



THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY  
DEPARTMENT OF ELECTRONIC AND COMPUTER ENGINEERING  
AND  
IEEE LEOS (HONG KONG CHAPTER)

**Manipulation of Thermal Radiation Using Nano-photonic Devices**

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**Abstract**

With the advancement of nano-technology, manipulation of heat in nano-scale has become very important. Most of the researches consider heat transfer as a diffusion process of phonons or electrons. In this talk, we will focus on heat in the form of electromagnetic waves, and see how nano-photonic devices can be used to control the (i) transport, and (ii) emission of heat based on various wave phenomena.

First, we will take a multi-layer photonic crystal as the thermal-conducting medium. The crystal is composed of alternate layers of lossless dielectric slabs and vacuum such that heat is conducted only by photons. Two opposing mechanisms, evanescent tunneling of photons, and the effect of photonic band gaps, would alternatively enhance or suppress the thermal conductance of the medium. By merely tuning the size of the vacuum spacing, we can control the relative dominance of these two mechanisms, and the medium can thus be tuned from being thermally more conducting, to thermally more insulating, as compared to vacuum.

Next, we will examine the effects of wave evanescence and resonance on the properties of emitted thermal fields. We consider a lossy dielectric slab as the thermal source. At the near-field regime closed to the slab surface, the spectrum of energy density shows significant deviations from typical emission spectrum of gray bodies at far field: It would exceed the blackbody value at extremely long wavelengths where evanescent waves dominate. Also at wavelengths comparable to the slab thickness, due to excitation of multiple waveguide modes, resonance fringes can be observed. We will briefly discuss how these phenomena can be exploited to control near-field radiative transfer, and to realize a thermal antenna.

**Biography**

Wah Tung Lau is currently a PhD student in the Department of Electrical Engineering at Stanford University, under the supervision of Professor Shanhui Fan. His research focuses on theoretical and computational nanophotonics, with emphasis on the manipulation of thermal radiation using photonic crystals or other nano-photonic structures. He received his BENG degree in the Department of Electrical and Electronic Engineering at the University of Hong Kong. Then he went to Stanford University, where he had also attained a MS degree in Electrical Engineering, and a PhD minor degree in Physics.

**Date : 18 August 2008 (Monday)**  
**Time : 11:00 – 12:00 noon**  
**Venue : Rm 2463 (lift 25, 26), 2/F,**  
**Academic Complex, HKUST**

**~ ALL ARE WELCOME ~**