



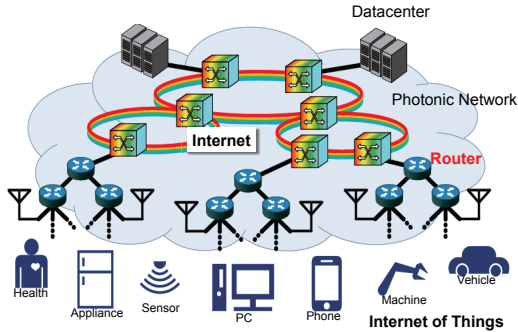
Shoji Lab

Silicon Photonic Devices using Magneto-Optical Materials

FIRST, Quantum Nanoelectronics Research Core

<http://mizumoto-www.pe.titech.ac.jp>

Increase of Network Traffic



Increase of power consumption in electric router (especially for high bit-rate signal processing)

Datacenter



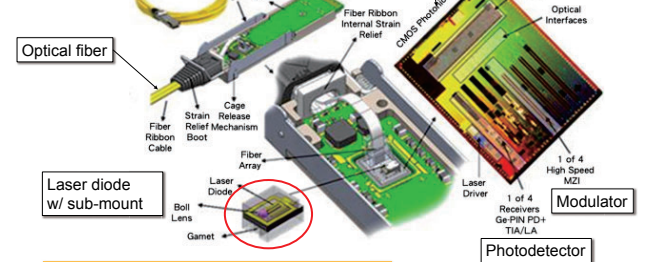
High Performance Computer



Bottleneck of transmission speed between rack-to-rack

Silicon Photonics

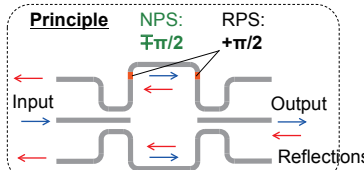
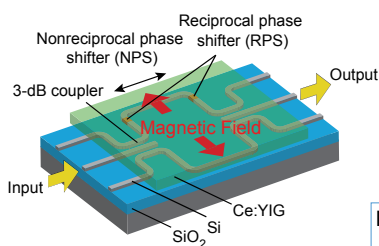
Active Optical Cable



Challenge of optical transceiver: Monolithic integration of Optical isolator with LD

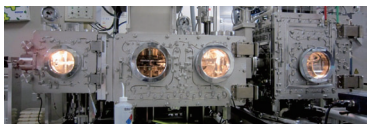
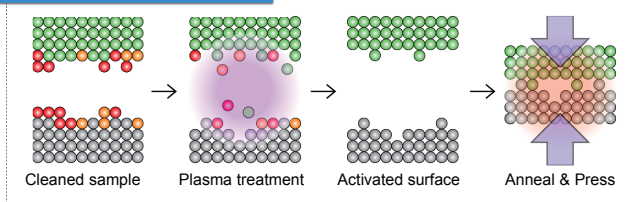


Si optical isolator



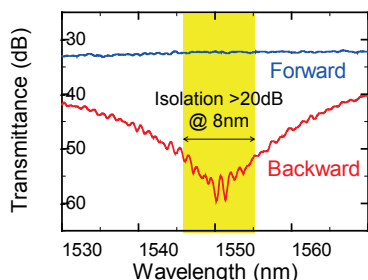
Problem: Integration of MO garnet -> Difficulty in growth on Si

Surface Activated Bonding

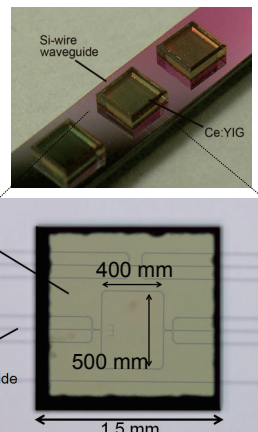


- Gas : N₂
- RF 500W, 10sec
- Anneal : 200°C, 30min

World' first demonstration of waveguide optical isolator on Si

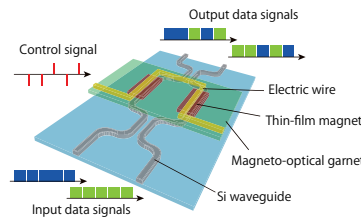


Y. Shoji, et al., APL, 92, 071117 (2008).
Y. Shoji, T. Mizumoto, JJAP, 53, 022202 (2014).

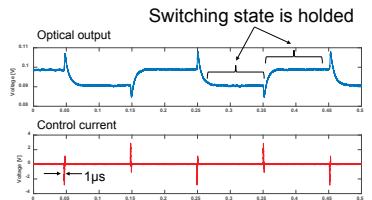
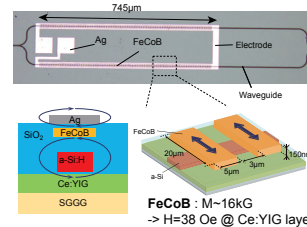
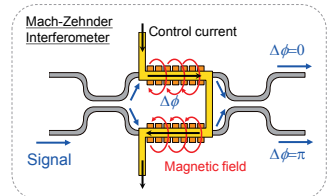


Self-holding optical switch

Non-volatility of magnet -> Self-holding of switching state

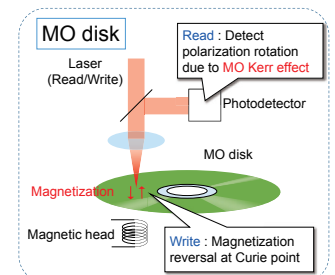
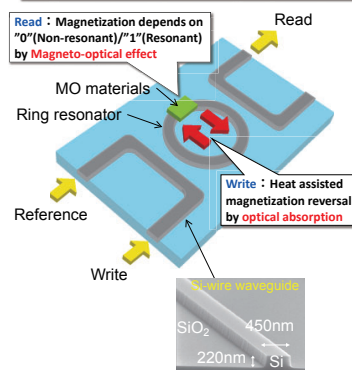


- ✓ Switching state is held w/o power
- ✓ Low power consumption
- ✓ Switching speed : ~10 ns
- ✓ Size (2 x 2) : ~0.5 x 0.1 mm²



K. Okazeri, et al., PTL, 30, 371 (2018).

Optical memory switch



- ✓ Dense integration with Si photonics
- ✓ 1bit : 20µm sq. -> 1.5KB : ~2 mm sq.
- ✓ Read/Write packet data (Sequential access memory)