

XI CHEN, PhD

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RESEARCH INTERESTS

Thermal management, thermoelectrics, spin caloritronics, lithium ion batteries, crystal growth

EDUCATION

Ph.D., Materials Science and Engineering, The University of Texas at Austin Dec. 2014

M.S., Materials Science and Engineering, Zhejiang University, China Apr. 2010

B.S., Materials Science and Engineering (with honor), Southeast University, China July 2007

PROFESSIONAL EXPERIENCE

Instructor, Department of Mechanical Engineering, UT Austin Jun. 2018—Aug. 2018

- Instructed a summer course (*Introduction to Materials Engineering*) for Mechanical Engineering and Aerospace Engineering undergraduates

Postdoctoral Researcher and Lab Manager, UT Austin Jan. 2015—present

Thermal Management: *oxide and arsenide crystals with high thermal conductivity* Advisor: Li Shi

- Produced large-size high-quality cuprate crystals with thermal conductivity $>100 \text{ Wm}^{-1}\text{K}^{-1}$ using traveling solvent floating zone method
- Investigated novel electron spin mediated thermal transport mechanisms by steady-state measurement, inelastic neutron and Raman scattering
- Discovered ultra-high bulk thermal conductivity of $\sim 1000 \text{ Wm}^{-1}\text{K}^{-1}$ in boron arsenide crystals using steady-state and Raman lock-in methods
- Investigated effect of defects on electrical and thermal transport properties of boron arsenide
- Led a team of 4 students and visiting scholars for crystal growth and characterization

Battery Interface Chemistry: *mastering the interface for all-solid-state lithium batteries*

- Reduced the interfacial resistance by one order of magnitude through the formation of Li-ion conducting passivation layer
- Designed a new electrolyte $\text{LiZr}_2(\text{PO}_4)_3$ with improved high ion conductivity by 50% compared to other oxide electrolytes
- Produced an all-solid-state cell with high coulombic efficiency of 99.5% over 60 cycles
- Collaborated with lithium-ion battery inventor, Prof. John Goodenough

Graduate Research Assistant, UT Austin Sept. 2010—Dec. 2014

Thermoelectric Waste Heat Recovery: *synthesis of low-cost and eco-friendly silicides*

Advisors: Li Shi, Jianshi Zhou

- Developed high-performance semiconducting silicides (90% material cost reduction) for energy conversion between heat and electricity
- Enhanced thermoelectric performance of manganese silicides by 60% through defect engineering
- Discovered grain-size dependence of transport properties in ball-milled silicides
- Designed high-efficiency silicide thermoelectric generators for US Department of Energy
- Diagnosed and solved problems regarding silicides processing and characterization for commercial applications

- Fundamental research on origin of low thermal conductivities of manganese silicide crystals through investigating phonon dispersion and scattering processes

Research Assistant, Zhejiang University

Sept. 2007—Apr. 2010

Nanomaterials Synthesis for Energy Conversion: controlled synthesis of PbTe nanostructures

Advisors: Tiejun Zhu, Xinbing Zhao

- Designed novel PbTe nanostructures with controlled size and shape using wet chemical methods
- Mastered X-ray photoelectron spectroscopy, Infrared spectroscopy, SEM and TEM
- Discovered new growth mechanisms of PbTe nanostructures

AWARDS AND HONORS

- Professional Development Award, The University of Texas at Austin, USA, 2011, 2014
- Outstanding Student Award and First-Class Scholarship, Zhejiang University, China, 2008, 2009
- Graduate with honors, Southeast University, China, 2007
- Outstanding Student Award, Southeast University, China, 2005

PUBLICATIONS AND PRESENTATIONS

- 20 peer-reviewed papers (including **11 first-authored or co-first-authored**) published in *Science*, *PNAS*, *Nature Communications*, *Physical Review Letters*, *Journal of the American Chemical Society*, *Physical Review B (editors' suggestion)*, *Advanced Energy Materials*, and so on

Google Scholar: <https://scholar.google.com/citations?user=hGJg-s0AAAAJ&hl=en>

- **2 invited talks** at University of Connecticut (2017) and The University of California, Riverside (2016)
- 1 poster nominated for **Best Poster Award** at the 2017 Materials Research Society's Spring Meeting

SKILLS

- Product development and improvement of semiconductors, batteries, thermal management materials
- 11 years of experience in Crystal Growth (Bridgman, TSFZ, Cz, flux, CVT, hydrothermal)
- Material characterization and defect analysis (XRD, Laue, Raman, EBSD, AFM, SEM, TEM), physical and chemical properties measurements
- Project leadership in collaboration with 8 international industrial and academic teams

OTHER INFORMATION

- Best goalkeeper in department soccer match, Zhejiang University, China, 2008
- Hobbies: soccer, hiking
- English (full professional proficiency), Chinese (native)
- Peer reviewer of over 10 journals, including *Advanced Materials*, *Nano Energy*, *Physical Review B*, *Applied Physics Letters*, and *ACS Energy Letters*.
- Members of International Thermoelectric Society, Materials Research Society and American Physical Society
- Green card pending, authorized to work in US

PUBLICATION LIST

- (1) F. Tian[#], B. Song[#], **X. Chen[#]**, N. Ravichandran, Y. Lv, K. Chen, S. Sullivan, J. Kim, Y. Zhou, T.H. Liu, M. Goni, Z. Ding, J. Sun, G. G. U. Gamage, H. Sun, H. Ziyadee, S. Huyan, L. Deng, J. Zhou, A. J. Schmidt, S. Chen, C.W. Chu, P. Y Huang, D. Broido, L. Shi, G. Chen, Z.F. Ren, "Unusual High Thermal Conductivity in Boron Arsenide Bulk Crystals," **Science**, 361, 582 (2018)
- (2) **X. Chen[#]**, A. Weathers[#], J. Carrete[#], S. Mukhopadhyay[#], O. Delaire, D. A. Stewart, N. Mingo, S. N. Girard, J. Ma, D. L. Abernathy, J. Yan, R. Sheshka, D. P. Sellan, F. Meng, S. Jin, J. Zhou and L. Shi, "Twisting Phonons in Complex Crystals with quasi-one-dimensional Substructures," **Nat. Commun.**, 6, 6723 (2015)
- (3) **X. Chen**, K. Jarvis, S. Sullivan, Y. T. Li, J. S. Zhou, and L. Shi, "Effects of Grain Boundaries and Defects on Anisotropic Magnon Transport in Textured $\text{Sr}_{14}\text{Cu}_{24}\text{O}_{41}$," **Phys. Rev. B**, 95, 144310 (2017) [selected as **Editors' Suggestion**; featured in **PRB Kaleidoscopes**]
- (4) **X. Chen**, D. Bansal, S. Sullivan, D. L. Abernathy, A. A. Aczel, J. S. Zhou, O. Delaire, and L. Shi, "Weak Coupling of Pseudoacoustic Phonons and Magnon Dynamics in the Incommensurate Spin Ladder Compound $\text{Sr}_{14}\text{Cu}_{24}\text{O}_{41}$," **Phys. Rev. B**, 94, 134309 (2016) [selected as **Editors' Suggestion**]
- (5) Y. T. Li[#], W. D. Zhou[#], **X. Chen[#]**, X. J. Lv, Z. M. Cui, S. Xin, L. G. Xue, Q. X. Jia, J. B. Goodenough, "Mastering the Interface for Advanced all-solid-state Lithium Rechargeable Batteries," **Proc. Natl. Acad. Sci. USA**, 113, 13313, (2016)
- (6) **X. Chen**, S. Girard, F. Meng, E. Lara-Cruzio, S. Jin, J. B. Goodenough, J. S. Zhou and L. Shi, "Approaching the Minimum Thermal Conductivity in Rhenium-substituted Higher Manganese Silicides," **Adv. Energy Mater.**, 4, 14, 1400452 (2014)
- (7) Y.T. Li, **X. Chen**, A. Dolocan, Z. Cui, S. Xin, L. Xue, H. Xu, K. Park, and J. B. Goodenough, "Garnet Electrolyte with an Ultralow Interfacial Resistance for Li-Metal Batteries," **J. Am. Chem. Soc.**, 140, 6448 (2018)
- (8) J. Xing, **X. Chen**, Y. Zhou, J.C. Culbertson, J. A. Freitas Jr., E. R. Glaser, J.S. Zhou, L. Shi, N. Ni, "Multimillimeter-sized Cubic Boron Arsenide Grown by Chemical Vapor Transport via a Tellurium Tetraiodide Transport Agent," **Appl. Phys. Lett.**, 112, 261901 (2018)
- (9) H. Man, Z. Shi, G. Xu, Y. Xu, **X. Chen**, S. Sullivan, J. S. Zhou, K. Xia, J. Shi, and P. C. Dai, "Direct Observation of Magnon-phonon Coupling in Yttrium Iron Garnet," **Phys. Rev. B Rapid Communication**, 96, 100406 (R) (2017) [selected as **Editors' Suggestion**]
- (10) K. An, K. S. Olsson, A. Weathers, S. Sullivan, **X. Chen**, X. Li, L. G. Marshall, X. Ma, N. Klimovich, J. S. Zhou, L. Shi, and X.Q. Li, "Magnons and Phonons Optically Driven out of Local Equilibrium in a Magnetic Insulator," **Phys. Rev. Lett.**, 117, 107202 (2016)
- (11) L. B. Zhang, **X. Chen**, Y. L. Tang, L. Shi, G. J. Snyder, J. B. Goodenough and J. S. Zhou, "Thermal Stability of $\text{Mg}_2\text{Si}_{0.4}\text{Sn}_{0.6}$ in Inert Gases and atomic-layer-deposited Al_2O_3 Thin Film as a Protective Coating," **J. Mater. Chem. A** 4, 17726 (2016)
- (12) **X. Chen**, J. S. Zhou, J. B. Goodenough and L. Shi, "Enhanced Thermoelectric Power Factor of Re-substituted Higher Manganese Silicides with Small Islands of MnSi Secondary Phase," **J. Mater. Chem. C**, 3, 10500 (2015) (Invited for 'themed issue on the chemistry of thermoelectric materials')
- (13) **X. Chen**, L. Shi, J. S. Zhou and J. B. Goodenough, "Effects of Ball Milling on Microstructures and Thermoelectric Properties of Higher Manganese Silicides," **J. Alloys Compd.**, 641,30 (2015)
- (14) S. N. Girard, **X. Chen**, F. Meng, A. Pokhrel, J. Zhou, L. Shi, and S. Jin, "Thermoelectric

Properties of Undoped High Purity Higher Manganese Silicides Grown by Chemical Vapor Transport," **Chem. Mater.**, 26, 5097 (2014)

- (15) **X. Chen**, A. Weathers, D. Salta, L. B. Zhang, J. S. Zhou, J. B. Goodenough and L. Shi, "Effects of (Al,Ge)-double Doping on the Thermoelectric Properties of Higher Manganese Silicides," **J. Appl. Phys.**, 114, 173705 (2013)
- (16) **X. Chen**, A. Weathers, A. Moore, J. S. Zhou and L. Shi, "Thermoelectric Properties of Cold-Pressed Higher Manganese Silicides for Waste Heat Recovery," **J. Electron. Mater.**, 41, 1564 (2012)
- (17) T. J. Zhu, **X. Chen**, X. Y. Meng, X. B. Zhao and J. He, "Anisotropic Growth of Cubic PbTe Nanoparticles to Nanosheets: Controlled Synthesis and Growth Mechanisms," **Cryst. Growth Des.**, 10, 3727 (2010)
- (18) **X. Chen**, T. J. Zhu and X. B. Zhao, "Synthesis and Growth Mechanism of Rough PbTe Polycrystalline Thermoelectric Nanorods," **J. Cryst. Growth**, 311, 3179 (2009)
- (19) T. J. Zhu, **X. Chen**, Y. Q. Cao and X. B. Zhao, "Controllable Synthesis and Shape Evolution of PbTe 3D Hierarchical Superstructures via an Alkaline Hydrothermal Method," **J. Phys. Chem. C**, 113, 8085 (2009)
- (20) T. J. Zhu, S. H. Yang, **X. Chen**, X. X. Liu, X. B. Zhao, L. Lu, M. O. Lai, "Step-flow Growth of Heteroepitaxial SrRuO₃ Thin Films on 0.04° SrTiO₃ (001) Vicinal Substrates," **Funct. Mater. Lett.**, 1, 253 (2008)

[#]contributed equally