

Andrew F. May
mayaf@ornl.gov; (865)576-4746

Materials Science and Technology Division
Oak Ridge National Laboratory

Positions Held/Education

2023 – Present: Senior Staff Scientist, Oak Ridge National Laboratory, Oak Ridge, TN
2018 – 2023: Staff Scientist, Oak Ridge National Laboratory, Oak Ridge, TN
2013 – 2018: Research Associate, Oak Ridge National Laboratory, Oak Ridge, TN
2010 – 2013: Postdoctoral Research, Oak Ridge National Laboratory, Oak Ridge, TN
2005 – 2010: Ph.D., M.S. in Chemical Engineering, Minor in Materials Science, California Institute of Technology, Pasadena, CA
2005: Research Assistant, Pennsylvania State University, University Park, PA
2000 – 2004: B.S. in Chemical Engineering, Minor in Environmental Science and Engineering, Pennsylvania State University, University Park, PA

Current Research

My scientific pursuits are centered around the interplay of lattice, electronic, and magnetic energies in complex, inorganic materials. The approach is grounded in the detailed characterization of high-quality samples, often single crystals. Once the intrinsic properties of a material are known, models are pursued to guide the manipulation or control of various behaviors and more complex experiments are pursued. These basic science investigations expand our ability to design energy- and technology-related materials with desired functionality by developing an understanding of how electrons respond to their environments and various stimuli. The types of materials investigated include novel magnetic materials, quasi-2D systems, thermoelectrics and superconductors. Materials physics research is inherently collaborative, and I frequently interact with a diverse set of scientists that specialize in theory, microscopy, spectroscopy and neutron scattering. To complement my research activities, I serve as Laboratory Space Manager for the Correlated Electron Materials Group.

Previous Research Positions

Oak Ridge National Laboratory 2010 – 2013
Postdoctoral research Mentors: [Michael McGuire](#) and [Brian Sales](#)

Single crystalline electronic and magnetic materials: This research investigated how structure and chemistry influence the physical properties of complex materials that are of potential interest to the nation's future energy landscape. The focus was primarily on structure and magnetism in near-superconducting materials, and electron and phonon transport in thermoelectrics.

California Institute of Technology 2005 – 2010
Graduate research Advisors: [Jeff Snyder](#) and [Sossina Haile](#)

Materials physics of thermoelectric transport: My graduate research focused on thermoelectric materials that will be utilized for power generation at high temperatures. Following synthesis and characterization, semiclassical transport models were developed to guide the optimization of properties/compositions through an understanding of the underlying electronic structures and transport mechanisms. This work led to the continued development of $\text{La}_{3-x}\text{Te}_4$ at NASA's Jet Propulsion Laboratory for future use in deep space missions.

Polymer physics simulations: This research provided insights into polymer dynamics by investigating systems that cannot be investigated experimentally, such as the infinite dilution limit in polyolefin blends. This was accomplished by using molecular dynamics to study the impact of intra-chain connectivity on local packing and dynamics in polyolefins.

Awards

- Outstanding Reviewer, American Physical Society (2018)
- Demetriades - Tsafka - Kokkalis Prize in the area of Environmentally Benign Renewable Energy Sources, California Institute of Technology, (Jun., 2010)
- 2010 Goldsmid Award for Excellence in Research in Thermoelectrics by a Graduate Student, awarded by the International Thermoelectric Society (May, 2010)
- Division of Materials Physics' Ovshinsky Student Award, Meeting of the American Physical Society (Mar., 2010)
- NASA Tech-Brief Award, *Mechanical Alloying for Making Thermoelectrics*, (Sept., 2007)
- Robert and Nancy Frantz Centennial Scholarship (Apr., 2002)
- Charles B. Manula Memorial Scholarship (Apr., 2002)

Conference Presentations

- 2023 American Physical Society March Meeting, Las Vegas, NV.
2021 (invited) American Physical Society March Meeting, virtual
(invited) American Conference on Crystal Growth and Epitaxy, virtual
2019 American Physical Society March Meeting, Boston, MA.
(invited) MMM conference, Las Vegas, NV.
(invited) North American Thermoelectric Workshop, Northwestern University
2018 American Physical Society March Meeting, Los Angeles, CA.
2017 American Physical Society March Meeting, New Orleans, LA.
2016 American Physical Society March Meeting, Baltimore, MD.
2014 (invited) American Physical Society March Meeting, Boston, MA.
(invited) SPP 4th Status Meeting, Bad Aussie, Austria
2012 American Physical Society March Meeting, Boston, MA.
2010 International Conference on Thermoelectrics, Shanghai, China.
American Physical Society March Meeting, Portland, OR.
2009 International Conference on Thermoelectrics, Freiburg, Germany.
2008 Materials Science and Technology Conference, Pittsburgh, PA.
International Conference on Thermoelectrics, Corvallis, OR.
Space Tech. and App. Int. Forum, Albuquerque, NM.
2007 Materials Research Society Meeting, Boston, MA.
Electronic Materials Conference, Notre Dame, IN
2005 American Physical Society March Meeting, Los Angeles, CA.

Outreach and Activities

- Reviewer for journals and fellowships: Physical Review B, Physical Review Materials, Physical Review Letters, Physical Review X, Physical Review Applied, Proceedings of the National Academy of Sciences, ACS Nano, Chemistry of Materials, Journal of Chemical Physics, Journal of Alloys and Compounds, Applied Physics Letters, Journal of Applied Physics, Journal of Physics and Chemistry of Solids, Journal of Chemical Physics, Inorganic Chemistry, Physical Review X Energy, Progress in Materials Science, Solid State Communications, Journal of Electronic Materials, Journal of Alloys and Compounds, The Austrian Lise-Meitner Fellowship Program
- Session chair at various conferences, organizing efforts for 2019 Joint MMM-Intermag and MRS Spring 2024 Symposium, Quantum and Energy Materials Seminar Series at ORNL (2019,2020), Materials Science and Technology Division and Chemical Science Division seminar series at ORNL (2022)
- Elementary school volunteer: Assistance with science labs for sixth grade students at Burbank Elementary School (May-Dec., 2009) and with the eighth grade students at Eliot Middle School (Sept.-Dec., 2009); Pasadena, CA
- Caltech Earth Day Celebration, Organizer of Graduate Student Poster Section (2009)
- East Los Angeles Community College Science Club Presentation Series, *The Science of Energy, A Focus on Thermoelectric Energy Conversion*, (October, 2008)
- Materials Research Lecture Series Coordinator, Caltech, (2008-2010)
- Center for Talented Youth Energy and Environment Conference, Caltech, Assistant/Lab tours (2006-2008)

Publications

 ORCID 0000-0003-0777-8539

[Google Scholar](#)

- [138] Hang Chen, Shahidul Asif, Kapildeb Dolui, Yang Wang, Jeyson Támara-Isaza, VML Durga Prasad Goli, Matthew Whalen, Xinhao Wang, Zhijie Chen, Huiqin Zhang, et al. “Above-Room-Temperature Ferromagnetism in Thin van der Waals Flakes of Cobalt-Substituted Fe_5GeTe_2 ”. *ACS Applied Materials & Interfaces*, 15:3287, 2023.
- [137] Jierui Liang, Shanchuan Liang, Ti Xie, Andrew F. May, Thomas Ersevım, Qinqin Wang, Hyobin Ahn, Changgu Lee, Xixiang Zhang, Jian-Ping Wang, Michael A. McGuire, Min Ouyang, and Cheng Gong. “Facile integration of giant exchange bias in Fe_5GeTe_2 /oxide heterostructures by atomic layer deposition”. *Physical Review Materials*, 7:014008, 2023.
- [136] Alessandro R. Mazza, Shree Ram Acharya, Patryk Wasik, Jason Lapano, Jiemin Li, Brianna L. Musico, Veerle Keppens, Christopher T. Nelson, Andrew F. May, Matthew Brahlek, Claudio Mazzoli, Jonathan Pelliciari, Valentina Bisogni, Valentino R. Cooper, and T. Zac Ward. “Variance induced decoupling of spin, lattice, and charge ordering in perovskite nickselates”. *Physical Review Research*, 5:013008, 2023.
- [135] ME Manley, AF May, BL Winn, DL Abernathy, R Sahul, and RP Hermann. “Phason-dominated thermal transport in fesoite”. *Physical Review Letters*, 129(25):255901, 2022.
- [134] Xiaojian Bai, Frank Lechermann, Yaohua Liu, Yongqiang Cheng, Alexander I. Kolesnikov, Feng Ye, Travis J. Williams, Songxue Chi, Tao Hong, Garrett E. Granroth, Andrew F. May, and Stuart Calder. “Antiferromagnetic fluctuations and orbital-selective Mott transition in the van der Waals ferromagnet $\text{Fe}_{3-x}\text{GeTe}_2$ ”. *Physical Review B*, 106:L180409, 2022.

- [133] Shang Gao, Ganesh Pokharel, Andrew F May, Joseph AM Paddison, Chris Pasco, Yaohua Liu, Keith M Taddei, Stuart Calder, David G Mandrus, Matthew B Stone, et al. “Line-Graph Approach to Spiral Spin Liquids”. *Physical Review Letters*, 129(23):237202, 2022.
- [132] Joseph A. M. Paddison, Binod K. Rai, Andrew F. May, Stuart Calder, Matthew B. Stone, Matthias D. Frontzek, and Andrew D. Christianson. “Magnetic Interactions of the Centrosymmetric Skyrmion Material Gd_2PdSi_3 ”. *Physical Review Letters*, 129:137202, 2022.
- [131] William R. Meier, James R. Torres, Raphael P. Hermann, Jiyong Zhao, Barbara Lavina, Brian C. Sales, and Andrew F. May. “Thermodynamic insights into the intricate magnetic phase diagram of EuAl_4 ”. *Physical Review B*, 106:094421, 2022.
- [130] Seung-Hwan Do, Joseph AM Paddison, Gabriele Sala, Travis J Williams, Koji Kaneko, Keitaro Kuwahara, Andrew F May, Jiaqiang Yan, Michael A McGuire, Matthew B Stone, et al. “Gaps in topological magnon spectra: Intrinsic versus extrinsic effects”. *Physical Review B*, 106(6):L060408, 2022.
- [129] Brian C Sales, William R Meier, David S Parker, Li Yin, Jiaqiang Yan, Andrew F May, Stuart Calder, Adam A Aczel, Qiang Zhang, Haoxiang Li, et al. “Chemical Control of Magnetism in the Kagome Metal $\text{CoSn}_{1-x}\text{In}_x$: Magnetic Order from Nonmagnetic Substitutions”. *Chemistry of Materials*, 34(15):7069–7077, 2022.
- [128] G Sala, JYY Lin, AM Samarakoon, DS Parker, AF May, and MB Stone. “Ferrimagnetic spin waves in honeycomb and triangular layers of $\text{Mn}_3\text{Si}_2\text{Te}_6$ ”. *Physical Review B*, 105(21):214405, 2022.
- [127] Shashi Pandey, Han Zhang, Junyi Yang, Andrew F. May, Joshua J. Sanchez, Zhaoyu Liu, Jiun-Haw Chu, Jong-Woo Kim, Philip J. Ryan, Haidong Zhou, and Jian Liu. “Controllable Emergent Spatial Spin Modulation in Sr_2IrO_4 by In Situ Shear Strain”. *Physical Review Letters*, 129:027203, 2022.
- [126] Binod K Rai, Shang Gao, Matthias Frontzek, Yaohua Liu, Andrew D Christianson, and Andrew F May. “Magnetic properties of Fe-substituted NiBr_2 single crystals”. *Journal of Magnetism and Magnetic Materials*, page 169452, 2022.
- [125] MP Jiang, S Fahy, A Hauber, ÉD Murray, I Savić, C Bray, JN Clark, T Henighan, M Kozina, AM Lindenberg, et al. “Observation of photo-induced plasmon–phonon coupling in PbTe via ultrafast x-ray scattering”. *Structural Dynamics*, 9(2):024301, 2022.
- [124] Yijing Huang, Shan Yang, Samuel Teitelbaum, Gilberto De la Peña, Takahiro Sato, Matthieu Chollet, Diling Zhu, Jennifer L Niedziela, Dipanshu Bansal, Andrew F May, et al. “Observation of a Novel Lattice Instability in Ultrafast Photoexcited SnSe ”. *Physical Review X*, 12(1):011029, 2022.
- [123] Wilarachchige DCB Gunatilleke, Andrew F May, Angela R Hight Walker, Adam J Biacchi, and George S Nolas. “Synthesis, crystal structure, and physical properties of BaSnS_2 ”. *physica status solidi (RRL)–Rapid Research Letters*, 16(5):2100624, 2022.
- [122] J-Q Yan, Zengle Huang, Weida Wu, and Andrew F May. “Vapor transport growth of MnBi_2Te_4 and related compounds”. *Journal of Alloys and Compounds*, 906:164327, 2022.
- [121] Hang Chen, Shahidul Asif, Matthew Whalen, Jeyson Támara-Isaza, Brennan Luetke, Yang Wang, Xinhao Wang, Millicent Ayako, Saurabh Lamsal, Andrew F May, et al. “Revealing room temperature ferromagnetism in exfoliated Fe_5GeTe_2 flakes with quantum magnetic imaging”. *2D Materials*, 9(2):025017, 2022.

- [120] Andrew F May, Jiaqiang Yan, Raphael Hermann, Mao-Hua Du, and Michael A McGuire. “Tuning the room temperature ferromagnetism in Fe_5GeTe_2 by arsenic substitution”. *2D Materials*, 9(1):015013, 2021.
- [119] Shang Gao, Vilmos Kocsis, Minoru Soda, Feng Ye, Yaohua Liu, Andrew F May, Yasujiro Taguchi, Yoshinori Tokura, Taka-hisa Arima, Werner Schweika, et al. “Suppressed incommensurate order in swedenborgite $\text{Ca}_{0.5}\text{Y}_{0.5}\text{BaCo}_4\text{O}_7$ ”. *Physical Review B*, 104(14):L140408, 2021.
- [118] Jie Xing, Liurukara D Sanjeeva, Andrew F May, and Athena S Sefat. “Synthesis and anisotropic magnetism in quantum spin liquid candidates AYbSe_2 (A=K and Rb)”. *APL Materials*, 9(11):111104, 2021.
- [117] Wilarachchige DCB Gunatilleke, Rinkle Juneja, Oluwagbemiga P Ojo, Andrew F May, Hsin Wang, Lucas Lindsay, and George S Nolas. “Intrinsic anharmonicity and thermal properties of ultralow thermal conductivity $\text{Ba}_6\text{Sn}_6\text{Se}_{13}$ ”. *Physical Review Materials*, 5(8):085002, 2021.
- [116] Jason Lapano, Yun-Yi Pai, Alessandro R Mazza, Jie Zhang, Tamara Isaacs-Smith, Patrick Gemperline, Lizhi Zhang, Haoxiang Li, Ho Nyung Lee, Gyula Eres, et al. “Self-regulated growth of candidate topological superconducting parkerite by molecular beam epitaxy”. *APL Materials*, 9(10):101110, 2021.
- [115] James R Torres, Victor R Fanelli, Yuya Shinohara, Andrew F May, Mariano Ruiz-Rodriguez, Michelle S Everett, and Raphael P Hermann. “Resonant ultrasound spectroscopy probe for in-situ neutron scattering measurements”. In *Proceedings of Meetings on Acoustics 180ASA*, volume 43, page 045001. Acoustical Society of America, 2021.
- [114] James Torres, Victor Fanelli, Yuya Shinohara, Andrew May, Mariano Ruiz-Rodriguez, and Raphael Hermann. “In situ resonant ultrasound spectroscopy for neutron scattering”. *The Journal of the Acoustical Society of America*, 149(4):A126–A126, 2021.
- [113] BC Sales, WR Meier, AF May, J Xing, J-Q Yan, S Gao, YH Liu, MB Stone, AD Christianson, Q Zhang, et al. “Tuning the flat bands of the kagome metal CoSn with Fe, In, or Ni doping”. *Physical Review Materials*, 5(4):044202, 2021.
- [112] Shang Gao, Andrew F May, Mao-Hua Du, Joseph AM Paddison, Hasitha Suriya Arachchige, Ganesh Pokharel, Clarina Dela Cruz, Qiang Zhang, Georg Ehlers, David S Parker, et al. “Hierarchical excitations from correlated spin tetrahedra on the breathing pyrochlore lattice”. *Physical Review B*, 103(21):214418, 2021.
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- [110] Gabriele Sala, Matthew B Stone, Binod K Rai, Andrew F May, Pontus Laurell, Vasile O Garlea, Nicholas P Butch, Mark D Lumsden, George Ehlers, Ganesh Pokharel, et al. “Van Hove singularity in the magnon spectrum of the antiferromagnetic quantum honeycomb lattice”. *Nature communications*, 12(1):1–8, 2021.
- [109] Binod K Rai, Ganesh Pokharel, Hasitha Suriya Arachchige, Seung-Hwan Do, Qiang Zhang, Masaaki Matsuda, Matthias Frontzek, Gabriele Sala, V Ovidiu Garlea, Andrew D Christianson, et al. “Complex magnetic phases in the polar tetragonal intermetallic NdCoGe_3 ”. *Physical Review B*, 103(1):014426, 2021.
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- [106] Wilarachchige DCB Gunatilleke, Noha Alzahrani, Andrew F May, Hsin Wang, and George S Nolas. “Thermal Properties of the Quaternary Chalcogenide BaCdSnSe_4 ”. *physica status solidi (RRL)–Rapid Research Letters*, 14(12):2000363, 2020.
- [105] Bevin Huang, Michael A McGuire, Andrew F May, Di Xiao, Pablo Jarillo-Herrero, and Xiaodong Xu. “Emergent phenomena and proximity effects in two-dimensional magnets and heterostructures”. *Nature Materials*, 19(12):1276–1289, 2020.
- [104] Tyson Lanigan-Atkins, S Yang, Jennifer L Niedziela, Dipanshu Bansal, Andrew F May, Alexander A Puretzy, JYY Lin, Daniel M Pajerowski, Tao Hong, Songxue Chi, et al. “Extended anharmonic collapse of phonon dispersions in SnS and SnSe ”. *Nature Communications*, 11(1):1–9, 2020.
- [103] William R Meier, Mao-Hua Du, Satoshi Okamoto, Narayan Mohanta, Andrew F May, Michael A McGuire, Craig A Bridges, German D Samolyuk, and Brian C Sales. “Flat bands in the CoSn -type compounds”. *Physical Review B*, 102(7):075148, 2020.
- [102] Wilarachchige DCB Gunatilleke, Andrew F May, Hsin Wang, and George S Nolas. “Thermal properties of $\text{BaCu}_2\text{SnQ}_4$ ($Q = \text{S}, \text{Se}$) quaternary chalcogenides”. *Applied Physics Letters*, 117(9):092101, 2020.
- [101] Binod K Rai, AD Christianson, Gabriele Sala, Matthew B Stone, Yaohua Liu, and Andrew F May. “Magnetism of Nd_2O_3 single crystals near the Néel temperature”. *Physical Review B*, 102(5):054434, 2020.
- [100] Andrew F May, Jiaqiang Yan, and Michael A McGuire. “A practical guide for crystal growth of van der Waals layered materials”. *Journal of Applied Physics*, 128(5):051101, 2020.
- [99] Jennifer L Niedziela, Dipanshu Bansal, Jingxuan Ding, Tyson Lanigan-Atkins, Chen Li, Andrew F May, Hsin Wang, Jiao YY Lin, Douglas L Abernathy, Georg Ehlers, et al. “Controlling phonon lifetimes via sublattice disordering in AgBiSe_2 ”. *Physical Review Materials*, 4(10):105402, 2020.
- [98] ME Manley, K Hong, P Yin, S Chi, Y Cai, C Hua, LL Daemen, RP Hermann, H Wang, AF May, et al. “Giant isotope effect on phonon dispersion and thermal conductivity in methylammonium lead iodide”. *Science Advances*, 6(31):eaaz1842, 2020.
- [97] Andrew F May, Mao-Hua Du, Valentino R Cooper, and Michael A McGuire. “Tuning magnetic order in the van der Waals metal Fe_5GeTe_2 by cobalt substitution”. *Physical Review Materials*, 4(7):074008, 2020.
- [96] Xiangru Kong, Giang D Nguyen, Jinhwan Lee, Changgu Lee, Stuart Calder, Andrew F May, Zheng Gai, An-Ping Li, Liangbo Liang, and Tom Berlijn. “Interlayer magnetism in $\text{Fe}_{3-x}\text{GeTe}_2$ ”. *Physical Review Materials*, 4(9):094403, 2020.
- [95] Ganesh Pokharel, Hasitha Suriya Arachchige, Travis J Williams, Andrew F May, Randy S Fishman, Gabriele Sala, Stuart Calder, Georg Ehlers, David S Parker, Tao Hong, et al. “Cluster frustration in the breathing pyrochlore magnet $\text{LiGaCr}_4\text{S}_8$ ”. *Physical Review Letters*, 125(16):167201, 2020.
- [94] Jingxuan Ding, Jennifer L Niedziela, Dipanshu Bansal, Jiuling Wang, Xing He, Andrew F May, Georg Ehlers, Douglas L Abernathy, Ayman Said, Ahmet Alatas, et al. “Anharmonic

- lattice dynamics and superionic transition in AgCrSe₂". *Proceedings of the National Academy of Sciences*, 117(8):3930–3937, 2020.
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- [92] Han Zhang, Lin Hao, Junyi Yang, Josh Mutch, Zhaoyu Liu, Qing Huang, Kyle Noordhoek, Andrew F May, Jiun-Haw Chu, Jong-Woo Kim, et al. "Comprehensive electrical control of metamagnetic transition of a quasi-2D antiferromagnet by in situ anisotropic strain". *Advanced Materials*, 32(36):2002451, 2020.
- [91] Lekh Poudel, Jon M Lawrence, Liusuo S Wu, Georg Ehlers, Yiming Qiu, Andrew F May, Filip Ronning, Mark D Lumsden, David Mandrus, and Andrew D Christianson. "Multicomponent fluctuation spectrum at the quantum critical point in CeCu_{6-x}Ag_x". *npj Quantum Materials*, 4(1):1–7, 2019.
- [90] Andrew F May, Craig A Bridges, and Michael A McGuire. "Physical properties and thermal stability of Fe_{5-x}GeTe₂ single crystals". *Physical Review Materials*, 3(10):104401, 2019.
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- [85] Gabriele Sala, Matthew B Stone, Binod K Rai, Andrew F May, David S Parker, Gábor B Halász, YQ Cheng, Georg Ehlers, Vasile O Garlea, Qiang Zhang, et al. "Crystal field splitting, local anisotropy, and low-energy excitations in the quantum magnet YbCl₃". *Physical Review B*, 100(18):180406, 2019.
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- [78] Andrew F May, Huibo Cao, and Stuart Calder. “Impact of Sn substitution on the structure and magnetism of Sr_2IrO_4 ”. *Physical Review Materials*, 2(9):094406, 2018.
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