PURDUE MECHANICAL ENGINEERING

2014 HAWKINS MEMORIAL LECTURE

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Palaiseau, France

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4:30pm, ME 1061

Heat Transfer at the Nanoscale

Abstract:

The usual macroscopic concepts used to deal with energy transfer are no longer valid at the nanoscale. Using two examples, I will show that the nature of heat transfer changes as the size of the systems becomes smaller than some relevant length scales. Fourier law is no longer valid at small distances, the radiative heat flux between two parallel surfaces can be orders of magnitude larger than $s(T_1^4-T_2^4)$, an incandescent source can be monochromatic, it is possible to use visible light to heat spots as tiny as 50 nm. Studying these systems requires to revisit the usual concepts. It is also a formidable opportunity for novel technologies. I will give a brief survey of recent advances in heat transfer at the nanoscale with a particular emphasis on radiative heat transfer and some illustrations and practical applications.

In the second part of the talk, I would like to share some thoughts about innovation. Our society is facing tremendous challenges regarding energy. It is the responsibility of scholars to train creative engineers that will be able to address these issues by introducing disruptive technologies. Although I am not aware of any general recipe to develop creativity, I believe that it is possible to get inspiration from experience.

Bio:

Jean-Jacques Greffet is a professor at Institut d'Optique and a senior member of the Institut Universitaire de France. He is director of the Doctoral school of Physics of Université Paris-Saclay. He is an alumni of Ecole Normale Supérieure de Cachan (1979-82). He received his PhD from the University Paris-Sud Orsay in 1988 in solid state physics and the Habilitation in 1992. Jean-Jacques Greffet was a professor at Ecole Centrale Paris between 1994 and 2008. He has made a number of contributions in light scattering and radiative properties of opaque random systems. Between 1994 and 2005, he worked on the theory of image formation in near-field microscopy. Since 1998, he made a number of contributions in the field of thermal radiation at the nanoscale including the demonstration of coherent thermal sources and the prediction of enhanced heat transfer at the nanoscale between dielectric surfaces. His current research interests include nanophotonics (nanoantennas, quantum plasmonics) and the design of smart IR incandescent sources. He has coauthored 160 refereed papers with more than 5000 citations.

Reception @ 4:00 p.m. – Mechanical Engineering Building, Railside Station

GRADUATE SEMINAR SERIES: ME 691