**Thermal Nanophotonics in Functional Metamaterials**

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The fascinating nature of photonic nanomaterials has opened the door to novel approaches for conducting research in the field of energy conversion, storage and cooling technology. The ability to control thermal conductive and radiative properties of objects is of great interest in diverse areas like solar and thermophotovoltaic energy conversion, wavelength selective reflection and thermal emission/absorption, passive radiative cooling, and camouflage in military applications. Thermal transport of nanoengineered materials gets enhanced dramatically in comparison to their bulk counterparts. Nanoscale thermal radiative features of metamaterials can be significantly different from classical or macroscopic properties since near-field effects and metasurfaces play significant roles.

Nanoscale thermal transport has shown great potential applications for use in manipulating macroscale energy systems and thermal and optical sensing. This talk will mainly focus on small-scale energy transport due to the metamaterial-mediated surface polaritons through the following research projects: (1) A dyadic Green's function formalism has been developed to determine the roles of multi-species nanoparticle inclusions in thermal radiative property; (2) Mie-resonance and metal-insulator-metal high-temperature insensitive metamaterials have been studied and designed for particular broad/narrow-band wavelength selective thermal emitters/absorbers in order to increase energy conversion efficiency in solar energy harvesting; (3) Non-contact-mode near-field enhanced thermal diodes and transistors have been investigated using phase-change and reconfigurable metamaterials; (4) Functional composite materials and structures have been experimentally proposed for high-efficient solar-driven water desalination and passive radiative cooling.