Michael Hoerner

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Education:

Ph.D: Metallurgical and Materials Engineering — August 2011 – September 2017
Advanced Steel Processing and Products Research Center (ASPPRC)
Molecular Theory Group (MTG)
Colorado School of Mines, Golden, CO

Bachelor of Science: Engineering Physics — August 2008 – May 2011
Rose-Hulman Institute of Technology, Terre Haute, IN

Fundamentals of Engineering Exam Passed — April 2011

Research Experience:

Materials Advisor

KnightHawk Materials Lab (KML) — July 2018-Present

- Serve as the technical lead for metallurgical and materials failure analysis for KML
- Perform specialized testing and analysis as required by customers
- Support Knighthawk Engineering on issues relating to metallurgical and materials engineering
- Identify opportunities for new business growth and development

Advanced Steel Processing and Products Research Center (ASPPRC) Research Assistant

Colorado School of Mines, Golden, CO — August 2011 – Present

- Developed a thesis research program to investigate solute drag on austenite grain boundaries in Fe using DFT and MD modeling to understand short-range atomic interactions
- Prepared semi-annual technical research reports for industrial sponsors many of whom had no experience with atomistic modeling to convey an understanding of the results and the potential of modeling
- Received input on the project from industrial mentors interested in industrial application of results
- Performed both TA and class work involving physical metallurgy, heat treating, foundry work, and mechanical testing using both servo-hydraulic and screw driven mechanical test frames
- Attended semi-annual research meetings and obtained wide exposure to modern research techniques
- Used novel analysis of the charge density to gain an understanding of the sub-atomic structures leading to solute interaction with grain boundaries (Bader analysis, molecular orbital and DOS analysis)
- Implemented multi-scale modeling using MD to generate grain boundary structures and DFT to determine solute interactions with grain boundaries
- Compared simulation results to literature data to provide validation and industrial relevance to results
- Worked with the Molecular Theory Group (MTG) to develop the Bondalyzer package for Tecplot360
- Collaborated with students in both the ASPPRC and the MTG to develop a multidisciplinary project and expose students and industrial mentors to new techniques for studying materials

Visiting Summer Researcher

Sandia National Labs, Albuquerque, NM — Summer 2012

- Developed an understanding of requirements for performing rigorous MD and DFT simulations
- Performed initial investigations of solute energetic interaction with grain boundaries using VASP

National Nanotechnology Infrastructure Network Summer REU

University of Colorado, Boulder, CO — Summer 2010

- Performed research on improving solar cell efficiency using photonic nanogrids
- Used a scanning electron microscope for imaging and electron beam lithography

Colorado Center for Biorefining and Biofuels Summer REU

Colorado State University, Fort Collins, CO Summer 2009

- Performed research on the effect of vegetable oil on engine cylinder durability at the Engines and Energy Conversion Laboratory and prepared a final report

Relevant Software and Research Skills:

Physical Metallurgy

- ASTM Test procedures for Tensile, compression, fracture toughness
- Investment Casting: Wax mold making, refractory coating, spin and vacuum casting
- Aluminum and brass green sand casting
- Programming and data collection from tensile test frames (tensile, compression, low cycle fatigue)
- Heat treatment
- Cryogenic and elevated temperature mechanical testing
- Charpy impact testing, ductile to brittle transition, and fracture analysis
- Metallographic sample preparation and analysis including grain size and phase composition
- Fracture analysis using optical microscopy and scanning electron microscopy

DFT Codes- Vienna ab-initio Simulation Package (VASP) and Amsterdam Density Functional (ADF)

- Simulations of large crystalline systems with and without defects
- Spin restricted and spin polarized configurations
- System, single atom, and orbital resolved DOS and band analysis
- Simulation verification: KPOINT, energy, force convergence, and functional testing
- Nudged elastic band and Geometry Optimization simulations to determine activation energies
- Single Point calculations of large Fe clusters with individual solute atoms
- Bader energy analysis, DOS, molecular orbital interactions

Additional Software Skills

- LAMMPS, Tecplot 360: Bondalyzer package, Microsoft Office, Bash scripting and HPC in Linux, R: Statistical Data Analysis, Mathematica, Matlab, COMSOL Multiphysics, Solid Edge, Python, Labview

Electronic Materials

- Clean Room Procedures
- Photo and Electron Beam Lithography
- Chemical and Physical Vapor Deposition
- Chemical Etching
- Semiconductor Device Design and Fabrication
- MEMS Device Design and Fabrication

Professional Publications:

- M. Hoerner, J. Speer, M. Eberhart, "Comparison of Ab-initio Solute-Boundary Binding Energies and Experimental Recrystallization Data in Austenite for Solute Nb and Other Elements," *ISIJ International*, Vol. 57 (10), 2017.
- M. Hoerner, M. Eberhart, J. Speer, "Ab-initio Calculation of Solute Effects on Austenite Grain Boundary Properties in Steel," Proceedings of the 3rd World Congress on Integrated Computational Materials Engineering, May 31-June 4, 2015.
- M. Hoerner, M. Eberhart, J. Speer, E. B. Damm, "The Structure Property Relationships Governing Solute-Boundary Binding Energies in Austenite," Proceedings of the International Conference on Solid-Solid Phase Transformations in Inorganic Materials 2015, June 28-July 3, 2015.