

PURDUE MECHANICAL ENGINEERING



Dr. Zhuomin Zhang

Professor

George W. Woodruff School of Mechanical Engineering
Georgia Institute of Technology

Thursday October 19, 2017
4:30pm, WALC 1055 (Hiler Theatre)

Controlling Far-Field and Near-Field Thermal Radiation with 2D Materials

Abstract: Micro/nanoscale thermal radiation has attracted great attention due to the promising applications in energy harvesting, nanomanufacturing, thermal control and management, and high-resolution thermal mapping. In the near field, radiative heat transfer between closely spaced objects can be greatly enhanced. Furthermore, the interaction of electromagnetic waves with micro/nanostructured materials can potentially modify their far-field radiative properties. Recent advances in graphene and other two-dimensional (2D) materials offer enormous potential to transform current microelectronic, optoelectronic, photonic devices, as well as energy systems. As a layered 2D material with carbon atoms arranged in a honeycomb lattice, graphene has unique electronic, thermal, mechanical, and optical properties. Exotic radiative properties and near-field enhancement can be enabled by graphene-covered micro/nanostructures, including perfect absorption, blocking assisted transmission, and enhanced near-field radiative transfer. As a natural hyperbolic material, hexagonal boron nitride (hBN) can support multiple orders of phonon-polariton waveguide modes in its two infrared Reststrahlen bands. We have theoretically demonstrated that hybrid graphene-hBN-film heterostructures can significantly augment photon tunneling. Furthermore, hBN-covered metal-gratings and gratings made of hBN exhibit unique radiative properties for the spectral and directional control of thermal radiation. These theoretical works will be presented in this talk, along with a discussion on the design and progress in the experiments to be performed in order to realize the potential of using 2D materials for controlling thermal radiation in both the near- and far-field regimes.

Bio: Professor Zhuomin Zhang earned a Ph.D. degree from MIT and worked at NIST and University of Florida prior to joining Georgia Tech, where he currently is a professor in mechanical engineering. He received his B.S. and M.S. degrees from the University of Science and Technology of China (Hefei). He is a Fellow of the AAAS, AMSE, and APS. Professor Zhang's research interests are in micro/nanoscale heat transfer, especially thermal radiation for energy conversion and temperature measurement. He has written a book on *Nano/Microscale Heat Transfer*, co-authored over 170 journal papers, and given over 300 invited and contributed presentations. His former students have established independent careers at major universities or industry in the United States, China (mainland and Taiwan) and South Korea. In addition, Professor Zhang has supervised many visiting scholars, postdoctoral fellows and undergraduate student researchers. He currently serves as an associate editor of the *Journal of Heat Transfer* and *Journal of Quantitative Spectroscopy & Radiative Transfer*. He served as the Program Chair of the *ASME 3rd Micro/Nanoscale Heat & Mass Transfer International Conference* (Atlanta, March 2012), Chair of the *2nd International Workshop on Nano-Micro Thermal Radiation* (Shanghai, June 2014), and General Chair for the *ASME 5th Micro/Nanoscale Heat & Mass Transfer International Conference* (Singapore, January 2016). Professor Zhang was a recipient of the 1999 Presidential Early Career Award for Scientists and Engineers (PECASE) and the 2015 ASME Heat Transfer Memorial Award (in the Science category). He has also won a number of teaching, research, and best paper awards.

Reception @ 4:00 p.m. – Faculty/Staff Lounge (ME 2052) in Mechanical Engineering Building

GRADUATE SEMINAR SERIES: ME 691