Advances in Monolithic Quantum Photonics for Sensing

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This talk will describe a technology that enables the utilization of second order nonlinearities, □(2) in monolithic semiconductors to be used as an optimal tool box for quantum optics. This approach uses dispersion engineering in Bragg reflection waveguides to harness parametric processes to produce non classical sources through down conversion [1-4]. These can also be realized in conjunction with concomitant dispersion and birefringence engineering in active devices such as semiconductor diode lasers [5-9]. On the classical front, the technology enables novel coherent light sources using frequency conversion in a self pumped chip-form factor.

Novel sources for non-classical states of photons in this monolithic platform will be reviewed. These chip-based sources can afford the integration of other devices such as laser pump sources, power and polarization splitters, gates, cavities and much more. This platform essentially offers the capability of transferring current quantum optical setups from the optical table in a lab into a practical realm and even the market place.

Also in this talk, some of the application that utilize the aforementioned sources will be discussed, including monolithic photonics architectures that enable deterministic splitting of entangled states of light will be discussed. In addition, sources for target detection and sensing protocols such as quantum illumination in integrated architectures will be also presented. The attributes of this platform offer unique opportunities in metrology applications where size, power, form-factor and space qualification are important factors.

References

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Amr is a Professor in the department of electrical and computer engineering at the University of Toronto. Prior to his academic career, he held a position at Agilent Technologies, R&D division, in the UK between 2000 and 2004. At Agilent his responsibilities included developing InP-based photonic semiconductor integrated circuits and high-powered submarine-class 980 nm pump lasers. He received his Ph.D. and M.Sc. from the University of Glasgow with a focus on photonic devices and fabrication technologies, in 1999 and 1995 respectively. He received his B.Sc. from Cairo University in 1993, in electronics and telecommunications engineering science. His research interests include photonic device physics and characterization techniques, with emphasis on nonlinear optics in III-V semiconductors; applied optical spectroscopy in III-V optoelectronic devices and materials; III-V fabrication and monolithic integration techniques. Amr has served the community in numerous roles. He has served as Vice President Membership for the IEEE Photonics Society (2008-2010). He is currently the CLEO Program Chair (2018-2020), where he previously served as the chair for the Semiconductor Lasers committee. He also serves as the Technical Program Chair for IPC 2016-2018, where he previously served as the chair for the committees on Semiconductor Lasers, Optical Materials and Metamaterials as well as the committees on Photonic Integration and Packaging. He has served as an associate editor for the Photonics Journal and is currently an associate editor for Optics Express.

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