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Silicon Photonics (short course)

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Abstract: This course discusses both fundamentals and applications of silicon photonics. Following a discussion on the design and performance of basic building blocks, more advanced circuits, integration with electronics and different application areas will be covered.

1. Description

The course will discuss both fundamentals and applications of silicon photonics. Silicon photonics is rapidly emerging as an attractive platform for realizing cheaper photonic integrated circuits. Silicon Photonics is now already commercially used in datacenters and telecom and new applications in biophotonics, quantum computing, optomechanics, sensing, metrology, spectroscopy are rapidly emerging [1].
The course will start with explaining the reasons for this interest and the possible advantages of the platform. Next the fundamentals of the waveguide platform and its performance will be discussed (straight and bend waveguides, filters, fiber-chip coupling …). The focus is on silicon waveguides but we will also shortly discuss Silicon Nitride as an alternative. Subsequently, we will also discuss more advanced devices such as detectors, switches, high speed modulators and lasers. Also the need for integration with other materials such as III-V semiconductors, Lithium Niobate and others will be discussed. In each case, we will also touch upon the problems that still need to be resolved and give a comprehensive overview of the current state-of-the-art.
The second part will discuss on the integration in a standard CMOS processing environment and on different approaches to integrate silicon photonics circuits with optical circuits. Finally, it will review of current and future applications, in optical communications, optical interconnect and optical sensing.
The course will contain extensive references for further study and discuss how to get access to the various available platforms.

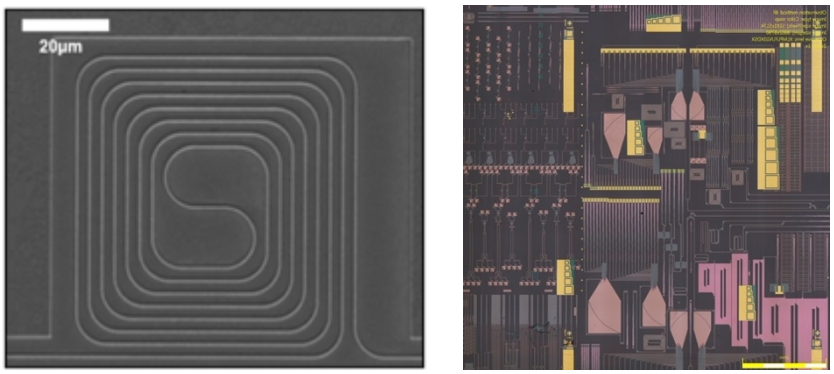

Fig. 1. a) Spiral of silicon waveguide [2]. b) Dense integration of silicon photonics devices.

2. References

[1] "December 2018 Special Issue: Silicon Photonics | Proceedings of the IEEE." https://proceedingsoftheieee.ieee.org/view-recent-issues/december-2018/ (accessed Mar. 25, 2019).
[2] W. Bogaerts et al., "Nanophotonic waveguides in silicon-on-insulator fabricated with CMOS technology," J. Lightwave Technol., vol. 23, no. 1, pp. 401–412, Jan. 2005, doi:10.1109/JLT.2004.834471.