Statement of Purpose

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My undergraduate study and research experience opened the door to the amazing nano world for me and stimulated my interest in research. I enjoy the process of solving challenging problems by innovative thinking and the PhD program will offer me a great chance to pursue my interests.

I am desirous to conduct research on nanoscale thermal transport, especially on phonon transport and phonon manipulation during my PhD studies. Innovative nanostructured materials have attracted extensive scientific interest due to their unique thermal properties. For traditional bulk materials, we cannot alter their thermal properties significantly. But at nanoscale, we can modulate the thermal properties of materials as we want. Nanomaterials actually give us a far better chance to produce next generation of thermoelectric devices to resolve energy shortage problems. Current energy conversion efficiency of these devices is not satisfying for commercial uses due to the lack of a detailed understanding of thermal transport in nanostructures. Thus I believe my research will help to bring us closer to that bright future.

My undergraduate study strengthened my skills and knowledge to study thermal transport. My major courses such as thermodynamics (91/100), heat transfer (96/100) and fluid dynamics (99/100) helped me to understand basic rules and principles of energy conversion and thermal management. Meanwhile, I acquired solid skills in coding for high precision scientific computation from the course of numerical methods (100/100) and C++ programming design (95/100). In Nano Heat Group led by Prof. Nuo Yang, I obtained further knowledge of mechanism of nanoscale thermal transport.

My research experience in Nano Heat Group taught me how to implement ideas in my mind via programming and helped me develop my ability of creating unique and optimal solutions by independent thinking. I focused on finding ways to reduce thermal conductivity of graphene for its potential thermoelectric application. Folding has been proved to be a useful way to manipulate the thermal conductivity of graphene nanoribbon. However, given that there exists a strong size effect on thermal conductivity of graphene, the large-area folded graphene may be a different case and thus should be investigated. I successfully applied my own FORTRAN program to set atom's initial position, initial velocity distribution and atom reciprocal potentials explicitly and reasonably. Challenging was that computers cannot deal with some cases of extremely large simulation scale. I subtly optimized the code to accelerate the computing process and solved this issue successfully. And my results show that thermal conductivity decreases significantly with increasing number of folds and stronger substrate effect, presumably caused by the enhanced phonon scattering. This proves that even for large-area graphene with folds, folding still greatly contributes to reducing the thermal conductivity. This work is being enriched and will be published soon. From this work, I leaned every detail of MD simulation and gained great pleasure from integrating my thoughts and efforts into efficient solutions.

Besides, capability of collaboration helped me more prepared for my future research. In the research on coupling between different phonon modes in graphene, doctoral candidate Meng An came up with theory model and I built the simulation model to verify its validity. Then we discussed how to modify the model based on simulation results. We did this feedback process time after time for months to make sure we finally obtained an appropriate model that can rationally quantify coupling strength. We kept doing double-check of each other's work to prevent mistakes. It was teamwork that inspired me constantly and promoted the research greatly.

With my strong background, I believe I am well prepared to go to graduate school. I seek advanced knowledge and skills I need from the graduate program to systematically conduct my research. I am looking forward to opportunities to do experiments to study thermal transport directly and verify my simulation work. Among the faculties of Department of Mechanical Science and Engineering at UIUC, Dr. Sanjiv Sinha has done an impressive job on measuring thermal transport across interface and his group did a pioneering research on energy conversion and storage in nanomaterials by a combination of experiments and theory. I will be honored and delighted to work with him. I will definitely keep pursuing my academic career in the area of nanoscale heat transfer after my graduation for I believe that Rome was not built in one day: to convert my expertise into valuable scientific and social contribution, years of continuous effort is a must.