총회초청강연 II 2월 12일(목) 17:10 ~ 18:00 지하1층 B114

Wavelength Scale Lasers

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The ability to localize photons into a photonic crystal semiconductor microcavity [1] having wavelength-scale volume and high quality factor enables us to study the cavity quantum electrodynamics in small semiconductor material systems. Photons trained by a high *Q/V* resonant mode could have a narrow spectral line and a well-defined quantum state. And photons out of a wavelength-scale resonator can be collected efficiently by controlling inner symmetries of the resonant cavity. Recent incorporation of quantum dot into PhC microcavity [2] reported meaningful, but limited success. These trials exposed two critical problems clearly. The first issue is that of the spatial and spectral overlaps of two relevant resonances, the cavity resonance and the quantum dot resonance. In order to answer this question, one needs to control the emission wavelength of a quantum dot on the order of nanometer or better. At the same time, this right quantum dot should be placed at the anti-node of the resonant mode with precision on the order of nanometers. The second issue is that of the efficient collection and delivery of valuable photons to customers. This nontrivial issue requires good understanding of photon coupling out of a resonant cavity.

The microfiber-coupled 'reconfigurable' resonator allows the repeatable formation of the cavity's physical position until the quantum dot of 'right' emission spectrum is identified at the 'right' physical position. Efficient out-coupling into the tapered single mode optical fiber follows naturally and easily. In this scheme spatially reconfigurable Gaussian-shaped photonic well [3] is generated by contacting a curved tapered micro-fiber onto a photonic crystal waveguide. We confirm the photon trapping in this re-locatable well by observing lasing action slightly below the corresponding band edge.

In addition, novel sub-nanometer spectral resonant tuning techniques [4] are demonstrated by employing electron-beam-induced nano-dots inside high-Q photonic crystal resonators. Feasibility of nano-printed photonic crystal resonators/lasers will also be discussed.

References

[1] O. Painter *et al.*, *Science* 284, 1819 (1999)
[2] A. Badolato *et al.*, *Science* 20, 1158 (2005)
[3] M. K. Kim *et al.*, *Opt. Express* 15, 17241 (2007).
[4] M. K. Seo *et al.*, *Appl. Phys. Lett.* 90, 171122 (2007)

• Educational Background

1977: Seoul National University, BS in Physics
1979: Korea Advanced Institute of Science and Technology, MS in Physics
1986: University of Arizona, Ph.D in Optical Sciences (Adviser: Hyatt M. Gibbs)

• Employment History

1979-1982: Agency for Defense Development, Researcher
1987-1991: AT&T Bell Laboratories, PostDoc/Member of Technical Staff
1991-present: KAIST, Physics Department, Assistant/Associate/Professor at KAIST

• Awards

1. 2007 IEEE Fellow
2. 2005 Scientist of the Month, MOST
3. 2005 Academic Award, Optical Society of Korea
4. 2004 Best Academic Achievement Award, KAIST
5. 2003 Distinguished Lecturer Award, IEEE/LEOS
6. 2002 Academic Award (Natural Science), The National Academy of Sciences
7. 2001 Best Paper Award, Korean Federation of Science and Technology Societies

• Journal Publication Services

1. Optics Express- Associate Editor
2. Journal of Optical Society of Korea - Editor-In-Chief, 1999-2004
3. Photonics and Nanostructures (Elservier) - Associated Editorial Board Member

• Research Activities:

During his stay at AT&T Bell Laboratories, he pioneered and demonstrated the 850-nm proton-implanted top-emitting VCSELs in 1990 and holds the original patent on this *industrially-accepted* VCSEL. In 1991, he joined the Department of Physics in KAIST and has continued his researches on VCSELs. Recently his main interest lies on photonic band gap laser structures and nano-photonic integrated optical circuits. His laboratory demonstrated various forms of 2D photonic band gap lasers from triangular and rectangular lattices. He received the National Academy of Sciences Award (Natural Science) in 2002 and the *2003 IEEE LEOS Distinguished Lecturer Award*. He was elected as an IEEE Fellow in 2007. He co-authored more than 130 international journal papers related to VCSELs and photonic crystals.

빛의 파장크기의 레이저

Wavelength Scale Lasers

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The ability to localize photons into a photonic crystal semiconductor microcavity [1] having wavelength-scale volume and high quality factor enables us to study the cavity quantum electrodynamics in small semiconductor material systems. Photons trained by a high *Q/V* resonant mode could have a narrow spectral line and a well-defined quantum state. And photons out of a wavelength-scale resonator can be collected efficiently by controlling inner symmetries of the resonant cavity. Recent incorporation of quantum dot into PhC microcavity [2] reported meaningful, but limited success. These trials exposed two critical problems clearly. The first issue is that of the spatial and spectral overlaps of two relevant resonances, the cavity resonance and the quantum dot resonance. In order to answer this question, one needs to control the emission wavelength of a quantum dot on the order of nanometer or better. At the same time, this right quantum dot should be placed at the anti-node of the resonant mode with precision on the order of nanometers. The second issue is that of the efficient collection and delivery of valuable photons to customers. This nontrivial issue requires good understanding of photon coupling out of a resonant cavity.

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References

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