DEMONSTRATION OF OPTICAL WIRELESS LINKS FOR ON-CHIP COMMUNICATIONS

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This work presents experimental results of on-chip optical communications between dielectric antennas realized on a Silicon on Insulator technology. The observed fast fading effects call for ray-tracing modeling of the propagation channel.
Keywords: On-chip-optical-communications, Photonic Antennas.

1. Introduction

Optical networks-on-chip are considered as a possible solution to overcome the communication bottleneck due to electrical links in modern kilo-cores architectures [1]. Network performance can be further enhanced by the use of optical wireless links to connect distant nodes. In this case, the design of the optical antennas and the knowledge of the propagation channel are both fundamentals steps for the realization of efficient communications in presence of noise and interference. Antenna radiation pattern and channel characterization are in fact the starting point for the maximization of the performance of the system in terms of mitigation of the interference and maximization of the signal to noise ratio [2]. In this work, the first results of optical link power budget measurements between dielectric antennas fabricated on a Silicon on Insulator platform are presented.

2. Results

The design of an optical wireless link encompasses different challenging tasks such as antenna design, wireless channel modelling, management and mitigation of interference issues. The integration of different techniques is therefore essential for the optimization of the overall system. In this work, the antennas have been designed through FDTD modelling. The obtained radiation patterns have then been integrated in a ray-tracing modelling used to characterize the propagation in a realistic scenario, where dielectric interfaces among the different layers on the chip cause multipath propagation.
In particular, in this first chip a set of wireless links of different distances (20 μm-1500 μm) composed of optimized taper antennas have been implemented.
By exciting the antennas with a tunable laser in C-band, the link output power has been first recorded as a function of the wavelength and then de-embedded with respect to the transmission of a straight waveguide, obtaining only the link budget. Results are reported in Fig. 1. As the antenna is wideband, the behaviour is shown at only 1550 nm, which is representative of the whole wavelength range. Comparison with the free-space link budget shows that an average improvement due to the guiding effect determined by the interfaces (see inset of Figure 1) is present. Nonetheless, fast fading effects due to multipath propagation can be observed.

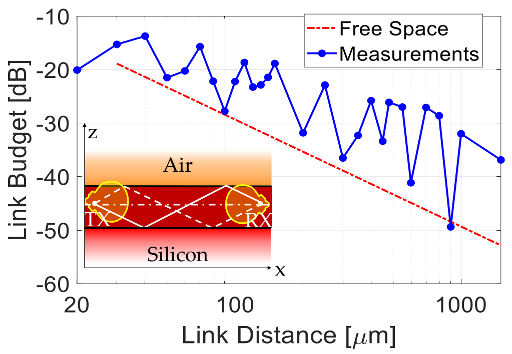

Fig. 1 Link budget measurements between the two optical antennas (blue curve) as a function of the link distance compared with the theoretical free space behaviour (red curve) at 1550nm. A sketch of the layer interfaces is shown as inset.

3. Conclusion

A first demonstration of optical wireless interconnections at a chip level is presented. Results show that the effects of the propagating channel determined by the unavoidable layer interfaces influence the received power and must be considered in the design of the network topology.

Acknowledgements

Research funded by the Italian Ministry of Education, University and Research (MIUR) in the framework of the PRIN 2015 "Wireless Networks through on-chip Optical Technology—WiNOT" Project (20155EA8BC-PE7).

References

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