工学系研究科専攻間横断型教育プログラム
「機械システム・イノベーション」

最先端融合科学イノベーション
教育研究コンソーシアム

東京大学 THE UNIVERSITY OF TOKYO

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Nano engineering Heat Conduction for Energy Harvesting and Storage Applications

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Materials with length scales on the order of few nanometers exhibit unique abilities to control thermal transport. Understanding the transport properties of heat carriers namely phonons at atomistic levels will enable us to design better materials for thermal energy conversion and storage applications. Tailoring the thermal properties of such systems using nanostructures have a promising application in the field of thermoelectrics, microelectronic cooling and thermal energy storage. In my talk I discuss the implications of utilizing nanomaterials for energy applications.

As a first example, I demonstrate a novel technique using high-pressure torsion (HPT) to create a high density of lattice defects on nanometer length-scales in semiconductor materials such as silicon, germanium and silicon germanium alloys. Based on ultrafast pico-second pump-probe measurements of thermal transport, I demonstrate a dramatic reduction in the thermal conductivity of bulk crystalline silicon when subjected to pressure induced phase transitions at 24 GPa using HPT. I discuss the potential mechanisms behind the dramatic reduction in thermal conduction using several microscopic and spectroscopic characterization techniques.

In an opposite example, I discuss how controlled dispersion of nano carbon materials especially single-walled carbon nanotubes, carbon nanohorns and graphene enhances the thermal transport of thermal storage materials. Based on freezing experiments, I show a novel way to tune the thermal and electrical transport of crystalline organic phase change materials (PCMs) which is often employed for thermal energy storage applications. Based on computational fluid dynamics calculations, I demonstrate the potential benefits and limitations of such nanocomposites in the thermal energy systems and discuss the importance of interfacial thermal properties.

主催：　東京大学大学院工学系研究科「機械システム・イノベーション」プログラム（GMSI）
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