## CONTACT INFORMATION

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## EDUCATION

*Doctor of Philosophy, Mechanical Engineering*
Mississippi State University, Starkville, MS
Advisor: Haitham El Kadiri, Co-advisor: Mark A Tschopp
January 2011 – May 2014, Overall GPA: 4.00/4.00

*Bachelor of Science, Mechanical Engineering*
Mississippi State University, Starkville, MS
August 2007 - December 2010, Overall GPA: 3.87/4.00, Graduated *Summa Cum Laude*

## RESEARCH EXPERIENCE

*Department of Mechanical Engineering, Mississippi State, MS*
*Associate Professor, August 2023-present*
*Assistant Professor, August 2017-August 2023*
Research topics:

- Machine learning atomistic model development and software development
- Atomic-scale model of martensitic transformations
- Atomistic characterization of high temperature hydrogen attack in steels
- Twin nucleation and twin-twin interaction modeling in hexagonal close-packed metals
- Pyramidal <c+a> slip characterization in magnesium

*Center for Advanced Vehicular Systems, Mississippi State, MS*
Computational Manufacturing and Design

- *Postdoctoral Associate, May 2014 – August 2017*
  Validated multiscale metal materials model project. Specific task was development of a new modified embedded atom method potential for computational steel alloy development.
- *Graduate Research Assistant, January 2011 – May 2014*
  Extended previous research in molecular dynamics to study more complex single-crystal, bicrystalline, and nanocrystalline magnesium, characterize deformation properties, and develop automated analysis methods for such systems.
- *Undergraduate Researcher, May – December 2010.*
  Worked with molecular dynamics and visualization software to study the properties of magnesium twinning in homogeneous single crystals.

## TEACHING EXPERIENCE

*Instructor of Record*

| | | | | |
|---|---|---|---|---|
| 1. | ME 3423 Mechanics of Machinery, | Fall 2017, | 55 students, | Evaluation Average: 3.1/5 |
| 2. | ME 3423 Mechanics of Machinery, | Spring 2018, | 45 students, | Evaluation Average: 4.4/5 |

3. ME 3423 Mechanics of Machinery, Fall 2018, 60 students, Evaluation Average: 4.1/5
4. ME 3423 Mechanics of Machinery, Spring 2019, 61 students, Evaluation Average: 4.4/5
5. ME 3423 Mechanics of Machinery, Fall 2019, 82 students, Evaluation Average: 4.2/5
6. ME 3423 Mechanics of Machinery, Spring 2020, 94 students, Evaluation Average: 4.3/5
7. ME 3423 Mechanics of Machinery, Fall 2020, 84 students, Evaluation Average: 4.2/5
8. ME 4990/6990 Special Topics in ME, Spring 2021, 18 students, Evaluation Average: 4.6/5
9. ME 3613 System Dynamics, Fall 2021, 78 students, Evaluation Average: 3.3/4
10. ME 8213 Engineering Analysis, Fall 2022, 20 students, Evaluation Average: 4.0/4
11. ME 3423 Mechanics of Machinery, Spring 2023, 57 students, Evaluation Average: 3.6/4
12. ME 3613 System Dynamics, Spring 2023, 57 students, Evaluation Average: 3.7/4

*Teaching assistant*

- Materials for Mechancial Engineering Design, taught by Haitham El Kadiri, Fall 2013.

*Graduate student mentoring*

- Mashroor Nitol, on materials modeling with machine learning
- Mike Bodden Connor, on high temperature hydrogen attack in steel
- Alejandro Martinez, on martensite transitions at the atomistic scale in steel
- Deepesh Giri, on the free energy necessary to induce twin nucleus formation as a function of preexisting defects
- Yub Raj Paudel, on the formation of regularly spaced twin bands in three point bending of magnesium
- Aidin Imandoust, on the effects of rare-earth grain boundary segregation on mitigating energy cusps in magnesium.
- Mukti Patel, on design of a new steel alloy using predictive modeling with the modified embedded atom method.

*Undergraduate student mentoring*

- Micah Nichols, machine learning interatomic potential development
- Chase Allen, machine learning interatomic potential development
- Alejandro Martinez, on how to apply MATLAB and LAMMPS to study steel properties.
- Hala Ben Masoud, on magnesium-rare earth interface characterization with LAMMPS
- Soukaina Boukerch, on magnesium-rare earth characterization with LAMMPS
- Ashley Coffman, on how to apply MATLAB and LAMMPS to study steel properties.
- Yub Raj Paudel, on the application of MATLAB and LAMMPS to study magnesium properties.

## PROFESSIONAL SERVICE

*Journal Reviewer*

- Acta Materialia, Philosophical Magazine, Philosophical Magazine Letters, Metallurgical and Materials Transactions, Scripta Materialia, International Journal of Plasticity, Science China

*Professional society leadership*

- Co-organized and chaired "Role of grain boundaries in plasticity I" session at 2015 International Symposium on Plasticity, Montego Bay, Jamaica, Jan 3–8, 2015.
- Co-organized "Role of grain boundaries in plasticity" minisymposium at 2016 International Symposium on Plasticity, Kona, Hawaii, Jan 3–8, 2016.
- Chaired session of Magnesium Technology symposium at TMS 2018, Phoenix, AZ, 3/13/18
- Chaired session of Magnesium Technology symposium at TMS 2020, San Diego, Ca, 2/26/20

*Professional society memberships*

- TMS
- TMS ICME committee

## INDUSTRIAL EXPERIENCE

*Holifield Engineering, McComb, MS*

- *CNC Programmer – 2008-2009*

Computer numeric control (CNC) machine programmer and operator; prepared solid models for machining and various other tasks related to producing rapid prototyping molds.

## TECHNICAL EXPERIENCE

*Computational methods*

- Molecular Dynamics, molecular statics, density functional theory, interfacial defect theory, Crystal Plasticity

*Software experience*

- Mathematica, Mathcad, Matlab, LAMMPS, VASP, C++, Java, VMD, Ovito, Latex, SolidWorks, Mastercam, Linux, Microsoft Windows, Office, and Visual C++.

## HONORS AND ACTIVITIES

- NSF Career Award
- 2022 Mechanical Engineering outstanding junior faculty research award
- 2018 Mechanical Engineering outstanding junior faculty research award
- Bagley College of Engineering Graduate Researcher of the Year, 2014
- Bagley College of Engineering Graduate Publication Award, January 2014 & May 2014 (five individual awards)
- Bagley College of Engineering Fellowship, 2011-2013
- Mississippi State University President's List (six semesters)
- Shackouls Honors College Member
- National Merit Scholar

## FUNDED PROPOSALS

- Advanced Modeling and Simulation of Multi-Physics Material Response in Geo-environments, Task 3A: Machine Learning for Atomistic Potential Development of Steel alloys, DoD ERDC, $182,000.
- Materials design of polycarbonates at the atomistic scale with machine learning, DoD ARC, $312,244.
- CAREER: Unlocking ductility in magnesium: How to replace twinning to suppress damage, NSF, $650,000.

## JOURNAL PUBLICATIONS (42)

h-index: 19

1. Nitol, M. S., Dang, K., Fensin, S. J., Baskes, M. I., Dickel, D. E., & Barrett, C. D. (2023). Hybrid interatomic potential for Sn. Physical Review Materials, 7(4), 043601.
2. Paudel, Y., Barrett, C., Mujahid, S., Rhee, H., & El Kadiri, H. (2023). Micromechanics-based strain energy study of {1 0 $1^{-}$ 2} twin-band pattern in a three-point bend Mg alloy. Journal of Materials Research, 38(2), 461-472.
3. Rustom, S., Paudel, Y., Mujahid, S., Cagle, M., Anantwar, P., Hazeli, K., ... & Barrett, C. D. (2023). Manufacturing Strategies to Mitigate Deformation Twinning in Magnesium. ASME Open Journal of Engineering, 2.
4. Mirzaei, A., Barrett, C. D., Ma, X., Hodgson, P. D., & Beladi, H. (2022). On the propensity of lath martensite intervariant boundaries to hydrogen absorption using molecular statics simulation. Materialia, 101539.
5. Nitol, M. S., Dickel, D. E., & Barrett, C. D. (2022). Machine learning models for predictive materials science from fundamental physics: An application to titanium and zirconium. Acta Materialia, 224, 117347.
6. Nitol, M. S., Mun, S., Dickel, D. E., & Barrett, C. D. (2022). Unraveling Mg⟨ c+ a⟩ slip using neural network potential. Philosophical Magazine, 102(8), 651-673.
7. Barrett, C., Martinez, J., & Nitol, M. (2022). Faceting and Twin–Twin Interactions in {11 2 1} and {11 2 2} Twins in Titanium. Metals, 12(6), 895.
8. Bodden Connor, M. T., & Barrett, C. D. (2022). Introduction of Molecular Dynamics for HTHA and a Review Article of HTHA. Journal of Failure Analysis and Prevention, 1-20.
9. Nitol, M. S., Dickel, D. E., & Barrett, C. D. (2021). Artificial neural network potential for pure zinc. Computational Materials Science, 188, 110207.
10. Paliwal, B., Moser, R. D., Barrett, C. D., Whittington, W. R., Rhee, H., Paudel, Y., ... & El Kadiri, H. (2021). Martensitic microstructure evolution in austenitic steel: A thermomechanical polycrystalline phase field study. Journal of Materials Research, 36(6), 1376-1399.

11. Dickel, D., Nitol, M., & Barrett, C. D. (2021). LAMMPS implementation of rapid artificial neural network derived interatomic potentials. Computational Materials Science, 196, 110481.
12. Paudel, Y., Giri, D., Priddy, M. W., Barrett, C. D., Inal, K., Tschopp, M. A., ... & El Kadiri, H. (2021). A Review on Capturing Twin Nucleation in Crystal Plasticity for Hexagonal Metals. Metals, 11(9), 1373.
13. Russell, W. D., Bratton, N. R., Paudel, Y., Moser, R. D., McClelland, Z. B., Barrett, C. D., ... & El Kadiri, H. (2020). In Situ Characterization of the Effect of Twin-Microstructure Interactions on {1 0 1 2} Tension and {1 0 1 1} Contraction Twin Nucleation, Growth and Damage in Magnesium. Metals, 10(11), 1403.
14. Nitol, M. S., Adibi, S., Barrett, C. D., & Wilkerson, J. W. (2020). Solid solution softening in dislocation-starved Mg–Al alloys. Mechanics of Materials, 150, 103588.
15. Giri, Deepesh, et al. "An atomistic gateway into capturing twin nucleation in crystal plasticity." Philosophical Magazine Letters 100.8 (2020): 375-385.
16. Esteban-Manzanares, G., et al. "Atomistic simulations of the interaction of basal dislocations with MgZn2 precipitates in Mg alloys." Materials Science and Engineering: A (2020): 139555.
17. Paudel, YubRaj, et al. "Characterization and modeling of {101¯ 2} twin banding in magnesium." Acta Materialia 183 (2020): 438-451.
18. Dickel, D., D. K. Francis, and **C. D. Barrett.** "Neural network aided development of a semi-empirical interatomic potential for titanium." Computational Materials Science 171 (2020): 109157.
19. Paudel, Y., Indeck, J., Hazeli, K., Priddy, M., Inal, K., Rhee, H., **Barrett, C.,** Whittington, W. R., Limmer, K. R., El Kadiri, H. (2019). Characterization and modeling of $\{$101\= 2$\}$ twin banding in magnesium. *Acta Materialia*.
20. Dickel, D. T., **Barrett, C.** (2019). Methods for the determination of diffusionless transformation conditions from atomistic simulations. *Modelling and Simulation in Materials Science and Engineering*, *27*(2), 023001.
21. Wang, F., **Barrett, C.,** McCabe, R. J., El Kadiri, H., Capolungo, L., Agnew, S. R. (2019). Dislocation induced twin growth and formation of basal stacking faults in {101¯2} twins in pure Mg. *Acta Materialia*, *165*, 471-485. https://api.elsevier.com/content/abstract/scopus_id/85058404116
22. Dickel, D., **Barrett, C**., Carino, R. L., Baskes, M. I., Horstemeyer, M. F. (2018). Mechanical Instabilities in the Modeling of Phase Transitions of Titanium. *Modelling and Simulation in Materials Science and Engineering*.
23. Dickel, D. E., Baskes, M. I., Aslam, I., **Barrett, C.** (2018). New interatomic potential for Mg--Al--Zn alloys with specific application to dilute Mg-based alloys. *Modelling and Simulation in Materials Science and Engineering*, *26*(4), 045010.
24. **Barrett, C.,** Imandoust, A., El Kadiri, H. (2018). The effect of rare earth element segregation on grain boundary energy and mobility in magnesium and ensuing texture weakening. *Scripta Materialia*, *146*, 46--50.
25. Imandoust, A., **Barrett, C.,** Al-Samman, T., Tschopp, M. A., Essadiqi, E., Hort, N., El Kadiri, H. (2018). Unraveling Recrystallization Mechanisms Governing Texture Development from Rare-Earth Element Additions to Magnesium. *Metallurgical and Materials Transactions A*, *49*(5), 1809--1829.
26. **Barrett, C.,** Imandoust, A., El Kadiri, H. (2018). The effect of rare earth element segregation on grain boundary energy and mobility in magnesium and ensuing texture weakening. *Scripta Materialia*, *146*, 46--50.
27. Dickel, D., **Barrett, C**., Carino, R. L., Baskes, M. I., Horstemeyer, M. F. (2018). Mechanical Instabilities in the Modeling of Phase Transitions of Titanium. *Modelling and Simulation in Materials Science and Engineering*.
28. Aidin Imandoust, Haitham El Kadiri, Christopher Barrett, Talal Al-Samman, Sean Agnew, Mark Tschopp, Elhachemi Essadiqi, "Unraveling recrystallization mechanisms governing texture development from rare earth element additions to magnesium," Acta Materialia, 138, 27-41, 2017.
29. YubRaj Paudel, Christopher Barrett, Mark Tschopp, Haitham El Kadiri, "Beyond initial twin nucleation in hcp metals: Michromechanical formulation for determining twin spacing during deformation," Acta Materialia, 133, 134-146, 2017.
30. C.D. Barrett, "Analysis of {1012} twinning via automated atomistic post-processing methods," Philosophical Magazine, 97(14), 1102-1128, 2017.
31. C.D. Barrett, A. Imandoust, A. Oppedal, K. Inal, H. El Kadiri, "Effect of Grain Boundaries on Texture Formation during Dynamic Recrystallization of Mg Alloys," Acta Materialia, 128, 270-283, 2017.
32. C.D. Barrett, H. El Kadiri, "Generalized interfacial fault energies," International Journal of Solids and Structures, 110-111, 106-112, 2017.
33. A. Imandoust, C.D. Barrett, T.Al-Samman, H. El Kadiri, "A review on the effect of rare earth elements on texture evolution during dynamic recrystallization of magnesium alloys" Journal of Materials Science, 52 (1), 1-29, 2017.
34. C.D. Barrett, R.L. Carino, "The MEAM parameter calibration tool: an explicit methodology for hierarchical bridging between ab initio and atomistic scales," Integrating Materials and Manufacturing Innovation, 5 (1), 1-15, 2016.
35. H. El Kadiri, C.D. Barrett, J. Wang, C.N. Tome, "Why are {1012} twins profuse in magnesium?" Acta Materialia, 85; 354-61, 2015.
36. C. D. Barrett, H. El Kadiri, "Fundamentals of mobile tilt grain boundary faceting," Scripta Materialia, 84-85; 15-18, 2014.
37. C. D. Barrett, H. El Kadiri, "{1012}, {1011}, and {1013} deformation faceting and impact on embryonic twin nucleation in hexagonal close-packed metals," Acta Materialia, 70 (15), pp. 137-161., 2014.
38. C. D. Barrett, H. El Kadiri, "The roles of grain boundary dislocations and disclinations in the nucleation of {1012} twinning," Acta Materialia 63 (15), pp. 1-15, 2014.
39. H. El Kadiri, C. D. Barrett, M. A. Tschopp "The candidacy of shuffle and shear during compound twinning in hexagonal close-packed structures," Acta Materialia, 61 (20), pp. 7646-7659, 2013.
40. H. El Kadiri, C. D. Barrett, "Comments on 'Extended zonal dislocations mediating {1122}<1123> twinning in

titanium,'" Philosophical Magazine 93 (26), 3491-3494. 2013.
41. C. D. Barrett, H. El Kadiri, M. A. Tschopp, "Breakdown of the Schmid Law in Homogeneous and Heterogeneous Nucleation Events of Slip and Twinning in Magnesium," Journal of the Mechanics and Physics of Solids, 60 (12), pp.2084-2099, 2012.
42. C. D. Barrett, M. A. Tschopp, H. El Kadiri, "Automated Analysis of Twins in Hexagonal Close-Packed Metals using Molecular Dynamics," Scripta Materialia 66 (9), pp.666-669, 2012.

## CONFERENCE PAPERS (10)

1. Barrett, C., Nitol, M., & Dickel, D. (2022). Unraveling Mg< c+ a> Slip Using Neural Network Potentials. In Magnesium Technology 2022 (pp. 273-279). Springer, Cham.
2. Paudel, YubRaj, **Christopher D. Barrett,** and Haitham El Kadiri. "Full-Field Crystal Plasticity Modeling of $$\mathbf {\{1\, 0\,\overline {1}\, 2\}} $$ Twin Nucleation." Magnesium Technology 2020. Springer, Cham, 2020. 141-146.
3. **Barrett, Christopher D.** "The Role of Faceting in $${\mathbf {\{10\bar {1} 2\}}} $$ Twin Nucleation." Magnesium Technology 2020. Springer, Cham, 2020. 129-134.
4. Giri, D., **Barrett, C.,** El Kadiri, H. (2018). Measurement of Twin Formation Energy Barriers Using Nudged Elastic Band Molecular Statics. *Magnesium Technology 2018. Springer.* (pp. 231--236).
5. F Wang, CD Barrett, K Hazeli, KD Molodov, T Al-Samman, A Oppedal, DA Molodov, A Kontsos, KT Ramesh, H El Kadiri, SR Agnew, "The Effect of {10-12} Twin Boundary on the Evolution of Defect Substructure," Magnesium Technology 207 symposium, TMS 2017.
6. C.D. Barrett, F. Wang, S.R. Agnew, H. El Kadiri, "Basal dislocation transmutation by {1012} twinning," Magnesium Technology 2017 symposium, TMS 2017
7. C.D. Barrett**,** H. El Kadiri, "The Deformation Gradient of Interfacial Defects on Twin-like Interfaces," Magnesium Technology 2015 symposium, TMS 2015
8. H. El Kadiri**,** C.D. Barrett, A Imandoust, SR Agnew, M Cherkaoui, K Inal, "Why do Magnesium Alloys Develop Sharp Textures Upon Dynamic Recrystallization?," Magnesium Technology 2015 symposium, TMS 2015
9. Barrett, C. D., El Kadiri, H., Tschopp, M. A, "Influence of Stress State On Single-Crystal Deformation in Magnesium," Proceedings of the International Plasticity Symposium, 2012.
10. Barrett, C. D., Tschopp, M. A., El Kadiri, H., Li, B., "Influence of Crystallographic Orientation on Twin Nucleation in Single-Crystal Magnesium," Magnesium Technology 2011 symposium, TMS 2011

## SELECTED PRESENTATIONS (26)

1. H. El Kadiri, **Christopher Barrett**, YubRaj Paudel, "Full-field crystal plasticity modeling of {1012} twin nucleation," TMS 2020, San Diego, Ca, 2/25/20.

2. (Invited) **Christopher Barrett**, "The role of faceting in {1012} twin nucleation," TMS 2020, San Diego, Ca, 2/25/20.

3. (Invited) **Christopher Barrett**, Doyl Dickel "Applications of Machine Learning to Potential Development for Molecular Dynamics of Ti," TMS 2019, San Antonio, Tx, 3/12/19.

4. (Invited) **Christopher Barrett**, "The role of faceting in twin-twin interactions," MACH conference, Annapolis, MD, 4/16/19.

5. (Invited) **Barrett, C**, El Kadiri, H.: "Microstructure & Property Relationship of Polycrystalline Materials: Characterization and Modeling," Crystal Plasticity Workshop, Santa Fe, NM, 9/21/18

6. **Christopher Barrett**, "Plasticity analysis in molecular dynamics via simple shear field decomposition," TMS 2018, Phoenix, AZ, 3/13/18

7. **C. Barrett**, "Characterizing the role of twins and special interfaces in magnesium deformation," Los Alamos National Laboratory, Los Alamos, NM, 11/9/2017.

8. **CD Barrett**, H El Kadiri, R. Moser, "Generalized Interfacial Fault Energies" MS&T 2017,

Pittsburg, PA.

9. **Y Paudel**, CD Barrett, MA Tschopp, K Inal, H El Kadiri, “"An Analytical Micromechanical Model Solution for Twin Nucleation in Hexagonal Close-packed Metals" MS&T 2017, Pittsburg, PA.

10. **CD Barrett**, F Wang, SR Agnew, H El Kadiri, “Basal Dislocation Transmutation through {1012} Twin Boundaries,” TMS 2017, San Diego, CA.

11. **CD Barrett**, H El Kadiri, “{1012} Twin Faceting on Non-tilt Interfaces”, TMS 2017, San Diego, CA.

12. **CD Barrett**, R Carino, H El Kadiri, R Moser, “Paving the Bridge from Ab Initio to Atomistic Modeling of Advanced High-strength Steels” TMS 2017, San Diego, CA.

13. **F Wang**, CD Barrett, K Hazeli, KD Molodov, T Al-Samman, A Oppedal, DA Molodov, A Kontsos, KT Ramesh, H El Kadiri, SR Agnew, “The Effect of {1012} Twin Boundary on the Evolution of Defect Substructure,” TMS 2017, San Diego, CA.

14. **CD Barrett**, Y Paudel, D Giri, H El Kadiri, “Efforts to Strategize Mesoscale Modeling of Twinning beginning with the Atomistic Scale,” Magnesium Workshop, Johns Hopkins University, 2017. Baltimore, MA.

15. F. Wang, **S.R. Agnew**, C.D. Barrett, H El Kadiri, “Transmutation of basal slip through the {1012} twin boundary,” International Symposium on Plasticity, Kona, Hi, January 3-8, 2016.

16. **C.D. Barrett**, H. El Kadiri, “Generalized interfacial fault energies,” International Symposium on Plasticity, Kona, Hi, January 3-8, 2016.

17. **C.D. Barrett,** H. El Kadiri, R. Moser, P. Allison, “Atomistic characterization of austenite retention in Q&P steel,” MS&T 2015, Columbus, OH, October 4-8, 2015.

18. **C.D. Barrett,** H. El Kadiri, “Dislocation-interface reactions in hexagonal close-packed metals,” MS&T 2015, Columbus, OH, October 4-8, 2015.

19. **C.D. Barrett,** H. El Kadiri, “The Deformation Gradient of Interfacial Defects on Twin-like Interfaces,” TMS 2015, Orlando, Fl, March 15-19, 2015.

20. **H. El Kadiri,** C.D. Barrett, A Imandoust, SR Agnew, M Cherkaoui, K Inal, “Why do Magnesium Alloys Develop Sharp Textures Upon Dynamic Recrystallization?,” TMS 2015, Orlando, Fl, March 15-19, 2015.

21. **C.D. Barrett**, H. El Kadiri, “Deformation faceting of twins in hexagonal close-packed metals,” International Symposium on Plasticity, Montego Bay, Jamaica, Jan 3-8, 2015.

22. **H. El Kadiri**, C.D. Barrett, “Why do magnesium alloys develop sharp texture?,” International Symposium on Plasticity, Montego Bay, Jamaica, Jan 3-8, 2015.

23. **C.D. Barrett,** H El Kadiri, “Fundamentals of Mobile GB Deformation faceting and Impact on {1012} Twin Mobility,” International Symposium on Plasticity, Freeport, Bahamas, Jan 3-8, 2014.

24. **C.D. Barrett,** H El Kadiri, M. A. Tschopp, “Analysis of Deformation Twinning in Magnesium with Molecular Dynamics,” Los Alamos National Lab, 2012.

25. **C. D. Barrett**, H. El Kadiri, M. A. Tschopp, "Influence of Crystallographic Orientation on Single Crystal Deformation in Magnesium," International Symposium on Plasticity, 2012.

26. Barrett, C. D., **Tschopp, M. A**., El Kadiri, H., Li, B., "Influence of Crystallographic Orientation on Twin Nucleation in Single Crystal Magnesium," Magnesium Technology 2011 symposium, TMS 2011.

## SELECTED POSTERS (2)

1. F. Wang, C.D. Barrett, S.R. Agnew, H. El Kadiri, "TEM and MD simulation of dislocation transmutation in Mg," HEXMAT workshop, University of Oxford, 2016.

2. Barrett, C.D, Tschopp, M.A., El Kadiri, H., "Twin Nucleation in Magnesium Single Crystals," MSU Undergraduate Research Symposium, 2010.

## REFERENCES

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