Riley Hanus

Education:

PhD candidate and Weertman Fellow Northwestern University — Evanston, Illinois — September 2014 – present — Expected graduation: Sep. 2019

- Materials Science and Engineering
- Cumulative GPA: **3.83/4.00**

B. S. Iowa State University — Ames, Iowa — August 2009 - December 2013

- Major: Materials Engineering
- Minor: Music Technology
- Cumulative GPA: **3.63/4.00**

Work experience:

Bemis North America

Jan. 2014 - Aug. 2014 — **Product Development Engineer**

Primary technical contact for Bemis forming film products

Supported sales and marketing on select Bemis customers in the 'Meat' market segment solving materials and processing issues and bringing new products to the market

Built Bemis' innovation pipeline with new technological developments and products.

Conducted independent research projects to differentiate Bemis technology from competitors.

Ames Laboratory: US Department of Energy

May 2010 - Aug. 2010 and May 2012 - Aug. 2012 — **Science Undergraduate Laboratory Internship (SULI)**

Worked in Dr. Michael Kessler's polymer composite research group

Developed a method for toughening a high performance thermosetting resin, bisphenol E cyanate ester (*see Publications*)

Analyzed the environmental degradation of bio-renewable polymers (*see Publications and Presentations*)

Aug. 2012 - Dec. 2013 — **Undergraduate Research Assistant**

Worked in Dr. Schmidt-Rohr's research group for Dr. Evgenii Levin developing high-performance thermoelectric materials (*see Publications and Presentations*)

Gained background in solid-state physics, semiconductor sample preparation, X-Ray diffraction/crystallography, and measurement of thermal and electronic transport properties

Iowa State University: Dept. of Materials Science and Engineering

Aug. 2010 - Aug. 2012 — **Polymer Composite Research Group**

Worked in Dr. Michael Kessler's polymer composite research group on projects developing biopolymers, polymer self-healing functionality, and analyzing fracture mechanics

Aug. 2012 - Dec. 2012 — **Grader/Course Assistant**

Aided the instruction and operation of Dr. Michael Martin's Mat E 351: Intro to Polymers

Guest lectured, held review sessions, and graded homework and lab reports

Publications:

(as of 3/28/19)

First Author:

1. **R. Hanus**, M. T. Agne, A. Rettie, Z. Chen, G. Tan, D. Y. Chung, M. G. Kanatzidis, Y. Pei, P. W. Voorhees, G. J. Snyder. Lattice softening significantly reduces thermal conductivity and leads to high thermoelectric efficiency. *Advanced Materials.* In press. (2019)
2. **R. Hanus**, Garg, A. & Snyder, G. J. Phonon diffraction and dimensionality crossover in phonon-interface scattering. *Commun. Phys.* 1, 78 (2018).
3. **R. Hanus**, X. Guo, Y. Tang, G. Li, G. J. Snyder, W. G. Zeier. A Chemical Understanding of the Band Convergence in Thermoelectric $CoSb_3$ Skutterudites: Influence of Electron Population, Local Thermal Expansion, and Bonding Interactions. *Chem. Mater.* **29,** 1156–1164 (2017).
4. P. Zong*, **R. Hanus***, M. Dylla, Y. Tang, J. Liao, Q. Zhang, G. J. Snyder, L. Chen. Skutterudite with graphene-modified grain-boundary complexion enhances zT enabling high-efficiency thermoelectric device. *Energy Environ. Sci.* **10,** 183–191 (2017). *contributed equally

Co-author:

1. Agne, M. T., **Hanus, R.** & Snyder, G. J. Minimum thermal conductivity in the context of diffuson-mediated thermal transport. *Energy Environ. Sci.* **11,** 609–616 (2018).
2. Pan, Y., Aydemir, U., Grovogui, J., Witting, I. T., **Hanus, R.**, Xu, Y., Wu, J., Wu, Sun, Zhuang, Dong, Li, Dravid, V. P. & Snyder, G. J.. Melt-Centrifuged $(Bi,Sb)_2Te_3$: Engineering Microstructure toward High Thermoelectric Efficiency. *Adv. Mater.* **30,** 1802016 (2018).
3. Xu, D., **Hanus, R.**, Xiao, Y., Wang, S., Snyder, G. J. & Hao, Q. Thermal boundary resistance correlated with strain energy in individual Si film-wafer twist boundaries. *Mater. Today Phys.* **6,** 53–59 (2018).
4. Tan, G., Hao, S., **Hanus, R.**, Xiaomi, Z., Anand, S., Bailey, T. P., Rettie, A. J. E., Su, X., Uher, C., Dravid, V. P., Snyder, G. J., Wolverton, C. & Kanatzidis, M. G. High Thermoelectric Performance in SnTe-$AgSbTe_2$ Alloys from Lattice Softening, Giant Phonon-Vacancy Scattering, and Valence Band Convergence. *ACS Energy Lett.* 705–712 (2018).
5. Chen, Z. Binghui, G., Wen, L., Lin, S., Shen, J., Chang, Y., **Hanus, R.**, Snyder, G. J. & Pei, Y. Vacancy-induced dislocations within grains for high-performance PbSe thermoelectrics. *Nat. Commun.* **8,** 13828 (2017).
6. Chen, Z., Jian, Z., Li, W., Chang, Y., Ge, B., **Hanus, R.**, Yang, J., Chen, Y., Huang, M., Snyder, G. J. & Pei, Y. Lattice Dislocations Enhancing Thermoelectric PbTe in Addition to Band Convergence. *Adv. Mater.* **1606768,** 1606768 (2017).
7. Nunna, R., Qui, P., Yin, M., Chen, H., **Hanus, R.**, Song, Q., Zhang, T., Chou, M. Y., Agne, M. T., He, J., Snyder, G. J., Shi, X. & Chen, L. Ultrahigh thermoelectric performance in Cu_2Se-based hybrid materials with highly dispersed molecular CNTs. *Energy Environ. Sci.* **10,** 1928–1935 (2017).
8. Kang, S. D., Pöhls, J.-H., Aydemir, U., Qiu, P., Stoumpos, C. C., **Hanus, R.**, White, M. A., Shi, X., Chen, L., Kanatzidis, M. & Snyder, G. J. Enhanced stability and thermoelectric figure-of-merit in copper selenide by lithium doping. *Mater. Today Phys.* **1,** 7–13 (2017).

9. Kim, H.-S., Kang, S. D., Tang, Y., **Hanus, R.** & Jeffrey Snyder, G. Dislocation strain as the mechanism of phonon scattering at grain boundaries. *Mater. Horiz.* **3,** 234–240 (2016).
10. Li, G., An, Q., Goddard III, W. A., **Hanus, R.**, Zhai, P., Zhang, Q. & Snyder, G. J. Atomistic explanation of brittle failure of thermoelectric skutterudite $CoSb_3$. *Acta Mater.* **103,** 775–780 (2016).
11. Tang, Y., **Hanus, R.**, Chen, S. & Snyder, G. J. Solubility design leading to high figure of merit in low-cost Ce-$CoSb_3$ skutterudites. *Nat. Commun.* **6,** 7584 (2015).
12. Levin, E. M., **Hanus, R.**, Cui, J., Xing, Q., Riedemann, T., Lograsso, T. A. & Schmidt-Rohr, K. Phase analysis and determination of local charge carrier concentration in eutectic Mg_2Si-Si alloys. *Mater. Chem. Phys.* **158,** 1–9 (2015).
13. Levin, E. M., **Hanus, R.**, Hanson, M., Straszheim, W. E. & Schmidt-Rohr, K. Thermoelectric properties of $Ag_2Sb_2Ge_{46-x}Dy_xTe_{50}$ alloys with high power factor. *Phys. status solidi* **210,** 2628–2637 (2013).
14. Levin, E. M., Besser, M. F. & **Hanus, R.** Electronic and thermal transport in GeTe: A versatile base for thermoelectric materials. *J. Appl. Phys.* **114,** 083713 (2013).
15. Cui, H., **Hanus, R.** & Kessler, M. R. Degradation of ROMP-based bio-renewable polymers by UV radiation. *Polym. Degrad. Stab.* **98,** 2357–2365 (2013).
16. Sheng, X., **Hanus, R.**, Bauer, A. & Kessler, M. R. Effect of PEGDE addition on rheological and mechanical properties of bisphenol E cyanate ester. *J. Appl. Polym. Sci.* **130,** 463–469 (2013).

Presentations:

Invited:

R. Hanus, G. J. Snyder. "Engineering thermal conductivity through microstructure"

- SPIE-MRSEC student seminar, October 2018

Conferences:

R. Hanus, G. J. Snyder. "The influence of interfacial structure and strain energy on phonon transport"

- American Physical Society, March 2019

R. Hanus, M. T. Agne, Z. Chen, Y. Pei, P. W. Voorhees, G. J. Snyder. "Internal-strain induced lattice softening reduces thermal conductivity and leads to high thermoelectric efficiency PbTe: reconsidering phonon scattering"

- International Conference of Thermoelectrics, July 2018

R. Hanus, A. Garg, and G. J. Snyder. "Phonon diffraction and dimensionality crossover in phonon-interface scattering"

- American Physical Society, March Meeting 2018

R. Hanus, A. Garg, and G. J. Snyder. "Phonon diffraction and dimensionality crossover in phonon-interface scattering"

- CECAM in Paris, 2018

R. Hanus, A. Garg, and G. J. Snyder. "Phonon diffraction and dimensionality crossover in phonon-interface scattering"

- Materials Research Society, Fall Meeting 2017

R. Hanus, *et al.* "The role of Sn vacancies in reducing the thermal conductivity of SnTe-$AgSbTe_2$ alloys"

- Materials Research Society, Fall Meeting 2017

R. Hanus, H. Kim, S. Kang, Y. Tang, A. Garg, and G. J. Snyder. "The influence of grain boundary structure on phonon scattering"

- International Conference of Thermoelectrics, 2017

R. Hanus, X. Guo, Y. Tang, G. Li, G. J. Snyder, W. G. Zeier. "A Chemical Understanding of Band Convergence in Thermoelectric $CoSb_3$ Skutterudites—Influence of Electron Population, Local Thermal Expansion, and Bonding Interactions"

- Electronic Materials Conference 2017

E. M. Levin, M. Hanson, R. Hanus, and K. Schmidt-Rohr. "Replacement of Ge in GeTe by [Ag+Sb] and rare earths: effect on thermoelectric properties", American Physical Society March Meeting 2013, Vol. 58, No. 1

Posters:

Poster: R. Hanus, H. Cui, M. Kessler. "Analysis of fracture mechanics of a ROMP-based bio-resin using the essential work of fracture (EWF) method"

- Represented ISU at the 2013 *Research in the Capitol* poster presentation, March 2013
- Presented poster at ISU's Biopolymers & Biocomposites Workshop, Aug. 2012

ISU MSE Undergraduate Research Poster Competition (*See Awards*)

- 1st place: "Effect of Xenon Radiation exposure on a bio-renewable polymer" by R. Hanus, H. Cui, M. Kessler. May 2012
- 3rd place: "Measurement of Seebeck Coefficient in Bi_2Te_3 Thin-Films" by R. Hanus, R. Gast, S. Reeve, and J. Graham. May 2013

Honors/Awards:

Science Graduate Research Award (SCGSR) (2018)

- National award enabling outstanding U.S. graduate students to pursue graduate research at a DOE laboratory (this case: Oak Ridge National Lab).

Johannes and Julia Randall Weertman Graduate Fellowship (2018)

- Achievement-based award to recognize a Ph.D. candidate in Northwestern Materials Science and Engineering for outstanding scholarly achievements and promise.

National Defense Science & Engineering Graduate Fellowship – Honorable Mention (2015)

National Science Foundation Graduate Research Fellowship – Alternate Selectee (2015)

Dean's List for the ISU College of Engineering (Fall 2009, Fall 2010, Fall 2011, Fall 2012, and Spring 2013)

The National Society of Collegiate Scholars (*2010-present*)

Iowa State Academic Recognition Award (2009-2013)

Delta Tau Delta National Fraternity

- Excellence in Recruitment Programming (Feb. 2012)
- Exceeding Recruitment Goals (Feb. 2012)
- Hugh Shields Award for Chapter Excellence (Feb. 2012)

ISU Materials Science and Engineering Undergraduate Poster Competition
- 2012: 1st place
- 2013: 3rd place

Leadership

Northwestern Materials Science Department

2015-2016

Vice President Materials Science Student Association

Organized and executed prospective student visit weekends

Conducted Materials Science social and professional networking events

Organized outreach programs

Delta Tau Delta Fraternity: Iowa State Chapter (Gamma Pi)

Jan. 2011 - Dec. 2011

Vice President of Recruitment

Operated on an award winning Executive Committee for a 90+ member chapter and managed a three-member recruitment team (*see Awards*)

Exceeded our recruitment goal by 36% and maintained a 97% retention rate while staying under budget.

Outreach

Joint Undertaking for an African Materials Institute

Teaching assistant for the thermoelectrics sub-section of 2016 JUAMI (www.juami.org)

Designed, built, and lead an hands on lab activity for native African scientists and other JUAMI participants.

Proficiencies:

Technical skills

- Laser Flash Analysis (experience running, servicing, and repairing Netzsch LFA 457)
- Ultrasound characterization (Pulse-Echo and Resonant Ultrasound Spectroscopy)
- X-Ray diffraction (phase analysis, structure refinement, Laue, microstructural analysis, synchrotron experience, 11-BM APS)
- Synthesis: powder metallurgy, solid state synthesis ('ampule' chemistry), single crystal growth and characterization
- Scanning electron microscopy (SEM)
- Electrical Conductivity (Van der Pauw, 4-point probe)
- Seebeck Coefficient
- Differential scanning calorimetry (DSC)
- Dynamic mechanical analysis (DMA)
- Fourier transform infrared spectroscopy (FT-IR)
- Mechanical testing (Instron)
- Rheology testing
- Thermogravimetric analysis (TGA)
- Thermomechanical analysis (TMA)

Coding Languages/Software

- Python (advanced, user interface development)
- Bash (intermediate)
- Mathematica (advanced)
- MATLAB (intermediate)
- HTML/CSS (intermediate)
- almaBTE (intermediate)
- VSAP (basic)
- General Structure Analysis System, GSASscriptable.py (advanced)