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PECVD SIN PHOTONIC INTEGRATED CIRCUIT FOR SWEPT SOURCE OCT AT 840 NM

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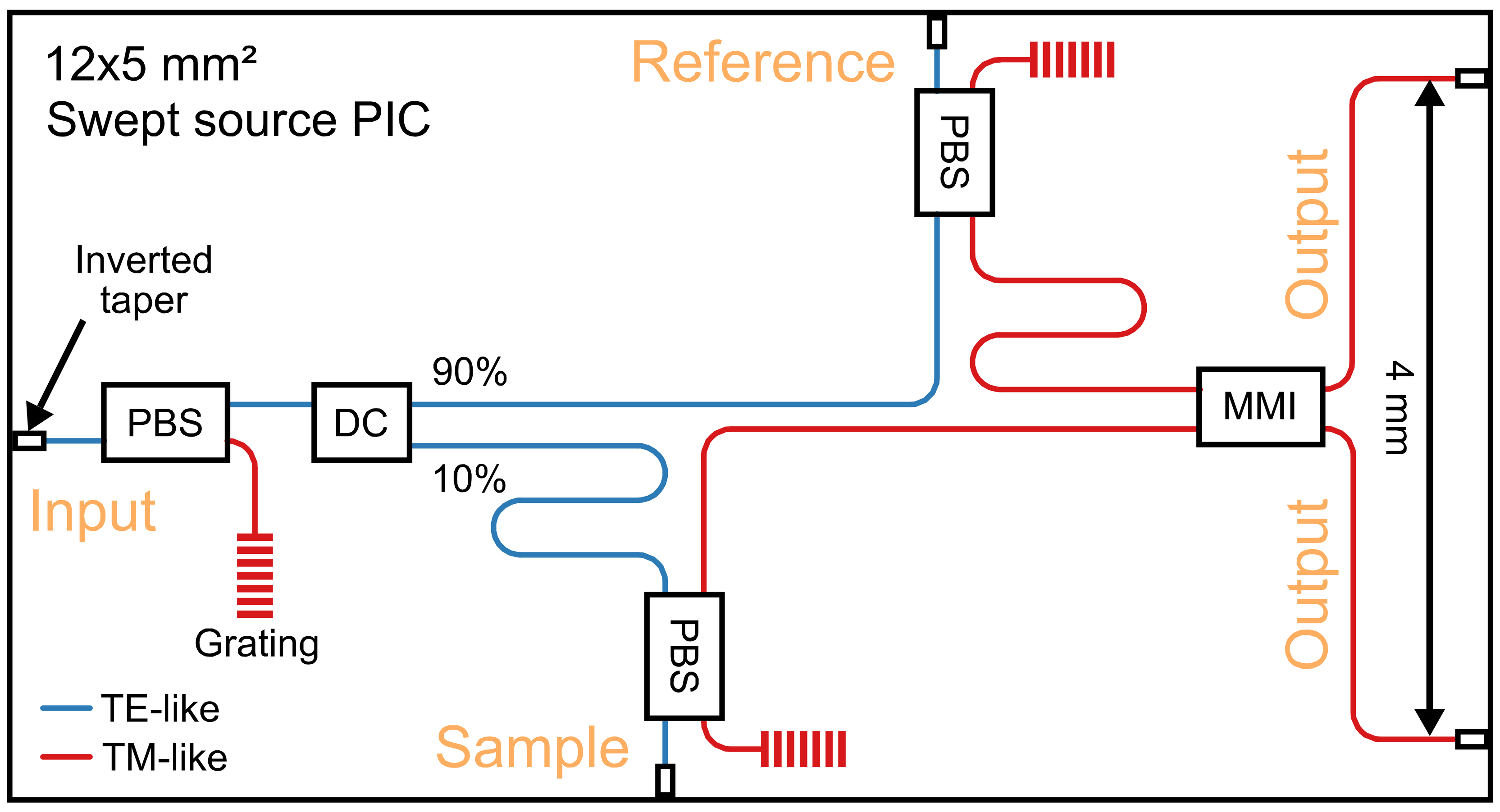
Introduction

Optical coherence tomography (OCT) is a non-invasive interferometric imaging technique used for retinal diagnostics with high axial resolutions of few micrometers [1].There is increasing interest in the cost reduction and miniaturization of OCT systems allowing wider usage especially for point-of-care applications. Using photonic integrated circuits (PICs) would reduce both cost and size in particular as monolithic co-integration of opto-electronic and electronic components for on-chip signal detection and processing is possible.

PIC based OCT

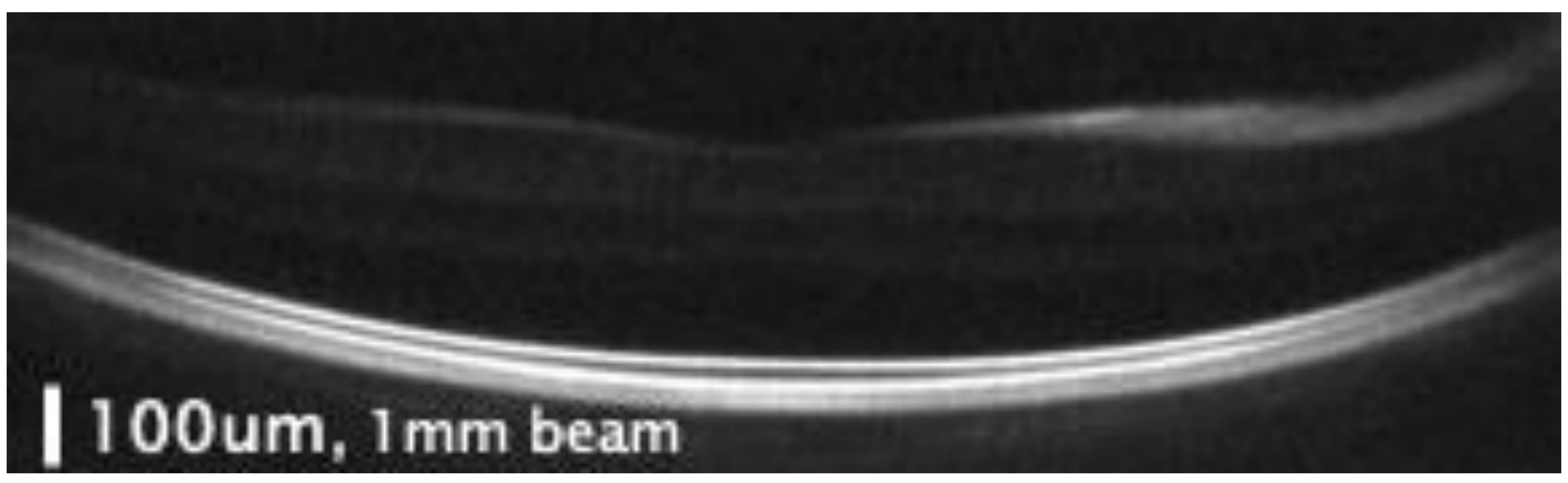
The swept source type OCT provides high performance while keeping the photonic building block requirements to a minimum. Here a spectral response of the sample reflection is created with a time varying wavelength from the source and a synchronized acquisition at two balanced photodiodes. Therefore, only the splitter and interferometer have to be provided by the PIC.

A major challenge for PIC based OCT are high excess losses. In particular the separation of light paths to and from they eye is critical. Previous OCT on a PIC implementations use power splitting to achieve this. We propose to use a simple to implement polarization beam splitter (PBS) in combination with an external λ/4 polarization rotation. Results of the different building blocks operating at 840 nm with a bandwidth of 100 nm have been shown in previous publications [3-5].



Results

The tomogram shows the healthy in-vivo human retina at the position of the fovea. Measurements were done with at the laser threshold limit of 0.75 mW for the retina. The image was 400x averaged.



Conclusion

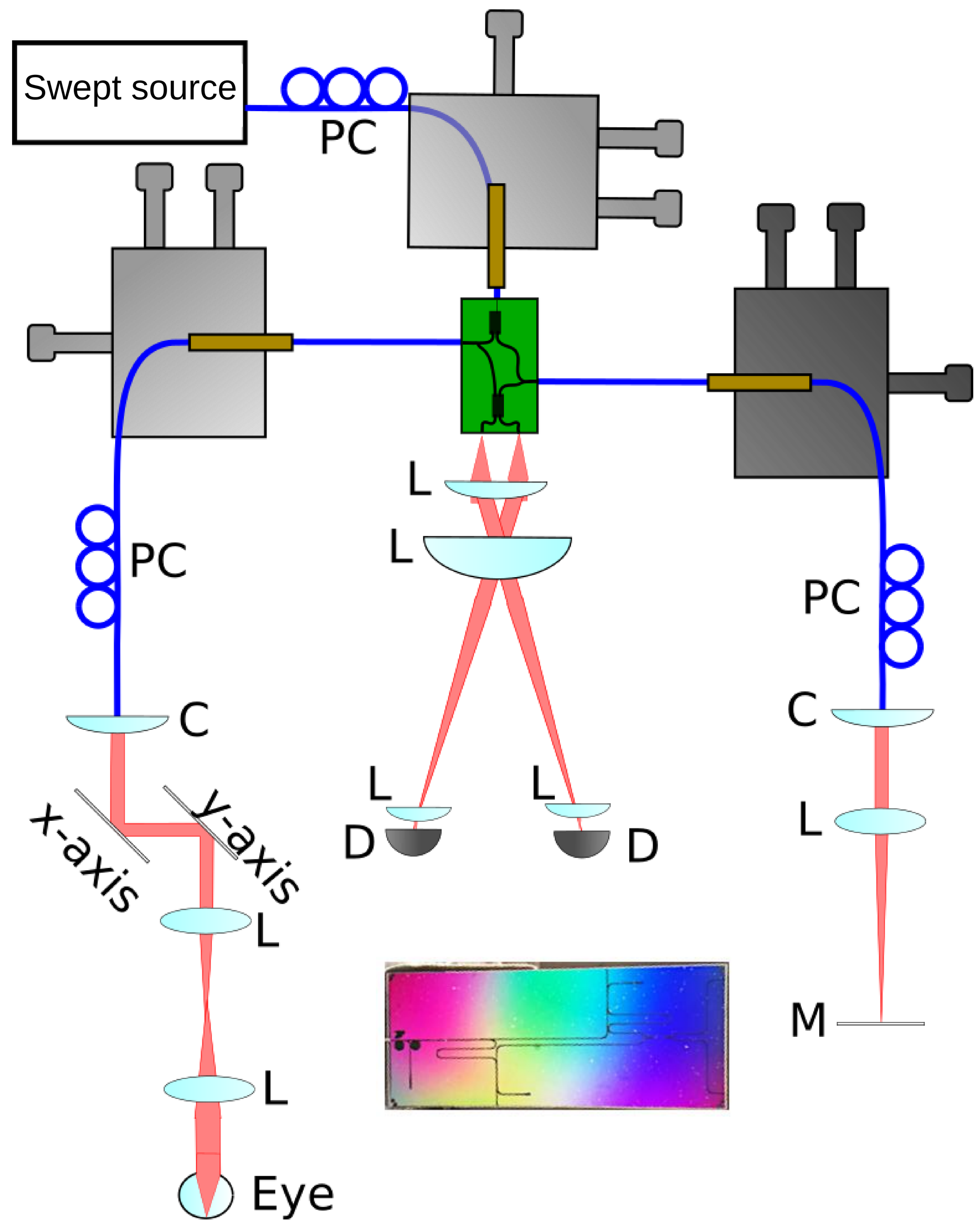
The first in-vivo measurement shows promising results with the available photonic building blocks and the built PIC. It is likely that further optimization in the measurement setup can lead to better tomograms especially from the output ports to the bulk photodiodes. With the PECVD SiN being CMOS-compatible the next step is the monolithic co-integration of the opto-electronic and electronic components. This will allow a compact feature-complete OCT system at a low single unit price.

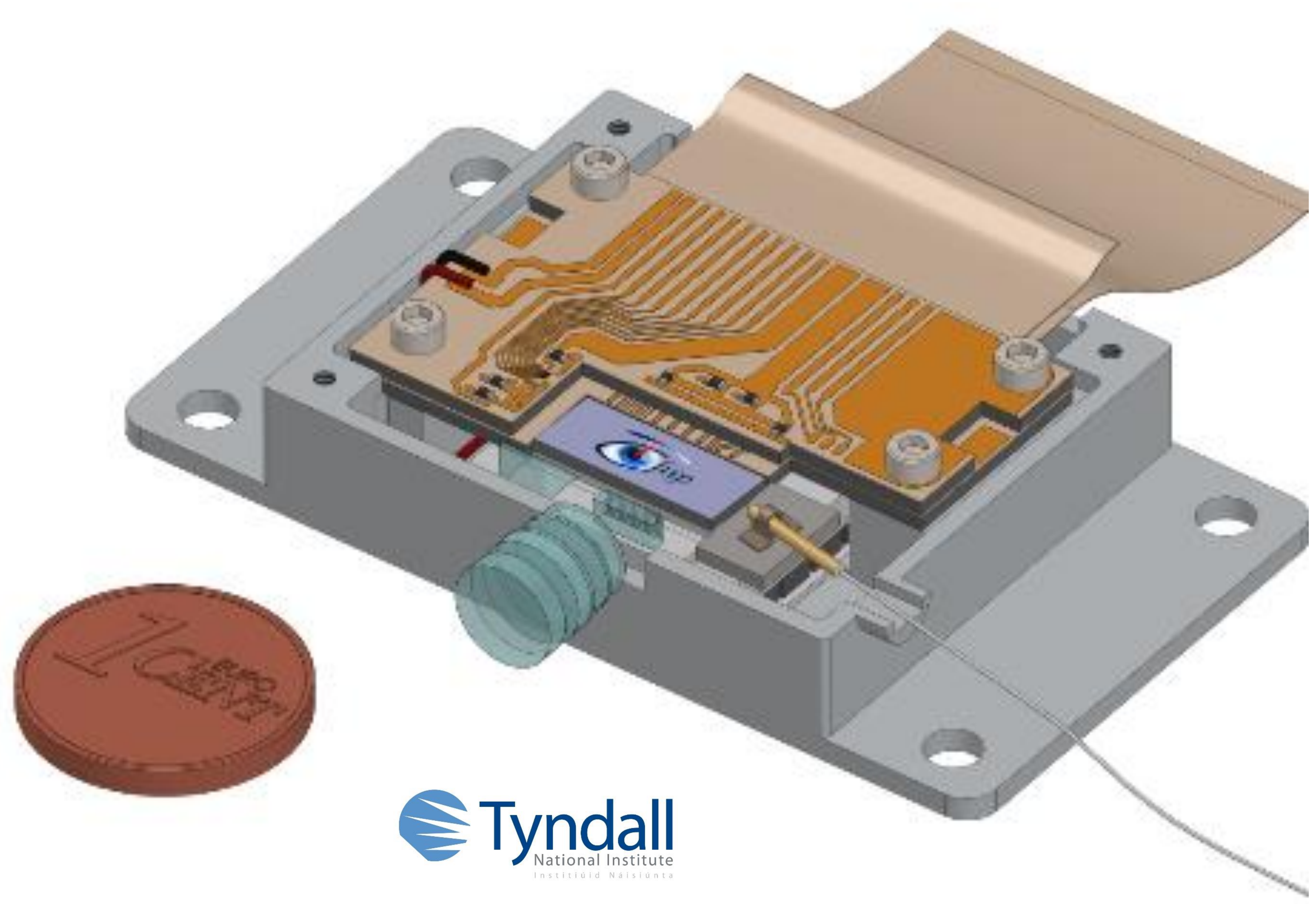
Fabrication

The PIC was fabricated at ams AG using PECVD with deep UV lithography and reactive ion etching [2]. The waveguide have a standard cross section of 700x160 nm^2. They consist of SiN and SiO2 with a refractive index of 1.916 and 1.455, respectively, at λ=840 nm.

OCT evaluation setup

The measurement with the PIC based OCT system was done at the Medical University of Vienna. Fiber based polarization controllers (PC) were used to rotate the polarization. The eye and mirror (M) in the sample and reference path, respectively, were illuminated through a collimator (C) and lenses (L). For the lateral scan galvanometric mirrors were used. The external balanced detector photodiodes (D) were accessed with bulk optics lenses.





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