

# Qichen Song

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**Research Interest** My research interests lie primarily in energy transport in nanostructured semiconductors using optical spectroscopy such as transient thermal grating (TTG) and frequency-domain thermoreflectance (FDTR), and nonequilibrium Green's function (NEGF) calculations.

**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<sup>#</sup>, X.X Yan<sup>#</sup>, **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', **2022**, accepted by *Nature*

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

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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<sub>x</sub> 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<sup>#</sup>, **Q.C. Song**<sup>#</sup>, 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**<sup>#</sup>, M. An<sup>#</sup>, 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, L<sup>A</sup>T<sub>E</sub>X, FORTRAN, C++

**References** Gang Chen      Asegun Henry      Mingda Li      Jarad Mason  
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