IEEE LEOS and IEAust ITEE College Seminar

IEEE Lasers and Electro-Optics Society and Institute of Engineers Australia Present:

Controlling Light by Photonic Crystals

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Room 210, Building 72

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Abstract:
In this talk, I will describe how photonic crystals (PCs) exhibit exotic characteristics concerning dispersion and confinement, which can not be achieved by conventional optical materials. Using these properties, we can realize enormous degree of freedom in controlling light, which has an impact on physics and applications.

In the first part of the talk, I will describe two aspects of exotic dispersion characteristics of PCs: spatial and frequency dispersions. The former leads to negative refraction, which was first predicted by us in 2000. This interesting phenomenon leads to various unconventional light propagation, such as perfect imaging. I will review also recent experimental studies. The latter leads to ultra-slow light modes. I will demonstrate our recent achievement in slowing down the light by 1/50,000 using PCs.

In the second part, I will describe how strongly we can confine light using PCs. I show our recent results about ultrahigh-Q PC wavelength-sized nanocavities with Q of over one million.
I also describe various coupled structures based on those ultrahigh-Q nanocavities, such as high-performance coupled-cavity waveguides, doubly-coupled photonic atoms, and their applications.

The third part of this talk will be about dynamic control of nanocavities, I will show our experimental results about all-optical bistable switching operation in Si PC nanocavities, and theoretical design of various logic function circuits (such as flip-flop) based on coupled nanocavities. Finally, I will describe dynamic control of ultrahigh-Q nanocavities within their photon lifetime leads to various interesting and novel optical phenomena, such as adiabatic wavelength conversion, all-optical photon DRAM, and also extremely efficient optical MEMS. All of those are based on long photon lifetime in small structures, namely ultrasmall high-Q cavities and slow-light media realized in PCs.

Biography

Masaya Notomi received his B.E., M.E. and Dr. Eng. degrees in applied physics from University of Tokyo, Japan in 1986, 1988, and 1997, respectively. In 1988, he joined Nippon Telegraph and Telephone Corporation, NTT Optoelectronics Laboratories, Japan. Since then, his research interest has been to control the optical properties of materials and devices by using artificial nanostructures, and engaged in research on semiconductor quantum wires/dots and photonic crystal structures. He is currently a Distinguished Technical Member of NTT Basic Research Laboratories, Japan and a group leader of photonic nanostructure research group. From 1996-1997, he was with Linkoping University, Sweden as a visiting researcher. From 2002, he is also a guest associate professor of Tokyo Institute of Technology, Japan. Dr. Notomi is a member of IEEE LEOS, OSA, the Japan Society of Applied Physics, and the American Physical Society.