

Exploring Thermal Phonon Transport  
from Atomic to Macroscopic Scales for Energy  
Conversion and Management

Thesis by  
Chengyun Hua

In Partial Fulfillment of the Requirements for the  
degree of  
Doctor of Philosophy

**Caltech**

CALIFORNIA INSTITUTE OF TECHNOLOGY  
Pasadena, California

2016  
Defended May 18, 2016



## ACKNOWLEDGEMENTS

First and foremost, I wish to express my genuine gratitude to my advisor, Professor Austin Minnich. His support and guidance throughout my stay at Caltech has had a profound influence on my development, both academic and personal. His passion for science, his creativity, and his critical thinking were a source of inspiration, motivation, and momentum that steered my research towards very interesting directions. I appreciated the freedom and independence he gave me to pursue my own ideas as well as the valuable suggestions and encouragement when needed. I consider myself fortunate to have had a mentor who dedicates so much time and attention to his students and hope to one day be able to emulate his example.

I thank Professors Melany Hunt, Guillaume Blanquart, and Brent Fultz, who, in addition to forming my thesis committee, have contributed many useful comments to this work. I appreciated their insightful suggestions on my research, which played a key role in the successful completion of my PhD work; I thank them for contributions to my career development, which will help me continue to thrive after Caltech. I also want to thank my undergraduate advisor Professor Eric Johnsen at the University of Michigan for introducing me to the fascinating world of science.

I wish to acknowledge the former and contemporary members of Minnich Lab, especially Dr. Xiangwen Chen and Navaneetha Krishnan Ravichandran, for all sorts of invaluable help they offered, insightful discussion over various research topics, and constructive critiques on my practice talks. I also want to thank the wonderful MCE (Cheryl Geer, Sonya Lincoln, and Maria Koeper) and ISP staff (Laura Flower Kim and Daniel Yoder) for always being available for assistance.

Caltech is not just about science and research. It is a place to discover talents, find passion as well as cultivate friendship. Without my friends, life at Caltech would have been far less colorful. I thank the fellows from my class Brandon Runnels, Lucas Meza, Brock Bobbit, and Hyun-Sik Kim for sharing the pains and joys inside and outside the classroom. I am also really grateful to have good friends like Nick Dou, Jackie Villadsen (and her cat Snug), Sunita Darbe, Sam Johnson, Esperanza Linares-Guerrero, Andres Goza, and Tess Saxton-Fox, who have shared with me the happiness and accompanied me through the difficulties. I particularly want to thank my dear friend Andrew Robbins for the enormous amount of time we spent in the office discussing research or simply procrastinating as well as all the outdoor

adventures we did together.

Finally, I want to thank my Mom and Dad, who have unconditionally supported me while I am chasing my dreams on the other side of the globe. Without their support, I would not have been able to make my way to Caltech.

Caltech is a truly amazing place. I was able to learn from the world-class scientists and engineers, work with the brightest minds, and have all sorts of adventures with the most wonderful people. I will forever cherish the memory of my life at Caltech.