Qichen Song

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Research Interest My research interests lie primarily in electron and phonon 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

Massachusetts Institute of Technology 2015 - present
Ph.D. in Mechanical Engineering, expected in Dec. 2021
Science Master in Mechanical Engineering, Feb. 2018

Huazhong University of Science and Technology 2011 - 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

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', *in preparation*, **2022**

Q.C. Song and G. Chen, 'Nonspecular electron transmission leads to drastically reduced contact resistance between dissimilar semiconductors', *to be submitted to PRB*, **2021**

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

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 interface reflected phonons by electron microscopy', **2021**, *in review with Nature*

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

C. Liu, **Q.C. Song**, J.N. Chen, X.H. Li, J.X. Cai, Z.G. Lu, W.D. Li, N.X. Fang, S-P Feng, 'Electromagnetic and Chemical Enhancements of Surface-Enhanced Raman Scattering Spectra from Cu_2O Hexagonal Nanoplates', *Adv. Mater. Interfaces*, **2019**, 6, 17, 1900534

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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