Le Zhou

Address: Haggerty Hall, Room 248
1515 W. Wisconsin Ave
Milwaukee, WI 53233
E-mail: le.zhou@marquette.edu
Phone: 414-288-0696

Research/Teaching Interests

Physical Metallurgy, Solidification, Phase Transformations, Diffusion in Multicomponent Solids, Additive Manufacturing, Laser Powder Bed Fusion, Gas Atomization, Superalloys, Lightweight Alloys, Materials Characterization via Electron Microscopy, Mechanical Testing

Appointments

Assistant Professor, Mechanical Engineering, Marquette University 8/2020 – present

Research Associate, Materials Science and Engineering, University of Central Florida 12/2017 – 8/2020

Professional Preparation

Postdoc, Materials Science and Engineering, University of Central Florida 6/2016 – 11/2017

Ph.D., Materials Science and Engineering, University of Central Florida 1/2011 – 5/2016

B.S., Materials Science and Engineering, Beihang University 9/2006 – 7/2010

Research Experiences

Assistant Professor, Mechanical Engineering, Marquette University 8/2020 – present

Building a research group with focus on processing-structure-property relationship of metallic alloys for various applications and a research laboratory with manufacturing and metallographic capability.

Understanding the generation of defects in additive manufacturing and effects on the mechanical property, finding approach to mitigate the defect formation in-process or post-process.

Characterizing microstructure in-situ or ex-situ with X-ray or electron beam based techniques.

Research Associate and Postdoc, University of Central Florida 6/2017 – 8/2020

Metallic alloy development for additive manufacturing (AM) sponsored by the U.S. Army Research Laboratory and Office of Naval Research.

- Successfully developed several Al alloys with outstanding printability for additive manufacturing, including high/medium strength AlZnMgScZr and AA6061+Zr alloys, corrosion-resistant AA5083+Zr alloy, and near-eutectic Al-10Ce alloy.
- Investigated the processing-structure-property relationship of various Al, Mg, Cu, Ni, Fe and Ti based alloys manufactured by laser powder bed fusion.
- Multiscale characterization of AM alloys through XRD, SEM, FIB, TEM, EBSD and APT.
- Tested the mechanical properties of AM alloys through micro/nano indentation and tensile tester.
- Collaborated with other research groups to design new AM material compositions.
- Extensive hands-on experience on laser powder bed fusion and gas atomization of metallic alloys.
- Developed standard operating procedures for gas atomization and laser powder bed fusion, and investigated/optimized the processing parameters.

Graduate Research Assistant 1/2011 – 5/2016

Diffusion, martensitic transformation and mechanical properties of magnetocaloric NiMnGa alloys sponsored by the U.S. Army Research Laboratory.

- Developed a combinatorial approach to accelerate the discovery and research of NiMnGa alloys.
- Designed diffusion couple experiments between selected alloys to generate compositional gradient.
- Characterized the interdiffusion zone using FIB, TEM, SEM, EPMA and nanoindentation.
- Correlated mechanical anomaly across the interdiffusion zone to martensitic transformation.
- Collaborated with other research groups to investigate the magnetocaloric effects.

Failure mechanisms of EB-PVD thermal barrier coatings (TBCs) with (Ni,Pt)Al bond coats sponsored by Doosan Heavy Industry.

- Tested the TBCs using furnace thermal cycling method.
- Analyzed the TGO stress by PSLS and quantified the bond coat rumpling through image analysis.
- Characterized the microstructural evolution and martensitic transformation using TEM.

Funded Research

- Co-PI (50%) with Dr. Yongho Sohn (PI) of a proposal titled "Wireless high temperature sensors for real-time monitoring of gas turbine engines", through Sensatek Propulsion Technology, Inc, funded by National Science Foundation SBIR Phase II, 2019.

Recent Publications

Google Scholar, Corresponding Author*

L. Zhou*, T. Huynh, S. Park, H. Hyer, A. Mehta, S. Song, Y. Bai, B. McWilliams, K. Cho, Y. Sohn, "Additive manufacturing of Al-10Ce alloy by laser powder bed fusion", *Journal of Materials Science*, 55, 14611–14625, 2020.

H. Hyer, **L. Zhou**, S. Park, G. Gottsfritz, G. Benson, B. Tolentino, B. McWilliams, K. Cho, Y. Sohn, "Understanding the laser powder bed fusion of AlSi10Mg alloy", *Metallography, Microstructure, and Analysis*, 9, 484–502, 2020.

A. Mehta, **L. Zhou**, D.D. Keiser, Y. Sohn, "Anomalous growth of Al_8Mo_3 phase during interdiffusion and reaction between Al and Mo", *Journal of Nuclear Materials*, 539, 152337, 2020.

L. Zhou*, H. Hyer, S. Thapliyal, R.S. Mishra, B. McWilliams, K. Cho, Y. Sohn, "Process-dependent composition, microstructure, and printability of Al-Zn-Mg and Al-Zn-Mg-Sc-Zr alloys manufactured by laser powder bed fusion", *Metallurgical and Materials Transactions A*, 51, 3215–3227, 2020.

S. Thapliyal, M. Komarasamy, S. Shukla, **L. Zhou**, H. Hyer, S. Park, Y. Sohn, R.S. Mishra, "An integrated computational materials engineering-anchored closed-loop method for alloy design for additive manufacturing", *Materialia*, 9, 100574, 2020.

H. Hyer, **L. Zhou***, G. Benson, B. McWilliams, K. Cho, Y. Sohn, "Additive manufacturing of dense WE43 Mg alloy by laser powder bed fusion", *Additive Manufacturing*, 33, 101123, 2020.

K.H. Arachchilage, M. Haghshenas, S. Park, **L. Zhou**, B. McWilliams, K. Cho, Y. Sohn, R. Kumar, "Numerical simulation of high-pressure gas atomization of two-phase flow: Effect of gas pressure on droplet size distribution", Advanced *Powder Technology*, 30 (11), 2726-2732, 2019.

L. Zhou*, H. Hyer, H. Pan, Y. Bai, K. Rice, Y. Sohn, "Microstructure and mechanical properties of modified AA5083 manufactured by laser powder bed fusion", *Additive Manufacturing*, 28, 485-496, 2019.

L. Zhou*, A. Mehta, B. McWilliams, K. Cho, Y. Sohn, "Microstructure, precipitates and mechanical properties of powder bed fused Inconel 718 before and after heat treatment", *Journal of Materials Science & Technology*, 35, 1153-1164, 2019.

L. Zhou*, H. Pan, H. Hyer, S. Park, Y. Bai, B. McWilliams, K. Cho, Y. Sohn, "Microstructure and tensile property of a novel AlZnMgScZr alloy additively manufactured by gas atomization and laser powder bed

fusion", *Scripta Materialia,* 158, 24-28, 2019.

L. Zhou*, A. Mehta, E. Schulz, K. Cho, Y. Sohn, "Microstructure, precipitates and hardness of selectively laser melted AlSi10Mg alloy before and after heat treatment", *Materials Characterization,* 143, 5-17, 2018.

Book Chapters

L. Zhou, Y. Sohn. "Diffusion and its Application in NiMnGa Alloys", Diffusion Foundations, Vol. 19. Trans Tech publishing, 2019.

L. Zhou, M. Dayananda, Y. Sohn "Diffusion in multicomponent alloys", Chapter 4 in "Handbook of solid state diffusion volume 1", Edited by Aloke Paul and Sergiy Divinski, Elsevier publishing, 2017.

H. Guo, R. Yao, **L. Zhou**, "Plasma-sprayed thermal barrier coatings with segmentation cracks", Chapter 8 in "Thermal barrier coatings", Edited by Huibin Xu and Hongbo Guo, Woodhead publishing, 2011.

Recent Conference Presentations and Seminars

Presenter*

L. Zhou*, H. Hyer, S. Park, G. Benson, Y. Sohn, "Effect of Zr alloying content on the printability and property of laser powder bed fused aluminum 5083 alloys", *149th TMS Annual Meeting & Exposition*, San Diego, CA, Feb 23-27, 2020.

S. Koul, **L. Zhou**, Y. Sohn, A. Kushima, "In-situ TEM analysis of mechanical behavior of the 3D printed alloys exposed to high temperature", 149th *TMS Annual Meeting & Exposition, San Diego*, CA, Feb 23-27, 2020.

Y. Sohn, **L. Zhou**, "Selected observations of microstructural development in additively manufactured metallic alloys", *149th TMS* Annual *Meeting & Exposition*, San Diego, CA, Feb 23-27, 2020.

S. Park, G. Benson, T. Huynh, H. Hyer, **L. Zhou**, E. Dein, Y. Sohn, "Gas atomization and powder bed fusion optimization studies for the Al10SiMg alloy", *149th TMS Annual Meeting & Exposition,* San Diego, CA, Feb 23-27, 2020.

H. Hyer, R.Newell, D. Matejczyk, S. Hsie, M. Anthony, **L. Zhou**, C. Kammerer, Y. Sohn, "Microstructural development in additively manufactured and heat treated IN625", *149th TMS Annual Meeting & Exposition*, San Diego, CA, Feb 23-27, 2020.

L. Zhou*, H. Hyer, T. Huynh, S. Park, B. McWilliams, K. Cho, Y. Sohn, "Additive manufacturing of Al-10Ce alloys by laser powder bed fusion of gas atomized powders", *149th TMS Annual Meeting & Exposition*, San Diego, CA, Feb 23-27, 2020.

L. Zhou*, "Metallic alloy development for additive manufacturing", University of Virginia, University of Alabama, University of North Texas, University of Nebraska, Lincoln, Wayne State University, Oakland University, Marquette University, **Invited Seminar**, 2019 and 2020.

L. Zhou*, S. Park, B. McWilliams, K. Cho, Y. Sohn, "Relationship between microstructure and laser powder bed fusion parameters in Al-6Zn-2Mg and Al-6Zn-2Mg-1(Sc+Zr) alloys", *Materials Science & Technology 2019*, Portland, OR, Sep 29-Oct 3, 2019.

H. Hyer, **L. Zhou**, B. McWilliams, K. Cho, Y. Sohn, "Microstructural characterization of laser powder bed fused WE43 magnesium alloy", *Materials Science & Technology 2019*, Portland, OR, Sep 29-Oct 3, 2019.

L. Zhou*, H. Hyer, S. Park, B. McWilliams, K. Cho, Y. Sohn, "Parametric optimization of laser-based powder bed fusion for gas atomized Al-Zn-Mg-Sc-Zr alloy", *148th TMS Annual Meeting & Exposition*, San Antonio, TX, Mar 10-14, 2019.

Teaching/Mentor Experiences

1. MEEN 2460: Materials Science, Marquette University, Fall 2020.
2. Research Mentor, mentored graduate and undergraduate students to carry out independent research

(before Marquette):

a. Holden Hyer, research topic: processing optimization and solidification behavior of additively manufactured Mg- and Al-based alloys, expect to graduate with Ph.D. on Fall, 2020.
b. Sharon Park, research topic: gas atomization of metallic alloys and effect of feedstock particle characteristics on microstructure and mechanical property of LPBF Al alloys, graduated with Master degree on Summer, 2020, now studying at the Department of Materials Science and Engineering at Johns Hopkins University with Fellowship.
c. Thinh Huynh, research topic: microstructure and mechanical property of laser powder bed fused Ni-based alloys, now entering PHD program at University of Central Florida.
d. Kevin Graydon, research topic: modeling of additive manufacturing of SS316L, now entering PHD program at University of Central Florida.
e. Asif Mahmud, research topic: microstructure and tensile property of as-built and HIP Ti6Al4V alloy, graduated with Master degree on Summer, 2020 and continuing PHD program at University of Central Florida.
f. Nathelia Vallejo, research topic: parametric investigation of Fe-based alloys manufactured by laser powder bed fusion, expect to graduate with Ph.D. on 2021.
g. Binghao Lu, research topic: laser powder bed fusion of Cu-based alloys, graduated with Master degree on Summer, 2020 and continuing PHD program at University of Central Florida.
h. Kevin Coffy, research topic: microstructure and chemistry evaluation of direct metal laser sintered 15-5 PH stainless steel, now working at Mitsubishi Hitachi Power Systems Americas, Inc.

Synergistic Activities

1. Session Chair:
   a. Session of PSDK XIV: Phase Stability and Diffusion Kinetics – Diffusion and Kinetics, *Materials Science & Technology*, 2019.
   b. Session of Advanced Materials for Harsh Environments – Advanced Materials for Harsh Environments I, *Materials Science & Technology*, 2018.
   c. Session of Electrocaloric Materials II, *EMN Meeting on Caloric Materials*, 2016.
2. Professional Membership: Member of The Minerals, Metals & Materials Society (TMS), ASM International (ASM) and Association for Iron and Steel Technology (AIST) since 2012.
3. Journal reviewer: *Materials Science and Engineering A, Journal of Alloys and Compounds, Metallurgical and Materials Transactions A, Materials & Design, Materials Characterization, Journal of Materials Processing Technology, Additive Manufacturing, Surface and Coatings Technology, Journal of Phase Equilibria and Diffusion, Calphad, Journal of Materials Engineering and Performance, Shape Memory and Superelasticity.*
4. Technical assistance for local high school students and freshman undergraduates for the tour and demonstration of UCF materials characterization facility (e.g., hands-on SEM and TEM).
5. Supervised four local high school students on metal additive manufacturing projects during NSF funded UCF Camp Connect III, 2018 and 2019.

Awards

UCF Graduate Dean's Dissertation Completion Fellowship (2016, one of 15 university wide)

UCF Graduate Research Excellence Fellowship (2014-2016)

UCF Graduate Presentation Fellowship (2012, 2013, 2014, 2015)

UCF SGA Travel Scholarship (2013, 2014)

Second prize for the poster presented at Florida Chapter of the AVS Science and Technology Society (2015)