Low loss waveguides in standardized TFLN platform

Arno Mettraux, Alberto Della Torre, Jacopo Leo, Fatemeh Arefi, Homa Zarebidaki, Gregory Choong, Mattia Orvietani, Yves Pétremand, Ivan Prieto, Olivier Dubochet, Michel Despont, Hamed Sattari
CSEM SA
Contact: arno.mettraux@csem.ch

INTRODUCTION

We present our characterization results of waveguide loss in the thin film lithium niobate (TFLN) photonic integrated circuit (PIC) platform.

- The waveguides are designed for C-band telecom transmission
- The waveguide widths range from 0.5 µm to 2.5 µm, with a particular focus on the 0.8 µm width design
- Characterization of propagation losses in waveguides is crucial for developing of the Process Design Kit (PDK)

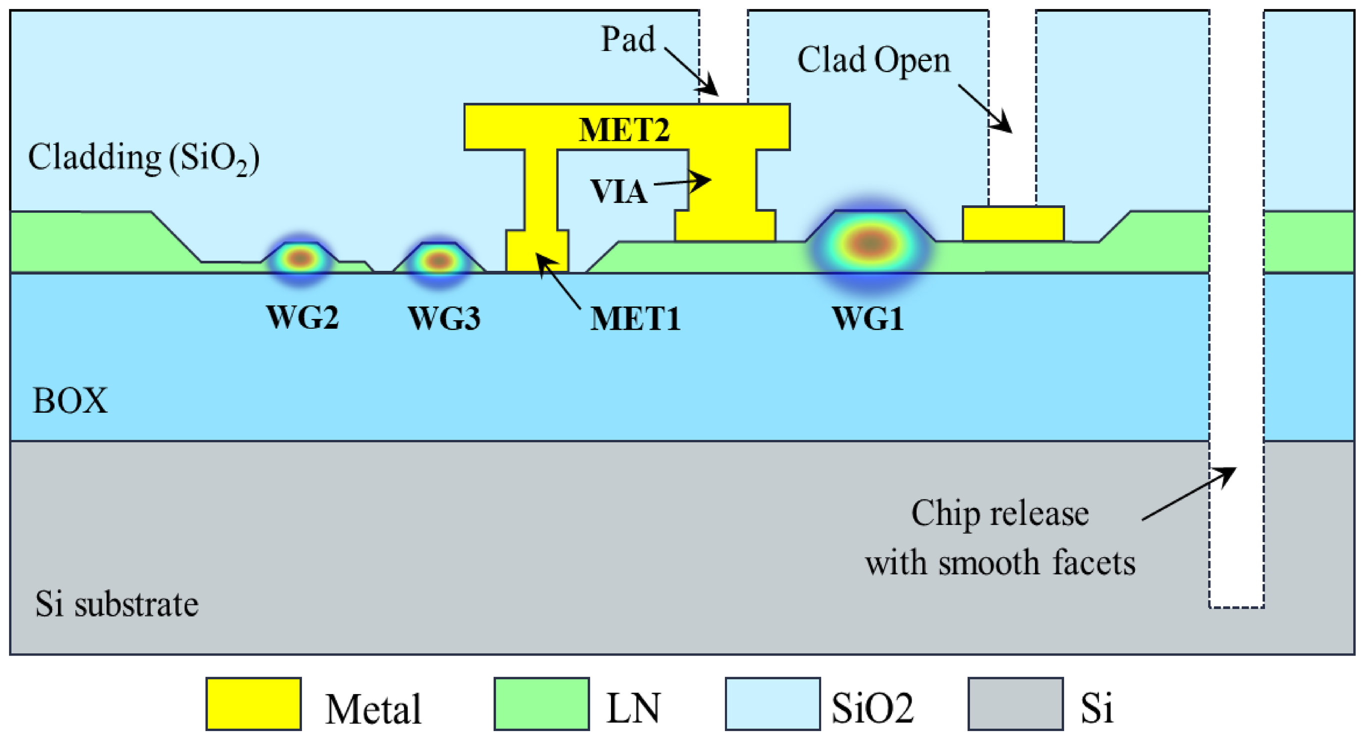

Fig. 1 Schematic view of CSEM's TFLN PIC platform, three levels of waveguides, two layers of metallization, clad and clad opening.

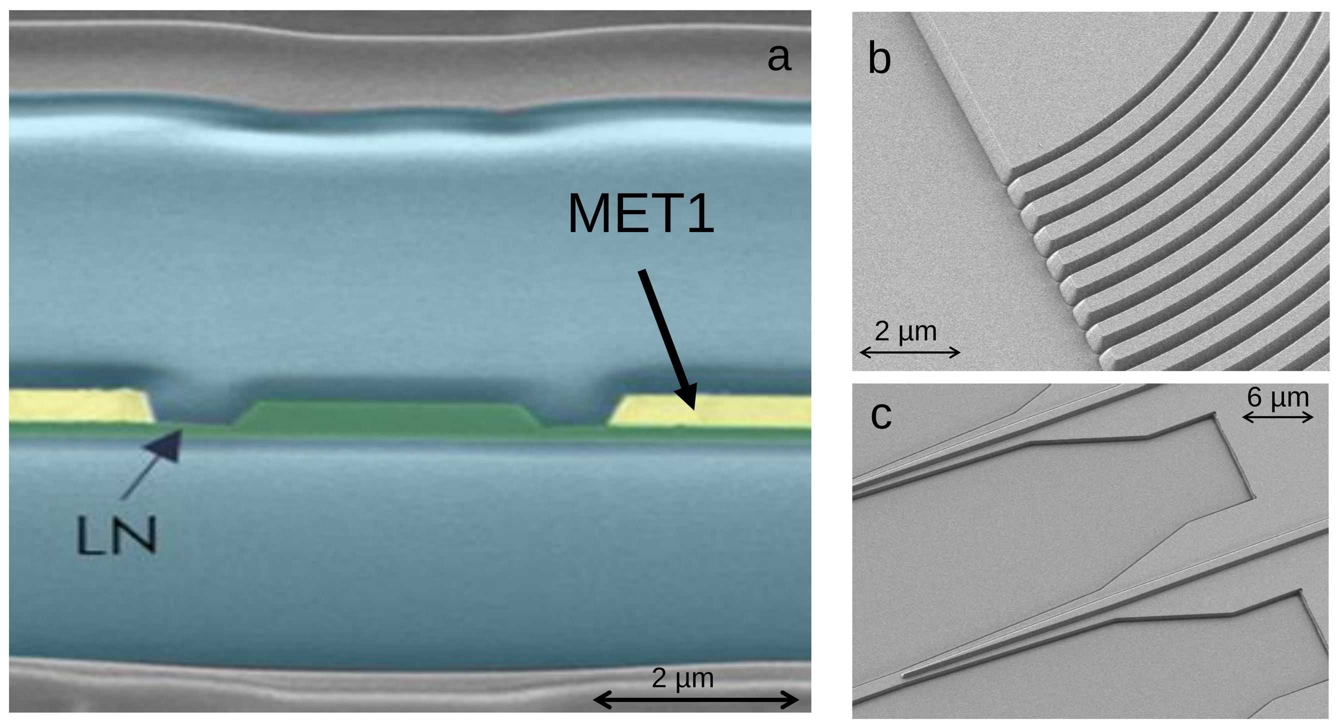

Fig. 2 SEM images of (a) cross section of our chip, with the Lithium Niobate waveguide color-coded in green, the metallization parts in yellow and the box and cladding in blue. (b) top view of a grating coupler. (c) top view of edge couplers.

METHODS

- Rings and racetracks were used to determine the propagation losses of the waveguides
- Spirals (waveguides with lengths ranging from 38,000 to 60,000 µm) were also used to get an initial estimate of the waveguide's propagation losses
- The coupling mode can be identified by using ring resonators with varying gaps and observing the transition from overcoupled to undercoupled regimes, as shown in Fig. 4 between the 700 nm and 800 nm gaps

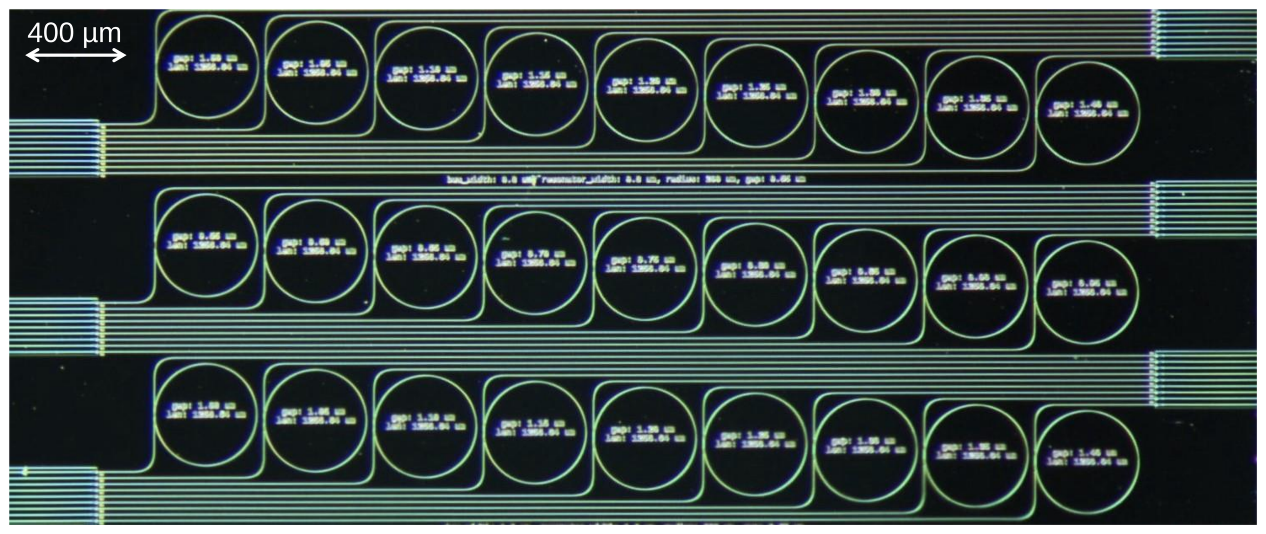

Fig. 3 Optical image of a series of ring resonators of 200 um radius with waveguide width of 800 nm and gap varying from 500 to 1300 nm.

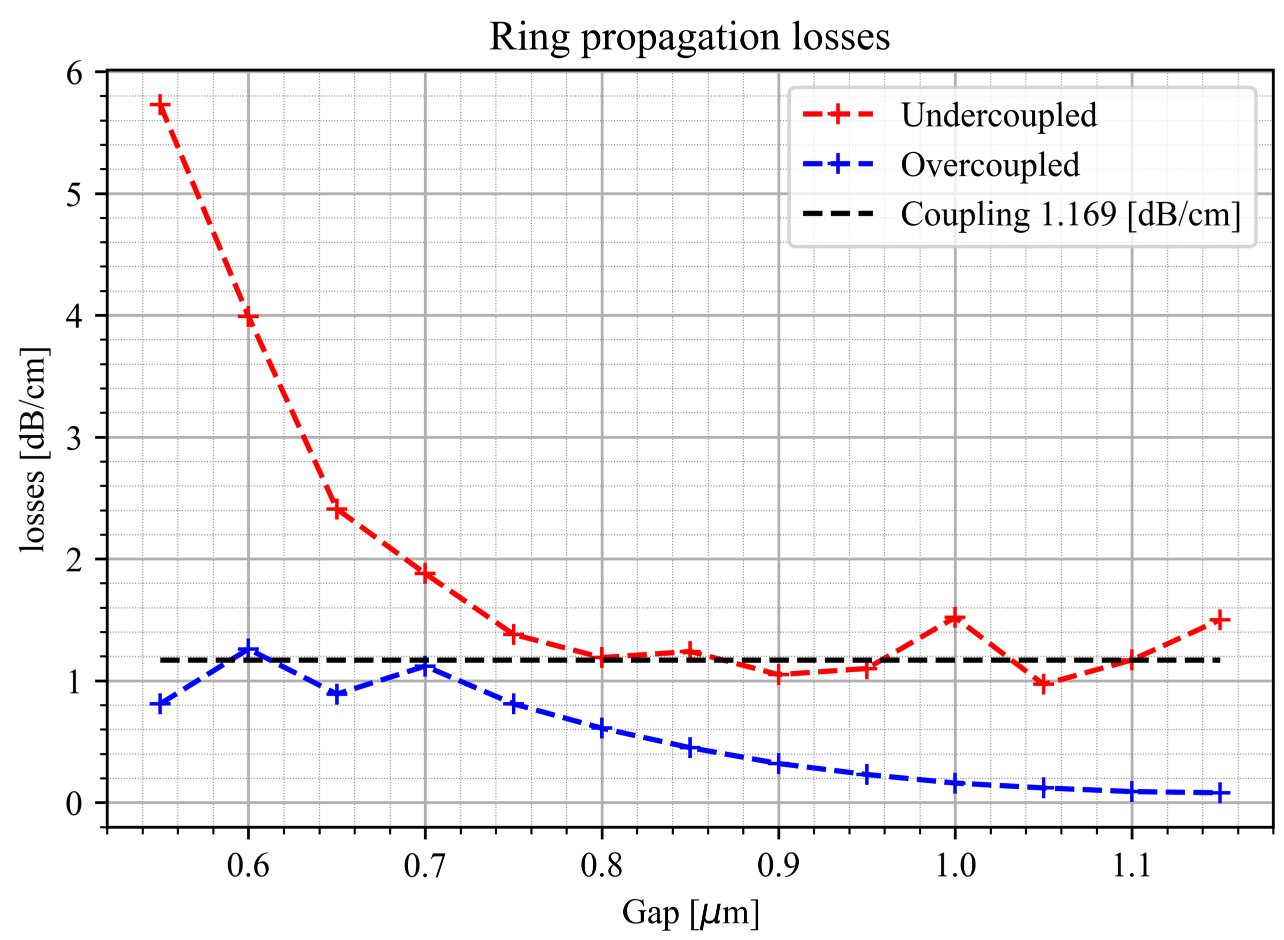

Fig. 4 Propagation losses of a series of ring resonators from so called RUN 2 with diameter of 200 um, waveguide width of 800 nm, and gap varying from 500 nm to 1150 nm.

RESULTS

- We obtained propagation losses of 0.67 dB/cm in 0.8 µm waveguides and as low as 0.26 dB/cm in 2.0 µm waveguides in the best fabrication run
- Larger waveguides exhibit significantly lower losses since the light interacts less with the edges
- We are continuously improving our fabrication process to ensure consistent quality across multiple runs

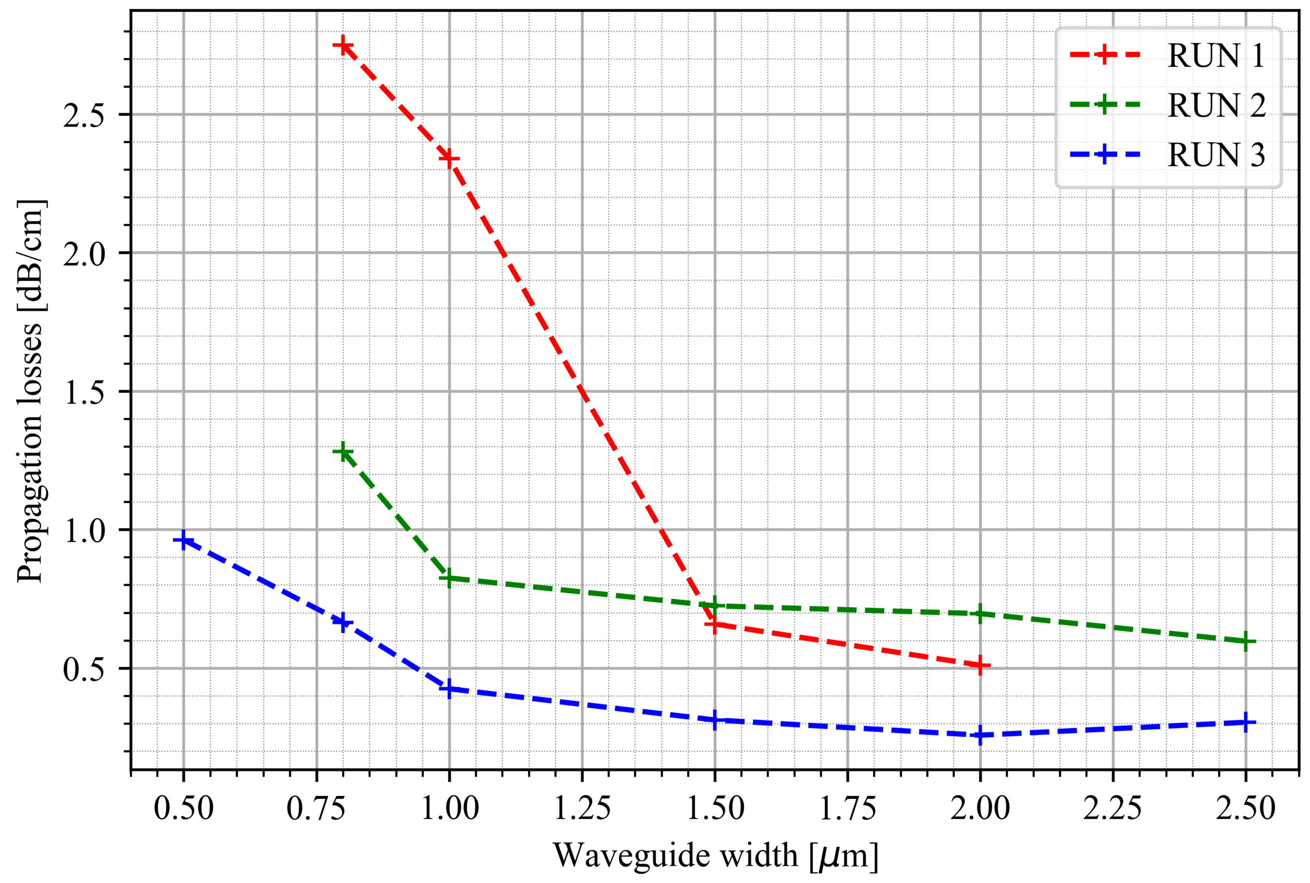

Fig. 5 Propagation losses of different waveguides lengths over different fabrication runs. The timespan between the first and last run is about 2 years

CONCLUSIONS

Throughout various runs, we observed a significant decrease in the propagation losses of our waveguides, indicating substantial improvements in fabrication quality. Monitoring and careful measurement of optical loss are important from a foundry perspective, and we are working for more improvement, even.

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