# NEAR-INFRARED ERBIUM/SILICON SCHOTTKY PHOTODETECTORS INTEGRATED WITH A SILICON-ON-INSULATOR WAVEGUIDE

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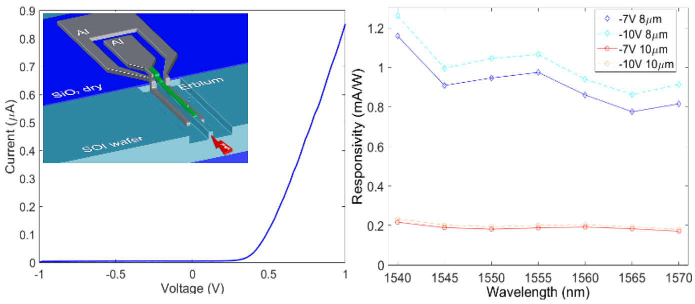
*In this work we have investigated the performance of photodetectors at 1550nm based on the internal photoemission effect through Erbium/Silicon Schottky junctions integrated with silicon-on-insulator (SOI) waveguides.*
**Keywords**: Photodetectors, Erbium.

## 1. Introduction

In the last two decades there has been growing interest in silicon photonics and in the possibility to integrate new materials to overcome the silicon (Si) intrinsic limitations [1][2]. Erbium (Er) has represented a viable solution for the realization of light sources at telecommunications wavelengths [3]. Although some works have already been reported on near-infrared free-space photodetectors based on hybrid Er/Si Schottky junctions [4], no investigations have been performed on the integration of Er/Si junctions in guiding structures. The integration of Er/Si junctions with silicon-on-insulator (SOI) waveguides could be very intriguing in the vision of integrating both Er-based LASERs and PDs on the same silicon substrate. The aim of this work is to investigate photodetectors based on the internal photoemission effect (IPE) integrated with waveguides having different width of 8 µm and 10 µm. IPE is the optical excitation of electrons in the metal to energy above the Schottky barrier and then transport of these electrons to the conduction band of the semiconductor, resulting in a photocurrent. We present the design, fabrication, and characterization of Schottky Er/Si waveguide photodetectors operating at 1.55 µm. These Er/Si junctions are carefully characterized by both electric and optical measurements at room temperature.

## 2. Discussion

We fabricated the PDs through a combination of optical lithography, reactive ion etching and metal deposition procedures, and fully characterized the detectors in terms of current-voltage (IV) curve and photoresponse at room temperature. Electrical measurements were performed in order to extract the values of the electrical parameters characterizing the Schottky junction. The current was measured by varying the voltage across the junction from 0V to 1V in direct bias. The rectifying Schottky diode behaviour is shown from the IV curve in fig.1 (a), from which both the series resistance and the ideality factor are extrapolated together with a Schottky barrier $\Phi_{B0}$ of 480meV corresponding to a cut-off wavelength of 2583nm.




(a) (b)

Fig. 1 a) IV curve of the PD with a waveguide width of 8µm; in the inset a sketch of a device is shown. b) Responsivity vs. wavelength of two devices with different waveguide width of 8µm and 10µm.; the measurements were repeated for each device with two different reverse bias applied of -7V and -10V.

Responsivity measurements were carried out in the range 1540–1570 nm (step of 0.05 nm) showing a maximum Responsivity value of 1.26 mA/W, achieved for a 8µm-width waveguide at 1540 and by applying a reverse bias of 10V.

## 3. Conclusion

In conclusion, we have demonstrated an Er-based photodetector integrated in a SOI waveguides for operation at 1.55 µm. We believe that our device paves the way to the integration of photonic components in an Integrated Circuit (IC) on a common chip, due to its compatibility with silicon technology, becoming an important underpinning platform for future applications.

## References

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