

**Michael S. Kesler**  
**Oak Ridge National Laboratory**

**Objective:**

A research position focusing on processing, characterization and analysis in the field of physical metallurgy

**Education:**

2006-2011: Doctor of Philosophy in Materials Science and Engineering at the University of Florida

2003-2006: Bachelor's degree in Materials Science and Engineering at the University of Florida

**Professional Experience:**

*R&D Associate (07/19-Present)*

Alloy Behavior and Design Group of the Materials Science and Technology Division in the Thermomagnetic Processing Laboratory at Oak Ridge National Laboratory

- Magnetic Heating of Nanoparticles for DAC Sorbent Regeneration (LDRD)
- Induction-coupled Thermomagnetic Processing of Steel and Aluminum Alloys (AMO)
- Advanced Neutron Characterization Insert Development (AMO)
- Thermomagnetic Processing of Magnetic and Structural Materials (AMO/CMI)
- High Magnetic Field/High Heating Rate Thermal Analysis Technique Development (AMO/CMI)
- Alloy Development of Al-Ce alloys (AMO/CMI - CRADA)
- Cast Heat Exchanger Using the Novel Al-Ce Alloy (BTO)
- Abnormal Grain Growth in Thermomagnetic Processed Materials (BES)
- Thermomagnetic Processing of Carbon Fiber (SEED)
- Casting Components for Magnet Gearbox (AMO/WPTO - CRADA)
- Direct Metal Write of Al-Ce Alloys (AMO - CRADA)

*Postdoctoral Researcher (07/16-06/19)*

Deposition Science and Technology Group of the Materials Science and Technology Division in the Advanced Processing Laboratory at Oak Ridge National Laboratory and Member of the Critical Materials Institute: A Department of Energy Hub

- Thermomagnetic Processing of Magnetic Materials (AMO/CMI)
- High Magnetic Field/High Heating Rate Calorimeter Technique Development (AMO/CMI)
- Direct Metal Writing of Al-Ce alloys (AMO/CMI)
- Alloy Development of Al-Ce alloys (AMO/CMI)
- Cast Heat Exchanger Using the Novel Al-Ce Alloy (BTO)
- Dual Phase Materials for Electric Motors (GE)
- Low-cost Phase Change Materials (BTO)

*Postdoctoral Researcher (05/13-6/16)*

The Materials Design and Prototyping Laboratory at the University of Florida

- Effects on microstructure and fatigue behavior of scribing marks necessary for improving automation and processing efficiency in weathering steels (FDOT)
- Self-Healing Metal-Matrix Composites (NASA)
- High Strength and High Temperature Shape Memory Alloys (NASA)
- Mentoring several undergraduate and graduate students

*Adjunct Lecturer (08/12-05/13)*

Department of Materials Science and Engineering at the University of Florida

- Undergraduate Lab Director (Classes: EMA 3080C and EMA 3013C)

*Materials Characterization Instructor (01/12-06/16)*

The Major Analytical Instrumentation Center (MAIC) at the University of Florida

- Operation, maintenance and training on an X-ray diffractometer, two transmission electron microscopes, environmental/conventional scanning electron microscopes, energy and wave length dispersive spectroscopy and electron backscattered diffraction systems for the MAIC at the University of Florida
- Data reduction and interpretation
- Preparation of training materials, instrument demos and formulation of SOPs for trained users

### *Transmission Electron Microscopy Laboratory Instructor (06/11-06/16)*

- Instructed graduate students weekly on the basic principles and operation of the TEM JEOL 200CX (Class: EMA 6518L)

### *Scanning Electron Microscopy Laboratory Instructor (06/09-06/16)*

- Instructed graduate students weekly on the basic principles and operation of the SEM JEOL 6400 and FEI x1-40 FEGSEM (Class: EMA 6507L)
- Conducted analysis of the structure of materials for reverse engineering projects (Class: EMA 3513C)

### *Mentoring*

- Advising and managing a Technical Professional at ORNL
- Advised a Bredesen Center graduate student and a postdoc at ORNL
- Advised and mentored several HERE, CCI, and SULI students at ORNL
- Advised and mentored many undergraduate students through the completion of their senior research
- Advised and mentored a high school student, Matthew Galbraith, for nine weeks as part of the Student Science Training Program (SSTP). He won first place in the program for, both, his paper and poster
- Advised two undergraduate students, Srishti Shrivastava and Emma Faulkner, in the REU Program

### **Publications:**

- B. Conry, M. Kole, W.R. Burnett, J.B. Harley, M.R. Tonks, M.S. Kesler, and A.R. Krause. **"The evolution of grain boundary energy in textured and untextured Ca-doped alumina during grain growth."** *Journal of the American Ceramic Society* (2023).
- R.J. Lane, M.S. Kesler, K. Nawaz, R. Mirzaeifar, **"Investigating the failure behavior of cast Al-11Ce-0.4 Mg alloys using in-situ scanning electron microscopy tensile testing"**, *Journal of Alloys and Compounds* 947, 169491 (2023).
- I.D. Khurjekar, B. Conry, M.S. Kesler, M.R. Tonks, A.R. Krause, J.B. Harley, **"Automated, high-accuracy classification of textured microstructures using a convolutional neural network"**, *Frontiers in Materials* 10 (1) (2023).
- W. Yan, J. Melville, V. Yadav, K. Everett, L. Yang, M.S. Kesler, A.R. Krause, M.R. Tonks, J.B. Harley, **"A novel physics-regularized interpretable machine learning model for grain growth."** *Materials & Design* 222, no. C (2022).
- Z.C. Sims, M.S. Kesler, H.B. Henderson, *et al.*, **"How Cerium and Lanthanum as Coproducts Promote Stable Rare Earth Production and New Alloys"**, *Journal of Sustainable Metallurgy* (2022).
- M.S. Kesler, M.A. McGuire, B. Conner, *et al.* **"A rapid heating and high magnetic field thermal analysis technique"**, *J Thermal Analysis and Calorimetry* 147, 7449–7457 (2022).
- B. Conry, J.B. Harley, M.R. Tonks, M.S. Kesler, A.R. Krause, **"Engineering grain boundary anisotropy to elucidate grain growth behavior in alumina"**, *Journal of the European Ceramic Society*, **42**, 13, 5864-5873, (2022).
- J. Cui, J. Ormerod, D. Parker, *et al.*, **"Manufacturing Processes for Permanent Magnets: Part I—Sintering and Casting"**, *JOM* 74, 1279–1295 (2022).
- J. Cui, J. Ormerod, D. Parker, *et al.*, **"Manufacturing Processes for Permanent Magnets: Part II—Bonding and Emerging Methods"**, *JOM* 74, 2492–2560 (2022).
- D. Weiss, B. Murphy, M.J. Thompson, H.B. Henderson, O. Rios, G.M. Ludtka, A. Perron, M.S. Kesler, **"Thermomagnetic Processing of Aluminum Alloys During Heat Treatment"**, *International Journal of Metalcasting* 15 (1), 49-59, 2021.
- E.E. Moore, P.E.A. Turchi, V. Lordi, D. Weiss, Z.C. Sims, H.B. Henderson, M.S. Kesler, O. Rios, S.K. McCall, A. Perron, **"Thermodynamic Modeling of the Al-Ce-Cu-Mg-Si System and Its Application to Aluminum-Cerium Alloy Design"**, *Journal of Phase Equilibria and Diffusion* 41 (6), 764-783, 2020.
- X.B. Liu, M.S. Kesler, M.F. Besser, M.J. Kramer, M.A. McGuire, I.C. Nlebedim, **"Effect of processing hydrogen pressure on magnetic properties of HDDR Nd-Fe-B magnet"**, *IEEE Transactions on Magnetics* 57 (2), 1-4, 2020.
- H.B. Henderson, E.T. Stromme, M.S. Kesler, Z.C. Sims, P. Chesser, B. Richardson, M.J. Thompson, L. Love, W. Peter, E. Morris, O. Rios, D. Weiss, **"Additively manufactured single-use molds and reusable**

*patterns for large automotive and hydroelectric components*”, International Journal of Metalcasting 14 (2), 356-364, 2020.

- C.R. Fisher, H.B. Henderson, M.S. Kesler, M.V. Manuel, **“A Reactive Element Approach to Improve Fracture Healing in Metallic Systems”**, Frontiers in Materials 6, 210, 2019.
- M.S. Kesler, B. Jensen, L. Zhou, O. Palasyuk, T.H. Kim, M.J. Kramer, I. C. Nlebedim, O. Rios, M. A. McGuire, **“Effects of High Magnetic Fields on Phase Transformations in Amorphous Nd<sub>2</sub>Fe<sub>14</sub>B”**, Magnetochemistry 5 (1), 16, 2018.
- M.S. Kesler, M.L. Neveau, W.G. Carter, HB Henderson, Z.C. Sims, D. Weiss, T.T. Li, S.K. McCall, M.E. Glicksman, O. Rios, **“Liquid direct reactive interface printing of structural aluminum alloys”**, Applied Materials Today 13, 339-343, 1, 2018.
- C.R. Fisher, H.B. Henderson, M.S. Kesler, P. Zhu, G.E. Bean, M.C. Wright, J.A. Newman, L.C. Brinson, O. Figueroa III, M.V. Manuel, **“Repairing large cracks and reversing fatigue damage in structural metals”**, Applied Materials Today 13, 64-68, 2018.
- M.A. McGuire, K.V. Shanavas, M.S. Kesler, D.S. Parker, **“Tuning magnetocrystalline anisotropy by cobalt alloying in hexagonal Fe<sub>3</sub>Ge”**, Scientific reports 8 (1), 14206, 2018.
- L. Zhou, T.H. Kim, B. Jensen, K. Sun, O. Palasyuk, I.C. Nlebedim, M.J. Kramer, M.A. McGuire, O. Rios, B.S. Conner, W.G. Carter, M.S. Kesler, **“Microstructural Development in Melt-spun Nd<sub>2</sub>Fe<sub>14</sub>B Under High Magnetic Field Annealing”**, Microscopy and Microanalysis 24 (S1), 958-959, 2018.
- E.T. Stromme, H.B. Henderson, Z.C. Sims, M.S. Kesler, D. Weiss, R.T. Ott, F. Meng, S. Kassoumeh, J. Evangelista, G. Begley, O. Rios, **“Ageless Aluminum-Cerium-Based Alloys in High-Volume Die Casting for Improved Energy Efficiency”**, JOM 70, 866-871, 2018.
- H.B. Henderson, V. Ramaswamy, A.E. Heid, M.S. Kesler, J.B. Allen, M.V. Manuel, **“Mechanical and degradation property improvement in a biocompatible Mg-Ca-Sr alloy by thermomechanical processing”**, Journal of the mechanical behavior of biomedical materials 80, 285-292, 2018.
- L. Li, K. Jones, K. Jones, B. Sales, J.L. Pries, I.C. Nlebedim, K. Jin, H. Bei, B. Post M.S. Kesler, O. Rios, V. Kunc, R. Fredette, J. Ormerod, A. Williams, T.A. Lograsso, M.P. Paranthaman, **“Fabrication of highly dense isotropic Nd-Fe-B bonded magnets via extrusion-based additive manufacturing”**, Additive Manufacturing, 2018.
- M.S. Kesler, S. Goyel, F. Ebrahimi, M.V. Manuel, **“Effect of microstructural parameters on the mechanical behavior of TiAlNb (Cr,Mo) alloys with  $\gamma+\sigma$  microstructure at ambient temperature”**, Journal of Alloys and Compounds, 695, 2672-2681, 2017.
- G.M. Ludtka, M.S. Kesler, H.B. Henderson, O. Rios, B.L. Murphy, **“Demonstration of the Impact of Thermomagnetic Processing on Cast Aluminum Alloys”**, Oak Ridge National Lab (ORNL), Oak Ridge, TN, 2017.
- P. Zhu, Z. Cui, M.S. Kesler, J.A. Newman, M.V. Manuel, M.C. Wright, L.C. Brinson, **“Characterization and modeling of three-dimensional self-healing shape memory alloy-reinforced metal-matrix composites”**, Mechanics of Materials 103, 1-10, 2016.
- M.S. Kesler, P. Feldtmann, E.S. George, S.M. Duke, and M.V. Manuel, **“Effect of plasma marking on the fatigue properties of Grade 50W steel”**, Journal of Materials in Civil Engineering, Accepted on January 7, 2016.
- G.E. Bean, M. S. Kesler, M.V. Manuel, **“Effect of Nb on phase transformations and microstructure in high Nb titanium aluminides”**, Journal of Alloys and Compounds, 613, 351-356, 2014.
- J.E.T. Channell, D.A. Hodell, V. Margari, L.C. Skinner, P.C. Tzedakis, M.S. Kesler, **“Biogenic magnetite, detrital hematite, and relative paleointensity in Quaternary sediments from the Southwest Iberian Margin”**, Earth and Planetary Science Letters, 376, 99-109, 2013.
- J.E.T. Channell, C. Ohneiser, Y. Yamamoto, and M.S. Kesler, **“Oligocene-Miocene magnetic stratigraphy carried by biogenic magnetite at sites U1334 and U1335 (equatorial Pacific Ocean)”**, Geochemistry Geophysics Geosystems, Vol. 14, 265-282, 2013.
- S. Goyel, O. Rios, M.S. Kesler, F. Ebrahimi, **“Two-step nucleation of the  $\gamma$ -phase in a Ti-45Al-18Nb alloy”**, Intermetallics, Vol. 18, 2010.

- M.S. Kesler, S. Goyel, O. Rios, D.M. Cupid, H.J. Seifert, F. Ebrahimi, "*A study of phase transformation in a TiAlNb alloy and the effect of Cr addition*", Materials Science and Engineering A, Vol. 527, 2857–2863, 2010.
- O. Rios, S. Goyel, M.S. Kesler, D.M. Cupid, H.J. Seifert and F. Ebrahimi, "*An Evaluation of High Temperature Phase Stability in Ti-Al-Nb System*", Scripta Materialia, 2009.

#### **Patents: 8 Issued US Patents**

- *Aluminum alloys with improved intergranular corrosion resistance properties and methods of making and using the same*  
US Patent 11,761,061  
Issued: September 19, 2023
- *Rare earth element-aluminum alloys*  
US Patent 11,718,898 B2  
Issued: August 8, 2023
- *Aluminum-fiber composites containing intermetallic phase at the matrix-fiber interface*  
US Patent 11,667,996  
Issued: June 6, 2023
- *Aluminum-cerium-manganese alloy embodiments for metal additive manufacturing*  
US Patent 11,608,546  
March 21, 2023
- *Reactive matrix infiltration of powder preforms*  
US Patent 11,565,318  
January 31, 2023
- *Structural direct-write additive manufacturing of molten metals*  
US Patent 11,535,912  
December, 27, 2022
- *Production of Castable Light Rare Earth Rich Light Metal Alloys from Direct Reduction Processes*  
U.S. Patent 111,365,463  
Issued: June 21, 2022
- *High command fidelity electromagnetically driven calorimeter*  
U.S. Patent 10,782,193  
Issued: September 22, 2020
- *Enhanced anodization functionality in Al-rare earth element-based alloys*  
US Patent App. 17/522,745
- *Rapidly solidified aluminum-rare earth element alloy and method of making the same*  
US Patent App. 15/901,759

#### **Awards:**

- **ORNL Innovation Award**, Received 5 issued patents in 2023
- **TechConnect Innovation Award**, Al-Ce Alloys for Additive Manufacturing
- **R&D100 Award**, ACE: Ageless Aluminum Revolution
- **NASA Group Achievement Award: Shape Memory Alloy Self-Healing Technology Team**

#### **Presentations:**

- **TMS annual meeting 2023: The Effect of Thermomagnetic Processing on the Properties and Microstructure of Aluminum and Ferrous Alloys**, Michael S. Kesler, et al
- **Colorado School of Mines Graduate School Seminar: Fereshteh Ebrahimi Memorial Lecture Series, Invited, Induction Coupled Thermomagnetic Processing: A Path Towards Enhanced Materials Properties and Energy Efficient Manufacturing**, Michael S. Kesler.
- **AMO Thermal Process Intensification: Invited, Development of High Energy Density Thermomagnetic Processing Technology for Intensification of Industrial Heat-Treatment and Increased Material Performance**, Virtual Workshop Series (Nov. 9<sup>th</sup>, 2020 @12-2pm) Michael S. Kesler.

- ***CMI annual meeting 2020: Enhancing HDDR Powders***, Virtual, Michael S. Kesler, Ikenna C. Nlebedim.
- ***TMS annual meeting 2020: Invited, Processing and Calorimetry of Alnico in High Magnetic Fields***. Michael S. Kesler, Xubo Liu, Lin Zhou, Ikenna C. Nlebedim, Matthew Kramer, Orlando Rios, Michael A. McGuire.
- ***EUROMAT 2019: A New Rapid Heating and High Magnetic Field Thermal Analysis Technique***, Michael S. Kesler, Orlando Rios, Michael A. McGuire, Bart Murphy, Hunter B. Henderson, Gerard M. Ludtka, Ben Conner.
- ***EUROMAT 2019: Design and Fabrication of a Test Apparatus for Thermal Cycling and Property Measurement of Phase Change Materials (PCMs) Using the T- History Method***, Tim J. LaClair, Tony Gehl, Kyle Gluesenkamp, Jason Hirschey, Orlando Rios, Yuzhan Li, Navin Kumar, Michael S. Kesler.
- ***TMS annual meeting 2019: Effect of Magnetic Field Processing on CeCo-x Bulk Cast Magnets***. Michael S. Kesler, Andriy Palasyuk, Ryan Ott, Ikenna C. Nlebedim, Olena Palasyuk, Hunter B. Henderson, Orlando Rios, Matthew J. Kramer, Michael A. McGuire.
- ***CMI winter meeting 2019: Thermomagnetic processing and differential scanning calorimetry of magnet materials***. Michael S. Kesler, Brandt Jensen, Ikenna C. Nlebedim, Olena Palasyuk, Andriy Palasyuk, Lin Zhou, Orlando Rios, Matthew J. Kramer, Michael A. McGuire.
- ***MS&T fall meeting 2018: Thermomagnetic Processing and Differential Scanning Calorimetry of Permanent Magnet Materials***. Michael S. Kesler, Orlando Rios, Brandt Jensen, Ikenna C. Nlebedim, Scott K. McCall, Alexander Baker, Matthew J. Kramer, Lin Zhou, Michael A. McGuire.
- ***TMS annual meeting 2018: Microstructural Effects of Thermomagnetic Processing in Nd<sub>2</sub>Fe<sub>14</sub>B-based Permanent Magnet Materials***. Michael S. Kesler, Brandt Jensen, Lin Zhou, Olena Palasyuk, Kewei Sun, Kevin Dennis, Ben Conner, William G. Carter, Orlando Rios, Matthew J. Kramer, Ikenna C. Nlebedim, Michael A. McGuire.
- ***CMI winter meeting 2017: Thermomagnetic processing and differential scanning calorimetry of NdFeB and SmCo magnet materials***. Michael S. Kesler, Orlando Rios, Ikenna C. Nlebedim, Scott K. McCall, Matthew J. Kramer, William G. Carter, Michael A. McGuire.
- ***SEMS meeting 2016: Invited, Multi-scale characterization methods facilitating alloy design***. Michael S. Kesler, Orlando Rios, Damian M. Cupid, Hans J. Seifert, Fereshteh Ebrahimi and Michele V. Manuel.
- ***TRB annual meeting 2016: The Effect of Scribing Marks on the Fatigue Properties of Weathering Steel***. Michael S. Kesler, Peter Feldtmann, Edward S. George, Steve M. Duke, and Michele V. Manuel.
- ***TMS annual meeting 2015: Role of Precipitate Chemistry and Morphology on the Mechanical and Phase Transformation Behavior in a NiTiHfAl Shape Memory Alloy***. Michael S. Kesler, Derek Dai Hsu, Amanda Varela, Brandon Saraydar, Oscar Figueroa III, B. Chad Hornbuckle, Gregory B. Thompson, John A. Newman, and Michele V. Manuel.
- ***MS&T annual meeting 2010: Mechanical properties of TiAlNb(Cr,Mo) alloys with  $\gamma$ -TiAl +  $\sigma$ -Nb<sub>2</sub>Al microstructure***. Michael S. Kesler, Sonalika Goyel and Fereshteh Ebrahimi.
- ***TMS annual meeting 2009: Beyond Near-Gamma Alloys: Development of  $\gamma$ + $\sigma$  Alloys***. Fereshteh Ebrahimi, Michael S. Kesler, Sonalika Goyel, Hans J Seifert.
- ***Gordon Research Conference: Physical Metallurgy 2009: The Effect of Microstructure on the Mechanical Properties of  $\gamma$ + $\sigma$  Alloys at Ambient Temperature***. Michael S. Kesler, Sonalika Goyel, Orlando Rios, Fereshteh Ebrahimi.
- ***MRS Fall meeting 2008: Effect of Microstructural Parameters on Toughness of Ti-Al-Nb-Cr Alloys***. Michael S. Kesler, Sonalika Goyel, Orlando Rios, Hans J. Seifert and Fereshteh Ebrahimi.
- ***TMS annual meeting 2007: Development of TiAl-Based Alloys for High Temperature Applications***. Fereshteh Ebrahimi, Sonalika Goyel, Michael S. Kesler, Orlando Rios, Hans J. Seifert.

#### Research Areas and Interests:

- **Microstructure-properties relationships**

- **Phase transformation**
- **Mechanical testing**
- **Thermomechanical testing**
- **Thermomechanical processing**
- **Thermomagnetic processing**
- **Additive manufacturing**
- **Alloy development**
- **Permanent magnet processing**

**Characterization Expertise:**

- **Transmission electron microscopy (TEM, STEM, HR-TEM, SADP, HAADF)**
- **Scanning electron microscopy (SEM) with electron backscatter diffraction and energy dispersive spectroscopy (EDS/EBSD)**
- **Environmental (variable pressure) scanning electron microscopy (VP-SEM)**
- **Electron probe microanalysis (EPMA)**
- **Differential Thermal Analysis and Differential Scanning Calorimetry (DTA/DSC)**
- **Magnetic Field Extreme Rate Thermal Analyzer (ORNL Patented Technique)**
- **X-ray diffraction (XRD)**
- **Neutron diffraction analysis (SANS, USANS, PDF)**
- **Custom In-situ Neutron/TMP Characterization Insert**
- **Optical Microscopy**
- **Micro- and nanoindentation**

**Research Skills:**

- **Metallographic sample preparation**
- **Induction heating/melting**
- **Focused ion beam micromachining (FIB)**
- **Vacuum systems**
- **Arc melting**
- **Sand casting, die casting, and high pressure die casting (HPDC)**
- **Extrusion**
- **Machining**
- **Encapsulation techniques**

**Professional Activities:**

- **The Minerals, Metals & Materials Society and The Materials Society (TMS/ASM)**
- **TMS Committee Member: Aluminum Committee; Magnetic Materials Committee**
- **Outreach: WISE Camp, Middle School Science Fair Judge, SSTP, ASM Volunteer**

## List of References:

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