, Combustion synthesis of porous materials for bone replacement. Biomed. Sci. Instrum 37:463-468, 2001.

**2000:**

Bateman, TA, Dunstan, CR, Ferguson, VL, Lacey, DL, **Ayers**, RA, Simske, SJ, Osteoprotegerin mitigates tail suspension induced osteopenia by inhibiting resorption and increasing mineral composition. Bone 26:443-449, 2000.

**1999:**

**Ayers**, RA, Simske, SJ, Bateman, TA, Petkus, A, Sachdeva, RLC, Gyunter, VE, Effect of nitinol implant porosity on cranial bone ingrowth and apposition after 6 weeks. J Biomed Mater Res 45:42-47; 1999.

**Ayers**, RA, Wolford, LM, Bateman, TA, Ferguson, VL, Simske, SJ, Quantification of bone ingrowth into porous block hydroxyapatite in humans. J Biomed Mater Res 47:54-59; 1999.

Bateman, TA, **Ayers**, RA, Greenway, RB, An engineering evaluation of four fluid transfer devices for 384-well high throughput screening. Lab Robotics and Automat 11:250-259; 1999.

Ferguson, VL, Greenberg, AR, Bateman, TA, **Ayers**, RA, Simske, SJ, Effect of age and dietary restriction without nutritional supplementation on whole bone structural properties in C57BL/6J mice. Biomed. Sci. Instrument 35:85-91; 1999.

Ferguson, VL, Bateman, TA, Lacey, DL, **Ayers**, RA, Dunstan, CR, Simske, SJ Effect of osteoprotegerin on mechanical and material properties of maturing rat femora. J Bone Miner Res 14sup:S440; 1999.

**1998:**

**Ayers**, RA, Simske, SJ, Nunes, CR, Wolford, LM, Long-term ingrowth and residual microhardness of porous block hydroxyapatite implants in humans. J Oral Maxilofac Surg 56: 1297-1301; 1998.

**Ayers**, RA, Bateman, TA, Chapes, SK, Ferguson, VL, Simske, SJ Effect of major histocompatability class II knockout on the mouse peripheral skeleton. Bone 23:S441; 1998.

Bateman, TA, Zimmerman, RJ, **Ayers**, RA, Ferguson, VL, Chapes, SK, Simske, SJ, Histomorphometric, physical, and mechanical effects of spaceflight and insulin-like growth factor-I on rat long bones. Bone 23:527-535; 1998.

**1995:**

**Ayers**, RA, Miller, MR, Simske, SJ, Norrdin, RW, Correlation of flexural structural properties with bone physical properties: A four species survey. Biomed. Sci. Instrum 32:251-260, 1995.

***Conference Proceedings:***

**2021-2023:**

Reed A. Ayers, MS, PhD, Cheryl Ackert, MS, PhD, Michael Walker, Xerxes Steirer, MS, PhD, Evalina Burger, MD, Vikas Patel, MD, Christopher J. Kleck, MD. Direct Observation Of Microbial Influence On In-Vivo Human Spinal Implants. AMPP Biomaterials Corrosion Symposium (March 20, 2023, Denver, CO)

Mitchell Hutchings, Reed A. Ayers, MS, PhD, Cheryl Ackert, MS, PhD, Michael Rogers MS, PhD, Christopher J. Kleck, MD. Characterization of Corrosion on Orthopedic Spinal Devices Using Structured Light Scanning. AMPP Biomaterials Corrosion Symposium (March 20, 2023, Denver, CO)

Adriana Joyce, Greg Ottenberg, Evan Ammidown, Dr. Cheryl Ackert-Bicknell, Dr. Reed Ayers. Co-Cultured Bacterial Adherence To Silicon Nitride Surfaces. AMPP Biomaterials Corrosion Symposium (March 20, 2023, Denver, CO)

Reed Ayers, David C Ou-Yang, Evalina L Burger, Cheryl L Ackert-Bicknell, Christopher J Kleck Metallosis Observed in Spine Instrumentation Revision is Strongly Associated to Titanium Presence in Tissues as well as Patient Diagnosed Infection Status. AAOS (March 23, 2022, Chicago, IL)

**2019-2020:**

Reed Ayers, MS, PhD, Vikas Patel, MD, David Ou-Yang, MD, Christopher Cain, MD, Evalina Burger, MD, Christopher Kleck, MD. Failure analysis of explanted hardware: A path to developing better understanding of why devices fail in-vivo. CU Orthopedics Inaugural Research Symposium and D’Ambrosia Diversity Lectureship. May, 8 2019. Poster

Ayers R.A., Patel V., Ou-Yang D., Wesell N., Cain C., Burger E., Kleck C.J. Multiple Causes for Clinical Observation of Metallosis in Spine Instrumentation: A Single Center Study. SpineWeek 2020 - April 27-May 1, 2020. ePoster.

Dr. Reed Ayers, Dr. CJ Kleck, Dr. Vikas Patel, Dr. David Ou-Yang, Dr. Cristopher Cain, Michaela Pott, Dr. Evalina Burger. Laser Marking as the Origin of Spine Rod Fractures: A Single Center Study. IMAST 2020, April 1-4, 2020- Podium.

Reed Ayers, Nolan Wessell, Vikas Patel, David Ou-Yang, Christopher Cain, Evalina Burger, Christopher Kleck. Multiple Causes for Clinical Observation of Metallosis in Spine Instrumentation: A Single Center Study. SRS 55th Annual Meeting to be held September 9-12, 2020.

**2017:**

Reed Ayers, Christopher Kleck, Mackenzie Miller, Evalina Burger. Metal Release from Spine Instrumentation and theLocal Tissue Reaction. SICOT World Conference, South Africa, November 2017.

**2014:**

M. Hayne, E. Burger, R. **Ayers**, Time Dependent Strain Response of Biomedical Alloys used in Spinal Surgery. Society for Biomaterials Annual Meeting and Exposition 2014: Pioneering the Future of Biomaterials. Proceedings of a meeting held 16-19 April 2014, Denver, Colorado, USA. Transactions of the 38th Annual Meeting, pp. 432.

N. Vollmer, V. Patel, R. **Ayers**, Self-Propagating High Temperature Synthesis (SHS) of Porous Calcium Phosphates (CaP) Scaffolds Substituted with Magnesium or Strontium. Society for Biomaterials Annual Meeting and Exposition 2014: Pioneering the Future of Biomaterials. Proceedings of a meeting held 16-19 April 2014, Denver, Colorado, USA. Transactions of the 38th Annual Meeting, pp. 72.

**2013:**

N. Vollmer, R. Ayers. Antimicrobial Activity and Cytotoxicity of Silver Doped Calcium Phosphate Blocks Produced with Self-Propagating High-Temperature Synthesis. Materials Today Virtual Conference: Biomaterials 2013

**2012:**

N. Vollmer, R. Ayers. Combustion Synthesis of Calcium Phosphate Blocks Doped with Silver for Treatment of Large Scale Battlefield Injuries. Trans Soc for Biomat, 34, 2012.

**2011:**

R. Bhola, S. M. Bhola, B. Mishra, R. A. **Ayers**, and D. L. Olson, Electrochemical Characterization of a Low Modulus Ti35.5Nb7.3Zr5.7Ta Alloy in a Simulated Body Fluid Using EIS for Biomedical Applications. AIP Conference Proceedings 1335, 1184 (2011);

**2010:**

Reed **Ayers**, Matthew Karsh, Nina Vollmer, Nolan Hannigan, John Moore, Combustion Synthesis of CoCr, NiTi Intermetallic and Calcium Phosphate Ceramic Biomaterials. Medical Device Materials V, (2010), pp. 227-231.

Rahul Bhola, Shaily M. Bhola, Brajendra Mishra, Reed **Ayers**, David L. Olson , Electrochemical Characteristics of Titanium and its Alloys in Phosphate Buffer Saline. Medical Device Materials V, (2010), pp. 52-59.

M. Karsh, J. Tsai, A. S. Meir, S. Gordon S. Newman, M. Kaufmann, **R.** **Ayers**, Nickel Titanium (NiTi) Phase Properties and Use in Orthodontic Arch Wires. CU School of Dentistry Research Fair November 2010.

**2009:**

M. Karsh, N. Vollmer, C. Unuvar, J.J. Moore, **R. Ayers**, Porous Biomaterials Using Combustion Synthesis.Trans Soc for Biomat, 33, 2009.

Nina Vollmer, Douglas Burkes, John Moore, **Reed Ayers**, Effects of changes in structural hydration of multiphasic heterogeneous calcium phosphate powders created via auto-ignition combustion synthesis. Trans Soc for Biomat, 33, 2009.

**2008:**

**Ayers RA**, Moore JJ, Burkes DE, Biomimetic multiphasic calcium phosphates to enhance bone regeneration. Medical Device Materials IV, (2008) pp. 9-13.

**2005:**

R. **Ayers**,D. Burkes, G. Gottoli, H.C. Yi, J.Y. Guigné, J.J. Moore, The Application of Energetic SHS Reactions in the Synthesis of Multi-functional Bone Tissue Engineering and Drug Delivery Systems. Mat Res Soc. Boston, November 27-30, 2005 pp. 25-38.

High WA, **Ayers** RA, Chang A, Fitzpatrick JE. Unusual response to ear piercing: granulomatous response to titanium alloy. Presented in oral form at American Society of Dermatopathology - Annual Meeting, Seattle. October 21, 2005. Best Abstract, Oral Presentation Session #1.

F. Zhim, J. Pegna, J. Moore, R. **Ayers**, L'H. Yahia, Development of personalized implant for high tibial opening wedge: Combination of solid freeform fabrication with combustion synthesis process. SHS VIII International Symposium on Self Propagating High Temperature Synthesis, 21-24, June, 2005.

**Ayers** RA, Nielsen-Priess S, Gillette J, Kleebe HJ, Development of calcium phosphate mineral during mineralization in osteoblast-like cells. International Symposium on Advanced Biomaterials, Montreal, April 3-6, 2005.

Dezaman Z, MacCarthy P, **Ayers RA,** Structure and Composition of SHS-Produced Calcium Phosphates are Controlled by Reactant Stoicheometry and Green Density. Colorado Alliance for Biotechnology, Student Research Forum, March 2005.

**Ayers** RA, Nielsen-Preiss S, Ferguson V, MooreJJ, Kleebe HJ, Osteoblast-Like Cell Mineralization Induced by Multiphasic Calcium Phosphate Ceramic. TMS Annual Meeting & Exhibition, February 13-17, 2005.

**2004:**

Zhang X., Castillo M., **Ayers** R., Burkes D., Gottili G., Yi H.C., Moore J.J., The combustion synthesis of engineered porous composite materials for bone replacement applications. Western States Section/Combustion Institute, Spring Meeting, March 29-30, 2004.

Hernandez, R, Polizu S, Zhang X, Moore J, **Ayers** R. Yahia LH, Porous NiTi alloy produced by SHS process: Surface characteristics and corrosion behavior. SMST-2003, p. 409-416, 2004.

**2003:**

Gottoli G., **Ayers** R., Schowengerdt F., Moore J., Interaction of calcium phosphate ceramics produced via SHS with simulated body ionic solution. Trans Soc for Biomat, 2003; 29:239.

Hammill C., Smith D., **Ayers** R., Prediction of bone ingrowth in a porous coating. 11th Annual Pre-ORS Symposium of Computational Methods in Orthopaedic Biomechanics, New Orleans, LA. February 1, 2003.

**2000:**

Bateman, TA, Stodieck, LS, Kostenuik, PJ, Ferguson, VL, **Ayers**, RA, Simske, SJ. Use of Spaceflight and Spaceflight Simulation to Provide Evidence for Osteoprotegerin Treatment of Disuse Osteoporosis. Space Tech Appl Int Forum 2000 2:580-581, 2000.

Zhang, X, **Ayers**, R, Moore, JJ, Schowengerdt FD. Combustion synthesis of porous shape memory materials. SIBA, June 28- July 1, 2000.

Ferguson, VL, **Ayers**, RA, Bateman, TA, Simske, SJ. Development of endogenous osteoporosis in male C57BL/6J mice. J Bone Miner Res 15sup:S461; 2000.

**1999:**

Bateman, TA, Kostenuik, PJ, Ferguson, VL, **Ayers**, RA, Simske, SJ Osteoprotegerin treatment of tail suspension and sciatic nerve crush disuse osteopenia: comparison with bisphosphonates. Gravit Space Bio Bul*.* 13:65; 1999.

Bateman, TA, Lacey, DL, Ferguson, VL, Dunstan, CR, **Ayers**, RA, Simske, SJ Comparison of osteoprotegerin, pamidronate and ibandronate in the treatment of suspension induced osteopenia. J Bone Miner Res 14sup:S528, 1999.

Simske SJ, Bateman TA, **Ayers** RA, Dunstan CR, Ferguson VL, Lacey DL, Effect of osteoprotegerin, pamidronate and ibandronate on the sciatic nerve crush model for disuse osteoporosis in mice. J Bone Miner Res 14sup:S523, 1999.

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Bateman, TA, Zimmerman, RJ , **Ayers**, RA, Ferguson, VL, Chapes, SK, Simske, SJ Efficacy of insulin-like growth factor-1 is not altered by spaceflight unloading. Grav Space Bio Bul 12:62; 1998.

Bateman, TA, Dunstan, CR, Ferguson, VL, **Ayers**, RA, Simske, SJ Osteoprotegerin increases femoral mechanical properties in control and tail suspended mice. Bone 23:S563; 1998.

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Simske SJ, Bateman TA, Ferguson VL, **Ayers** RA, Dunstan CR, Effects of osteoprotegerin on the sciatic nerve crush model for osteoporosis. Bone 23:S355; 1998.

Stodieck, LS, Bateman, TA, **Ayers**, RA, Ferguson, VL, Simske, SJ Benefits attained from space flight in pre-clinical evaluation of candidate drugs. Space Tech Appl Int Forum98 420:627-632; 1998.

**1997:**

Ferguson, VL, Bateman, TA, **Ayers**, RA, Zimmerman, RJ, Simske, SJ Effects of tail suspension and insulin-like growth factor-I on mouse bone mechanical properties. Gravit Space Bio Bul 11:17; 1997.

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Bateman, TA, **Ayers**, RA, Simske, SJ, Bush, LL, Ferguson, VL Effects of spaceflight and insulin-like growth factor-1 on rat bone mechanical properties. Grav Space Bio Bul 10:16; 1996.

***Invited Presentations:***

Materials and Material Properties Relevant to Spinal Orthopedics and the Clinical Considerations. University of Colorado School of Medicine, Office of Continuing Medical Education, Department of Orthopedics, Grand Rounds. April 1, 2015. (1.0 AMA PRA Category 1 Credit™)

Microstructural design of materials for medical applications, Materials by Design Workshop, July 16-18, 2013. Los Alamos National Laboratory Materials Summer Research Group (SRG).

Spark Plasma Sintering (SPS) of HFAl Reactive Metal Structures, Joint Defense Armaments Conference, Exhibition and Firing Demonstration, May, 20-23 2013.

Applications of Energetic SHS Materials for Biomedical Applications, Calcitec Inc. January 6, 2006.

Combustion Synthesis of Porous Biomaterials, Stryker Orthopedics, April 21, 2005.

Bioactivity of Porous Multiphasic Bioceramics Calcium Phosphate Scaffolds Produced via SHS, Colorado State University, Department of Mechanical Engineering, September 10, 2004.

Bioactivity of Porous Calcium Phosphate scaffolds Produced Via Combustion Synthesis. 2004 Colorado Orthopaedics Research Retreat, Louisville, CO, January, 2004.

Porous biomaterials and BMPs (bone morphogenic proteins): Their appropriate application in bone repair and replacement. Colorado for Institute in Research in Biotechnology, University of Colorado, Boulder, CO, September 14, 1999.

***Student Advising Experience:***

Ph.D. Advisor: NinaVollmer (Metallurgical and Materials Engineering, 2014)

Ph.D. co-Advisor: Rahul Bola (Metallurgical and Materials Engineering, 2010); Denise Belk (Metallurgical and Materials Engineering, 2005)

Master’s Advisor: Michelle Akiyama (Bioengineering, 2018, content advisor), Mackenzie Miller (Bioengineering, 2017, content advisor), Ryan Arce (Bioengineering, 2015, content advisor), Matthew Karsh (Metallurgical and Materials Engineering, 2011); Nolan Hannigan (Metallurgical and Materials Engineering, 2010); Nina Vollmer (Metallurgical and Materials Engineering, 2009); Zachary Dezman (Chemistry, co-Advisor, 2005); Alejandro Criado (Metallurgical and Materials Engineering, 2005),

Content Advisor for 4 Bioengineering M.S. students with recent graduation dates of 2019-2020 (Zach Wulthrich - 2020, Lana Bowers - 2020, Trevor Pier - 2019, Jorge Cossio - 2020).



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