On-chip high speed photodetectors for microwave photonic filters

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Photonic integrated circuits (PICs) promise to revolutionize microwave photonic technologies, thanks to the reduction in complexity, size, power consumption and cost. This can be achieved by integrating light sources, high bandwidth modulators, filters and high-speed detectors on a single microwave photonic processor chip. Translating the optical signal into the microwave domain, via on chip high speed integrated photodetector, is one of the critical components to achieve such single chip microwave photonic processor[1]. In this contribution, we report on the progress of integrating high-speed detectors on PIC for achieving single-chip microwave photonic filters. For the photonic circuit, we chose a silicon nitride (SiN) optical waveguide platform on which we will integrate III-V photodetector[2] chiplets (see Fig. 1a). The optical field in the SiN waveguide will evanescently couple to the III-V detector, where iit gets absorbed creating free carriers.

So far, we have completed the fabrication of the SiN PIC with the wavelength filter (ring resonator), achieving a peak rejection > 20 dB and a quality factor 3.2 x 10^5 at the 1550 nm wavelength. Currently, we are in the process of fabricating the III-V photodetector chiplets, which were grown on a native substrate by MOCVD. After completing the fabrication of the chiplets, we will integrate the III-V photodetector on the SiN waveguide using micro-Transfer Printing Technology and characterize the microwave photonic filter. Progress towards this goal will be presented at the conference.

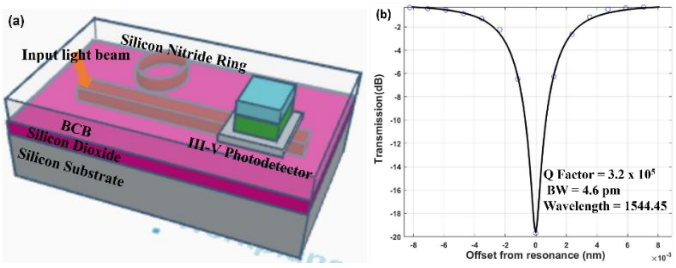

Figure 1: (a) Illustration of a III-V photodetector integrated on PIC. (b) Ring resonator response.

[1] Maram, R.; Kaushal, S.; Azaña, J.; Chen, L.R. Recent Trends and Advances of Silicon-Based Integrated Microwave Photonics. Photonics 2019, 6, 13.

[2] G. Chen, J. Goyvaerts, S. Kumari, J. Van Kerrebrouck, M. Muneeb, S. Uvin, Y. Yu, and G. Roelkens, Opt. Express **26**, 6351 (2018).