Photonic ICs
for Ultrahigh Speed and Coherent Systems

Andreas UMBACH
Finisar Germany, Reuchlinstraße 10-11, 10553 Berlin, Germany
andreas.umbach@finisar.com

Abstract: Photonic Integrated Circuits both in the InP and SiP material systems are becoming more and more popular as they provide solutions to the challenges of more and more miniaturization, optical and rf interconnects and the increasing cost pressure for optical components. Optical coherent transmission systems and photonic microwave photonics are application areas for highly complex and high speed PICs. Receiver PICs and transmitter PICs will be presented and discussed.

Introduction: The ever-growing demand of communication bandwidth driven by increasing use of video in social networks as well as the fast growing number of devices communicating with each other (IoT, Internet of Things) requires the highest possible aggregation of data transmission on single fibers. Gridless wavelength multiplexing is introduced to achieve high spectral density in the available EDFA-spectrum. Polarization multiplexing and complex modulation formats such as DQPSK, 16 QAM or even 64 QAM are applied to increase the number of bits per symbol for an intended reach. The highest possible symbol rates up to 64 GBaud is utilized to achieve the optimum throughput in each wavelength channel. At the same time, faceplate density of internet switches drives the miniaturization of space and power consumption of the very same components and CFP2 and CFP4 pluggable coherent modules are envisaged.

PICs: Photonic ICs comprising a multitude of functionalities are already used in the market and will be further developed. These can range from a parallel array of ultrafast photodiodes connected to a multimode interference coupler serving as an optical power splitter [1] to increase the power handling capability of photodetectors e.g. for millimeter-wave photonic applications, as depicted in Fig.1, to monolithically integrated dual polarization coherent receivers [2] with a set of 4 photodiodes per polarization to detect the differential encoded I and Q signals of the coherent transmission, see Fig.2. Nested Mach-Zehnder-Modulators [3] are used to encode phase and intensity information either to generate radio signals or coherent communication signals. On the transmit side as well as for local oscillators on the receive side narrow line width lasers

[e.g. 4] are required and present an opportunity for further integration on InP or for hybrid integration, if Silicon photonics is the chosen PIC technology.

The performance of these and related PICs on InP will be presented and opportunities for further photonic integration will be discussed.

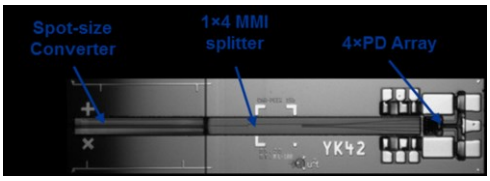

Fig. 1. Four waveguide integrated photodiodes coupled to a 1x4 MMI power splitter and recombined at the electrical rf-output.

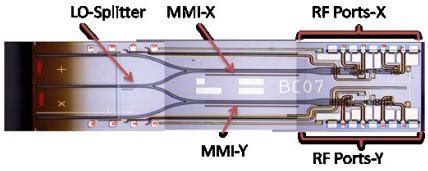

Fig. 2. Dual polarization coherent receiver chip on InP comprising spot-size converters, power splitters and optical mixers and 8 photodiodes.

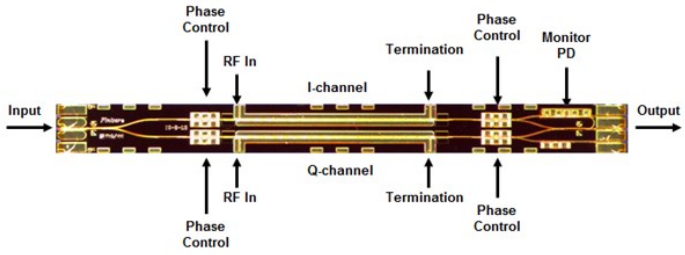

Fig. 3. I-Q modulator PIC on InP, comprising two nested MZMs, monitor PDs, phase control sections and electrical termination.

References

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