Integration of silicon photonic circuit and CMOS circuit

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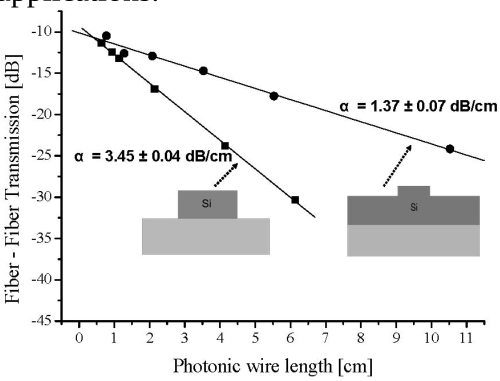
Integration of photonics and electronics has many advantages. This integration can bring complementary advantages to both photonic and electronic circuits. Electronic circuit can support photonics as a driver circuit for lasers, photo detectors and high-speed modulators, while optical interconnects can help to reduce the latency issues faced by the advanced microprocessors. As the optical circuits work at speed of light high-speed optical bus in an electronic chip can increase the processor speed. This can be realized using integrating passive (waveguides and filters) and active (lasers and detectors) optical components on to an electronic chip.

There are different schemes and material technology through which photonic-electronic integrated chip can be realized. The most practical and economical way of implementing this is by adding the photonic circuit layer on top of the CMOS chip (above-IC approach). Through this above-IC approach we can integrate the passive optical components, such as, optical waveguides and filters after CMOS metallization. The passive circuit can be built on top of the IC in depositing silicon (amorphous Si) using CMOS compatible processes. The two main requirements for building passive circuits on top of CMOS are, (1) the processing temperature should be $<400^{o}C$ and (b) the deposited material should have low optical propagation loss.

Silicon is a familiar material in CMOS fabrication process; we exploit silicon as a passive photonic circuit layer. With its high refractive index contrast (Si/SiO2) compact circuits can be made with low-loss bends and waveguides. The passive circuits can be made using amorphous silicon (a-Si) deposited by plasma enhanced chemical vapor deposition process at low temperature ($300^{o}C$) and with low optical propagation loss (3.45dB/cm). Unlike monocrystalline silicon-on-insulator technology deposited a-Si is a flexible material technology in terms of layer thickness, layer staking and integration.

In this poster, we will present our exploration of amorphous silicon as a viable candidate for photonic-electronic integration and other interesting optical applications.



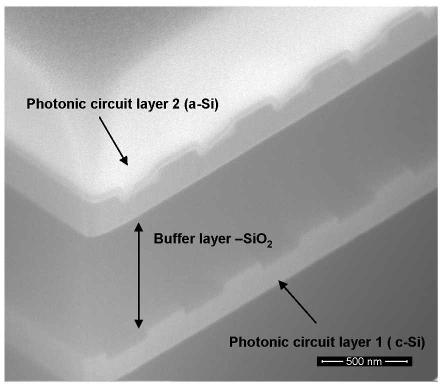


Figure 1 (left) Propagation loss of a silicon photonic wire (480X220nm) and a shallow etched ridge waveguide and (right) Optical Via to couple light from one photonic layer to other.