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An Accurate Characterization Method for Polarization Converters on the Indium-Phosphide-Membrane-on-Silicon Platform

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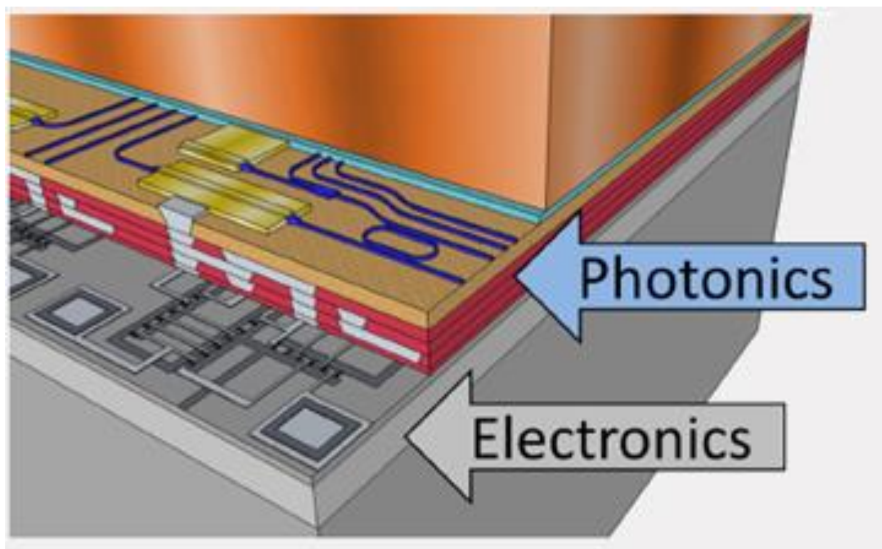
INTRODUCTION

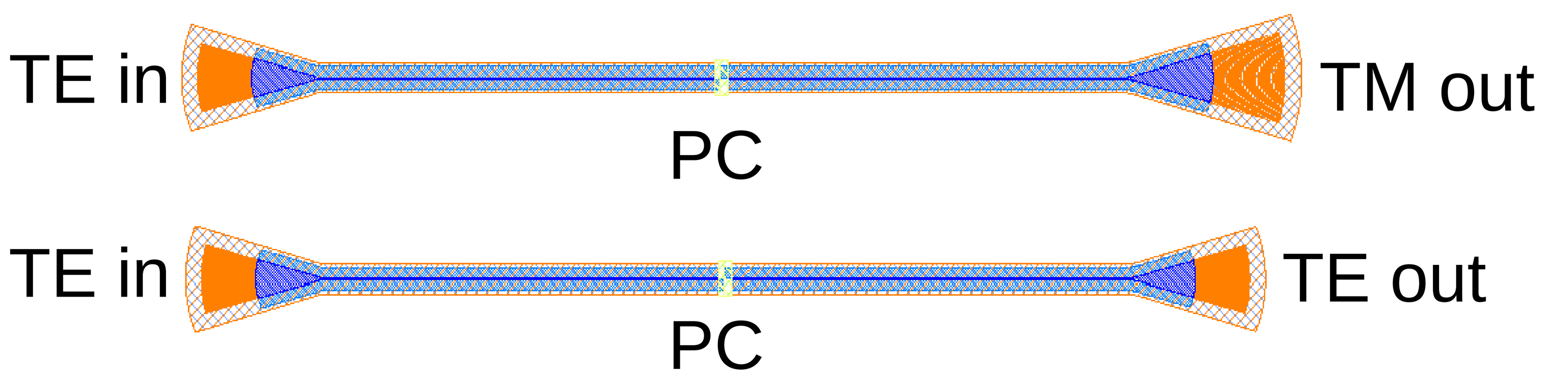
The InP-membrane-on-silicon (IMOS) platform consists of a 300 nm thick membrane bonded by BCB to a silicon carrier wafer, enabling tight light confinement and small footprint devices and waveguides.



We present an accurate method for determining the conversion efficiency of polarization converters on IMOS. We demonstrate circuits for these measurements and a conversion efficiency as high as 97.5%. The device is only 4.1 microns long.

METHODOLOGY

A direct 2-port measurement is limited in accuracy by the uncertainty of the insertion losses of the surface grating couplers, typically ±0.5 dB per coupler.

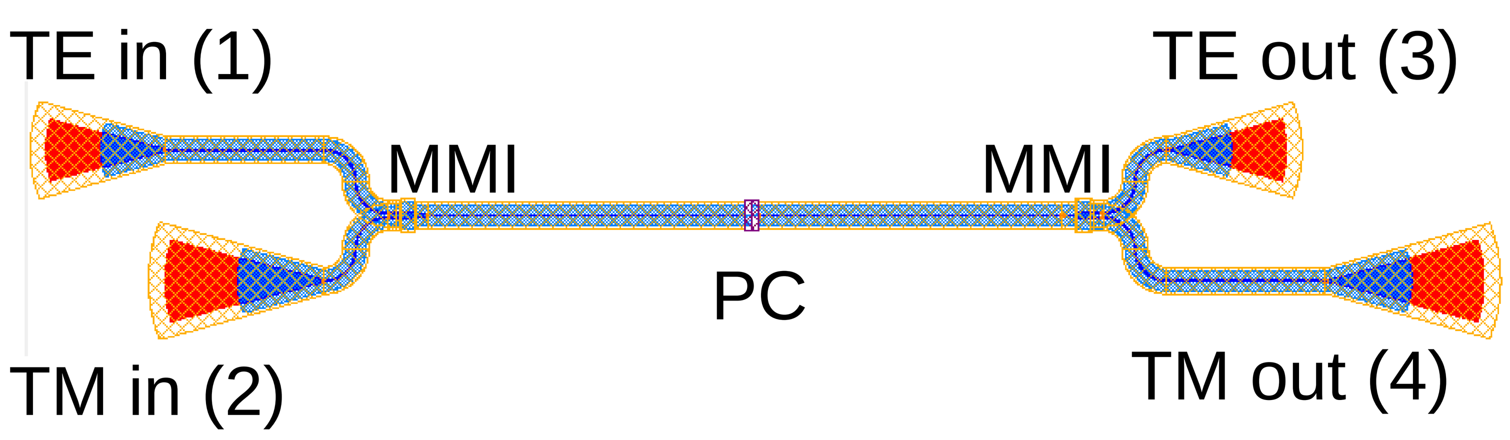


We introduce a new 4-port measurement method. The structures used for the measurements are shown below. The characterization is done by doing four measurements, which are the transmitted powers $P_{13}, P_{14}, P_{23}, P_{24}$:

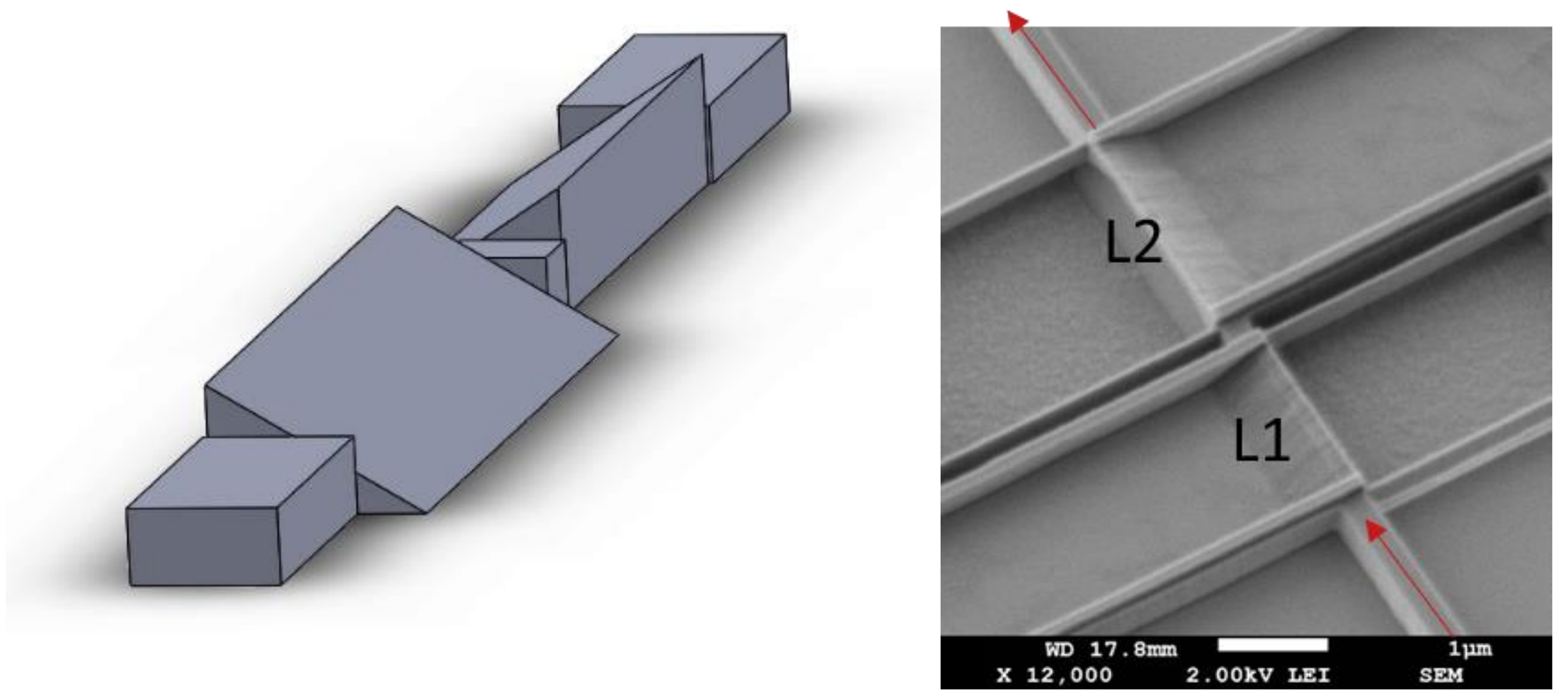
$$P_{13} = \alpha_1\alpha_3\alpha_{MMI}^2(1-\eta)P_{in}$$
$$P_{14} = \alpha_1\alpha_4\alpha_{MMI}^2\eta P_{in}$$
$$P_{23} = \alpha_2\alpha_3\alpha_{MMI}^2\eta P_{in}$$
$$P_{24} = \alpha_2\alpha_4\alpha_{MMI}^2(1-\eta)P_{in}$$

This gives an expression for the polarization conversion efficiency independent of the losses in the grating couplers, waveguides and MMIs:

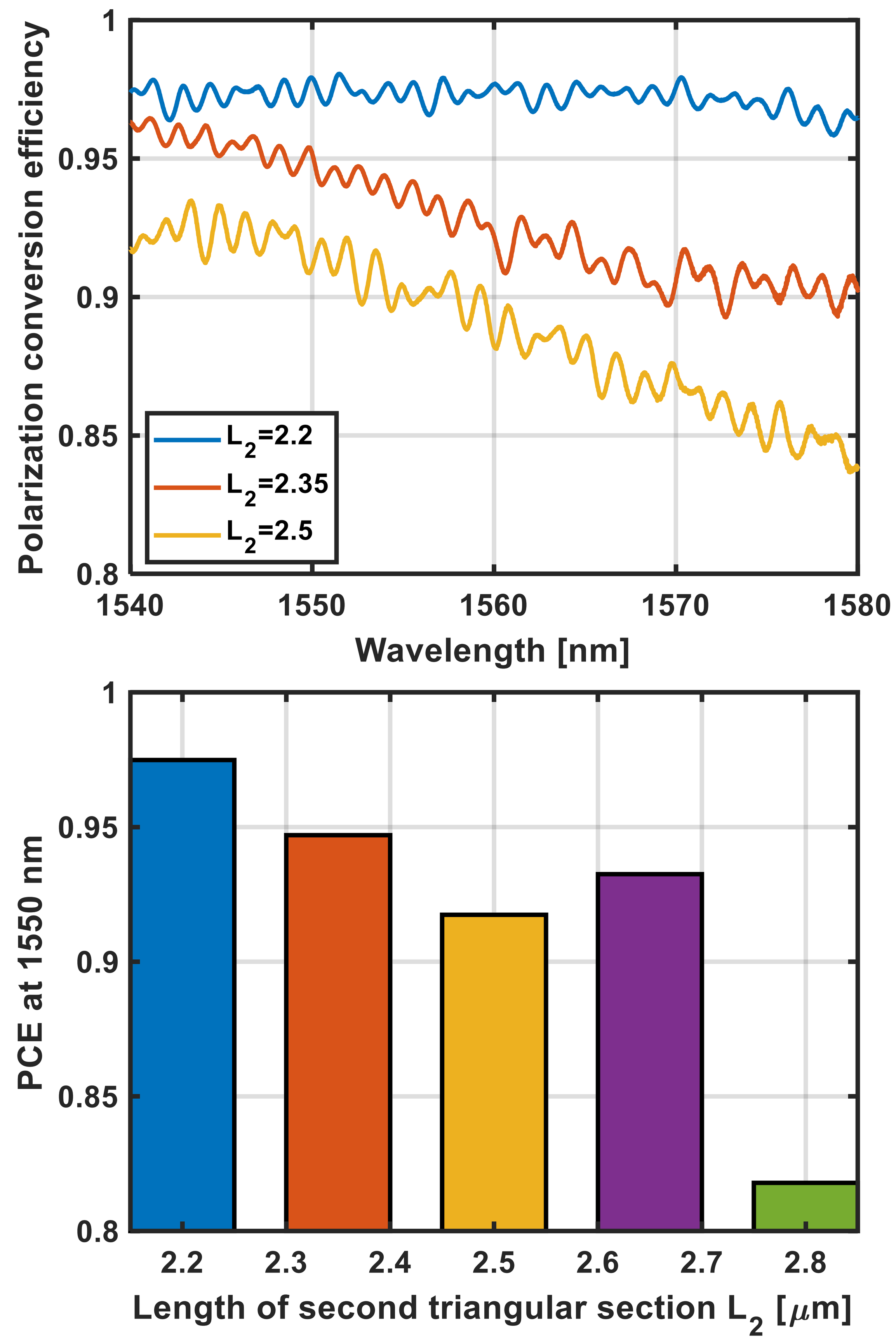
$$\eta = \frac{1}{1+\sqrt{\frac{P_{13}P_{24}}{P_{14}P_{23}}}}$$



POLARIZATION CONVERTER



RESULTS AND ANALYSIS



- Maximum 97.5±0.5% polarization conversion efficiency.
- The peak of the sinusoidal trend in the second graph is not reached, and higher conversion efficiency is possible.
- Ripple of ~0.5% on the measurement.

CONCLUSIONS

- Polarization conversion efficiency of 97.5±0.5% is achieved for a 4.1 microns long device.
- Improvement in measurement accuracy from ~15% uncertainty (2-port measurement) to 0.5% (4-port measurement).
- Further improvements can be achieved by suppressing reflections in the circuit.

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