Noninvasive and portable diagnoses for brain and heart disorder using angle-resolved IR spectroscopy based upon 3D concentric multi-quantum resonant version of 2D whispering gallery modes

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Abstract (300 word limit)

Unique angle-resolved coherent (AC) spectral data are presented for the first time, which will be capable of noninvasive and portable diagnoses in real time or delayed sequence for brain and heart disorder, and thus useful for developing angle-resolved coherent tomography (ACT) techniques, suitable for the transparent IR spectral window between water and hemoglobin barriers.

Multi-quantum well active mesas between top and bottom DBR structures, or the photonic quantum ring (PQR) laser can first create 3D AC multimode resonances by virtue of its 3D toroid version of Lord Rayleigh's 2D whispering gallery mode (WGM), giving rise to resonant double helix multiple waves (CW and CCW) inside the toroid as a function of quantized radiation angles.

The PQR laser thresholds are in the micro-ampere range as predicted by a quantum wire-like threshold formula, while the PQR lasers, with active diameters around 20 μm, exhibit 3D spectra of apex-angle-governed concentric blue-shifts in the 20nm range. We can thus extend systematically the PQR's tunable frequency ranges in 20nm steps roughly from 700 to 1,000 nm, available from a group of different PQR chips fabricated with selected semiconductors from GaAs to InGaAs, which covers the major ionic IR spectral window. This is quite different from the non-spectral technique of usual functional near-infrared spectroscopy (fNIRS) being confined to single or few frequencies, thus unable to produce any meaningful ionic spectra, and also different from interference-oriented OCT

We get non-invasive in vivo spectral data with the PQR laser beam incident to the human cortical (frontal lobe) region, by monitoring the spectra with a portable fiber probe in different directions, normal and off-normal, for the backward response through the cortical diffuse paths. The spectra observed for the first time in such a simple manner are surprising with symmetrically distinctive and blueshift features, and the details will be explained.

Recent Publications (minimum 5)

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O. Kwon, " Noninvasive and portable diagnoses for brain and heart disorder: Angle-distinguishable infrared spectroscopy based upon 3D resonant toroid version of whispering gallery modes(Invited)," IEEE Photonics Conf. IPC-2018 Reston,VA, USA(Oct. 2, 2018).



Biography (150 word limit)

O'Dae KWON is Prof. Emer. & Res. Prof. In Elec. Eng. Dept., POSTECH (Pohang University of Sci. & Tech.) Ph.D. 1978 Rice University; 78 - 82 Cornell Univ.;82- 86 Dow Research Center; 7/86 -8/11 POSTECH; 93 - 94 AT&T Bell Lab.; 7/00 - 7/01 UCLA. Also he was on sabbatical leaves ,2006- Korea University; 2007-08 Seoul National University : He received the gold prize of "Scientist of the Year 1997" in Korea. He also received 2006 IEEE NMDC Best Oral paper.
He wrote 2 Phys. Rev. Letts. & over 70 papers (over 30 papers on PQR lasers alone for the last 20 years.)

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Notes/Comments: