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Department of Mechanical Engineering
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"Nanoscale Radiation Transport in Emerging Bio-Applications"

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Abstract

In this talk, I will briefly introduce the two research topics conducted by our group at Rutgers University-New Brunswick: (1) modeling of radiation transport at the ultrashort time scale with potential applications of ultrafast lasers in biomedical imaging and welding; and (2) radiation transport in nanostructured optical microcavities used for biomolecular probing. In the first topic, we will emphasize on the modeling of ultrashort-pulsed laser radiation propagation in turbid biological tissues, the associated hyperbolic phenomena of heat conduction, and the concept of a new method of optical tomography for imaging of breast tumors. In the second topic, we will discuss the nanoscale gap effects on whispering-gallery mode (WGM) optical microresonances and the design and nanofabrication of WGM-based microsensors. WGMs describe resonant electromagnetic modes of photons that circulate in well-defined trajectories inside a microcavity. Photon tunneling between the cavity and light-delivery coupler is strongly dependent on the gap dimension. Under resonance, an enhanced radiation field exists inward the periphery of the cavity. A very strong evanescent field will then arise. Its strength decays exponentially with increasing distance from the surface up to the order of the optical wavelength involved. This evanescent field will certainly interact with target biomolecules adsorbed or covalently attached to the microcavity. Since WGMs are morphology-dependent, this molecule-radiation interaction will induce a change in the WGM resonant frequencies. In other words, a shift or broadening (narrowing) or intensity change in the resonances signifies an altered WGM microcavity environment.

About the Speaker

Zhixiong Guo is an Assistant Professor of Mechanical and Aerospace Engineering at Rutgers University-New Brunswick since joining in 2001. He received his B.S., M.S., and Doctorate, all in Engineering Physics, from Tsinghua University, Beijing, in 1989, 1991 and 1995, respectively. Then he worked as a Research Fellow in Korean Advanced Institute of Science and Technology (South Korea, 95-96) and a Research Associate in Tohoku University (Japan, 96-99). From 1999 to 2001, he worked as a Research Staff Member in Polytechnic University (a.k.a. Brooklyn Poly), NY, where he completed his Ph.D. in Mechanical Engineering in the same time period. His research interests include radiation-matter interactions at the nanoscale, laser applications in biology and medicine, and microscale heat transfer. Currently he is focusing on integrating nanophotonics with biotechnology, and conducting emerging technological applications such as MEMS/NEMS sensors, biomedical imaging and sensing at the molecular level. His research is funded by the NSF, NASA (through two NJSGC Industry-University Research Awards), NIH (through an industrial contract), USDA, New Jersey Nanotechnology Consortium, Rutgers University (Academic Excellence Funds Award; Charles and Johanna Busch Memorial Funds Award for Biomedical Research), and other sources. He also received a curriculum development award (2002) from Rutgers Vice President Office for Undergraduate Education. He is the author or co-author of over eighty scientific publications; and an active member in ASME, OSA, and SPIE.