Qichen Song

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Research Interest I am interested in the fundamental study of charge and energy transport in heterostructures for efficient electronic devices and quantum computing. I am also interested in understanding the thermal transport in novel inorganic materials for energy applications.

Education and Experiences

Harvard University Jan. 2022 - present
Harvard Quantum Initiative Postdoctoral Fellow in
Department of Chemistry and Chemical Biology

Massachusetts Institute of Technology Sept. 2015 - Jan. 2022
Ph.D. in Mechanical Engineering, Jan. 2022
Phonon and electron transport through interfaces and disordered structures
Science Master in Mechanical Engineering, Feb. 2018

Huazhong University of Science and Technology Sept. 2011 - Jun. 2015
Bachelor of Engineering in Thermal Energy and Power Engineering

Courses

MechE (major): Advanced fluid mechanics, General thermodynamics, Advanced heat & mass transfer, Nano-to-macro transport processes (TA)
Physics (minor): Theory of solids II, Relativistic quantum field theory I, Relativistic quantum field theory II, Statistical mechanics I, Statistical mechanics II
EECS: Applied quantum & statistical physics, Physics for solid-state applications, Principles & applications of quantum optics
MSE: Atomistic computer modeling of materials
Math: Mathematical methods in nanophotonics, Computational science & engineering I

Awards

Harvard Quantum Initiative Postdoctoral Prize	2022 - 2024
Kaufman Teaching Certificate Program	2020
Warren M. Rohsenow Fellowship	2015 - 2016
National Scholarship (three times)	2012 & 2013 & 2014

Publications

Q.C. Song, R. Pan, J. Shin, A. Schmidt, H. Lu, A. Henry and G. Chen, 'Observation of Anderson localization of phonons at moderate temperatures', **2022**, *in preparation*

C.A. Garde[#], X.X Yan[#], **Q.C. Song**, J. Li, L. Gu, T. Aoki, S-W Lee, G. Chen, R.Q. Wu, X.Q. Pan, 'Nanoscale imaging of phonon dynamics by electron microscopy', *Nature*, **2022**, 606, 292297

Q.C. Song and G. Chen, 'Significant reduction in semiconductor interface resistance via interfacial atomic mixing', *Phys. Rev. B*, **2022**, 105, 195306

L. Zhang, Y. Zhong, X. Qian, **Q.C. Song**, J. Zhou, L. Li, L. Guo, G. Chen, and E. N. Wang, Toward optimal heat transfer of 2D–3D heterostructures via van der Waals binding effects, *ACS Appl. Mater. Interfaces*, **2021**, 13, 38,

Q.C. Song and G. Chen, 'Evaluation of diffuse mismatch model for phonon scattering at disordered interfaces', *Phys. Rev. B*, **2021**, 104, 085310.

T. Nguyen, N. Andrejevic, H.C. Po, **Q.C. Song**, *et al.* M. Li, Signature of many-body localization of phonons in strongly disordered superlattices, *Nano Lett.*, **2021**, 17, 74197425

H.Z. Wang, Z.P. Yao, W.S. Leong, G. S. Jung, **Q.C. Song**, M. Hempel, T. Palacios, G. Chen, M. J. Buehler, A. Aspuru-Guzik, J. Kong 'Frank-van der Merwe Growth in Bilayer Graphene', *Matter*, **2021**, 4, 10, 3339-3353.

W. Ren, **Q.C. Song**, H. Zhu, J. Mao, L. You, G.A. Gamage, J. Zhou, T. Zhou, J. Jiang, C. Wang, J. Luo, J. Wu, Z. Wang, G. Chen, Z.F. Ren, 'Intermediate-level doping strategy to simultaneously optimize power factor and phonon thermal conductivity for improving thermoelectric figure of merit', *Material Today Physics*, **2020**, 15, 100250

Q.Y. Lu, S. Huberman, H.T. Zhang, **Q.C. Song**, J.Y. Wang, G. Vardar, A. Hunt, I. Waluyo, G. Chen and B. Yildiz, 'Bi-directional tuning of thermal transport in $SrCoO_x$ with electrochemically induced phase transitions', *Nat. Mater.*, **2020** 1, 8

K. Chen, B. Song, N.K. Ravichandran, Q.Y. Zheng, X. Chen, H. Lee, H.R. Sun, S. Li, G. A. Gamage, F. Tian, Z.W. Ding, **Q.C. Song**, A. Rai, H.L Wu, P. Koirala, A.J. Schmidt, K. Watanabe, B. Lv, Z.F. Ren, L. Shi, D. G. Cahill, T. Taniguchi, D. Broido and G. Chen, 'Ultrahigh thermal conductivity in isotope-enriched cubic boron nitride', *Science*, **2020**, 367, 6477

H.T. Zhu, J. Mao, Y. Li, J.F. Sun, Y.M. Wang, Q. Zhu, G.N. Li, **Q.C. Song**, J.W. Zhou, Y.H. Fu, R. He, T. Tong, Z.H. Liu, W.Y. Ren, L. You, Z.M. Wang, J. Luo, A. Sotnikov, J.M. Bao, K. Nielsch, G. Chen, D. J. Singh and Z.F. Ren, 'Discovery of TaFeSb-based half-Heuslers with high thermoelectric performance', *Nat. Commun.*, **2019**, 10, 270

Q. Zhang, **Q.C. Song**, X.Y. Wang, J.Y. Sun, Q. Zhu, K. Dahal, X. Lin, F. Cao, J.W. Zhou, S. Chen, G. Chen, Z.F. Ren, 'Functionally graded doping for High Thermoelectric Efficiency', *Energy & Environmental Science*, **2018**, 11 (4), 933-940.

J.W. Zhou, H.T. Zhu, T.H. Liu, **Q.C. Song**, R. He, J. Mao , Z.H. Liu, W.Y Ren, B. Liao, D. J. Singh, Z.F. Ren, G. Chen, 'The origin of large thermoelectric power factors in half- Heusler systems',*Nat. Commun* **2018**, 9, 1721

T.H. Liu , J.W. Zhou , M.D. Li , Z.W. Ding , **Q.C. Song** , B. Liao , L. Fu, G. Chen, 'Electron Mean-Free-Path Filtering in Dirac Material for Improved Thermoelectric Performance', *Proc. Natl. Acad. Sci.*, **2018**, 115 (5), 879-884.

M.D. Li[#], **Q.C Song**[#], W.W. Zhao, J. A. Garlow, T.H. Liu, L.J. Wu, Y.M. Zhu, J.S. Moodera, M. H. W. Chan, G. Chen, and C-Z Chang, 'Dirac-electron-mediated magnetic proximity effect in topological insulator/magnetic insulator heterostructures' , *Phys. Rev. B: Rapid Communications*, **2017**, 96, 201301.

Q.C. Song, T.H. Liu, J.W. Zhou, Z.W. Ding, G. Chen, '*Ab initio* study of electron mean free paths and thermoelectric properties of lead telluride', *Material Today Physics*, **2017**, 2, 69-77.

M. An, **Q.C. Song**, X.X. Yu, Z.L. Jin, D.K. Ma, B.L. Huang, N. Yang, 'Generalized two-temperature model for coupled phonons', *Nano Lett.*, **2017**, 17 (9), 5805-5810.

M.D. Li, **Q.C. Song**, T.H. Liu, L. Meroueh, G.D. Mahan, M.S. Dresselhaus, G. Chen, 'Tailoring superconductivity with quantum dislocations', *Nano Lett.*, **2017**, 17 (8), 4604-4610.

Q.C. Song, J.W. Zhou, L. Meroueh, D. Broido, Z.F. Ren, G. Chen, 'The effect of shallow vs. deep level doping on the performance of thermoelectric materials', *Appl. Phys. Lett.*, **2016**, 109, 263902.

Q.C. Song[#], M. An[#], X.D. Chen, Z. Peng, J.F. Zang, N. Yang, 'The adjustable thermal resistor by reversibly folding a graphene sheet', *Nanoscale*, **2016**, 8, 14943-14949.

Presentations

Probing local heating and cooling at interfaces: a non-equilibrium Green's function study, APS March meeting, 2018, Los Angeles, California

Ab initio study of electron transport in lead telluride, APS March meeting, 2017, New Orleans, Louisiana

Services Journal reviewer for PRL, Nano Lett., Adv. Mater., Joule

Computer Skills Python, Qiskit, MATLAB, LaTeX, FORTRAN, C++

References

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