Shigeru Nakagawa Group

Photonics for Future Computing

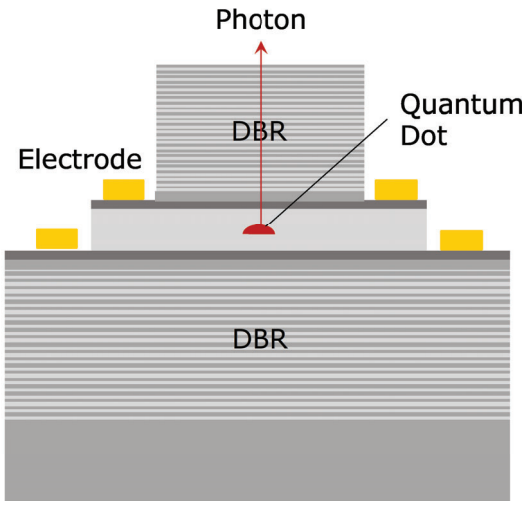
FIRST

http://photonics.ee.e.titech.ac.jp

- Single Photon Source for Photonic Quantum Computer
- Integrated Photonics for Photonic Reservoir Computing

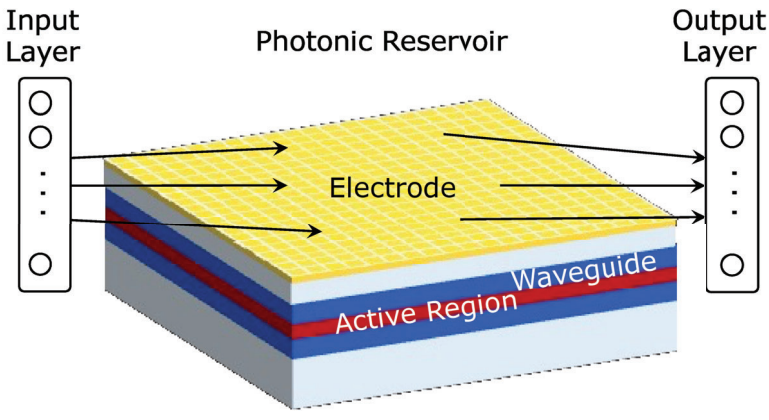
As CMOS scaling is approaching to physical limit and CMOS computer evolution is slowing down, next generation computing research has been accelerating. Quantum computing and brain-inspired computing have been intensely developed and demonstrated as promising candidates of next generation computing. Photonics realized CMOS computer scaling by data transmission, and will realize scaling next generation computing by data processing. Professor Nakagawa's research focuses on photonics for scaling next generation computing, more specifically, vertical microcavity quantum-dot single photon sources for photonic quantum computers, and integrated photonics for photonic reservoir computing.

Photonic quantum computer based on Silicon Photonics is one of the promising approaches to realize scaling quantum computer. Single-photon source is crucial for photonic quantum computer. We develop electrically-driven on-demand single-photon source, emitting identical telecom-wavelength single photon. Vertical microcavity quantum-dot controls photon generation and carrier injection, and minimize photon loss for highly-efficient and highly-indistinguishable photon emission.



Vertical Microcavity Quantum-Dot Single Photon Source

Reservoir computing exploits physical systems and processes sequential data to perform dynamic pattern recognition. We develop photonic-reservoir computing using integrated photonics as physical reservoir. Reservoir needs to possess short-term memory, nonlinearity and high dimensionality to transform temporal input data nonlinearly into high-dimensional space. Photonic reservoir with data input and output by electrical signal and data processing by light wave meets all the requirements and realizes scaling reservoir computing.



Photonic Reservoir Computing