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Editorial: Energy Transport for Nanostructured Materials

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Editorial on the Research Topic

Energy Transport for Nanostructured Materials

As one of the oldest topics in the engineering field, heat transfer has been widely studied for many energy-related applications over the years. Nowadays, new research opportunities are introduced by engineering the thermal transport at the nano- or atomic scale. This Research Topic focuses on some of the most exciting advancements along this line.

At the nanoscale, one focused topic is the interfacial thermal transport. Beyond the conventional acoustic mismatch model and diffuse mismatch model for ideal interfaces, Zhang et al. developed a "mixed mismatch model" to predict the phonon transmissivity by incorporating the roughness/bonding at the interface. Along another line, Xiong et al. reviewed the recent development of one-dimensional atomic junction model to address the thermal transport across an interface. A better understanding of the interfacial phonon transport can be critical to the thermal studies of nanostructured materials. For Si/Ge multilayered films, Ran et al. computed the phonon transport using an efficient Monte Carlo scheme with spectral phonon transmissivity. In practice, Hao et al. employed the grain-boundary thermal resistance and point inter-grain contacts to further reduce the thermal conductivity of bulk $GeSe_4$ for thermal insulation applications.

Besides interfacial phonon transport, other aspects of thermal transport can also attract attention. In addition to the linear Fourier's law of thermal conduction, Zhu et al. introduced non-linear thermal radiation following Stefan-Boltzmann law to asymmetric holey composites to realize the thermal rectifier. Li et al. demonstrated a ultra-broadband selective absorber with a hierarchical structure. A better understanding of phonon transport within a bulk material can be guided by simulations. Chen et al. revisited the thermal transport within type-I clathrate Ba_8Si_{46} by iteratively solving Peierls-Boltzmann transport equation with first-principles interatomic force constants. Their study provided fundamental physical insights into the impacts of rattlers on the lattice thermal conductivity of clathrates.

In short, the rapid development of nanotechnology has introduced unprecedented opportunities in advancing the current research of nanoscale heat transport. This Research Topic has shown the rich physics of this still vibrant research field. More interesting results are anticipated in the future.

AUTHOR CONTRIBUTIONS

QH drafted the editorial. NY helped to revise it. NL and XR read the editorial.

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