Silicon photonic Radio-over-Fiber transceivers and microwave photonic up-converters

K. Van Gasse[1,2], **A. Abassi**[1,2], **M. Mahmoud**[1,2], **J. Verbist**[1,2,3], **J. Kerrebrouck**[3], **G. Torfs**[3], **B. Moeneclaey**[3],**J. Bauwelinck**[3], **X. Yin**[3], **G. Roelkens**[1,2], **and G. Morthier**[1,2]

[1]Photonics Research Group, Ghent University - imec, Technologiepark-Zwijnaarde 126, 9052 Ghent, Belgium

[2]Center for Nano- and Biophotonics, Technologiepark-Zwijnaarde 126, 9052 Ghent, Belgium

[3] IDLab, INTEC, Ghent University - imec, Technologiepark-Zwijnaarde 126, 9052 Ghent, Belgium

1. EXTENDED ABSTRACT

We will present results of different radio-over-fiber experiments using silicon photonic transceivers. Both the use of a directly modulated III-V-on-silicon DFB laser and GeSi EAMs is investigated. The lasers are used in combination with high-speed integrated waveguide coupled Ge photodiodes to created a fully silicon photonic analogue link. The silicon photonic photodiodes are co-integrated with BiCMOS transimpedance amplifiers on a PCB to increase the link gain. A LTE (64-QAM OFDM) signal on a 3.5 GHz carrier is successfully transmitted over 5 km of single mode fiber using these integrated transceivers. Furthermore, 16-QAM data on a 20 GHz with a bit rate of 16 Gb/s is also transmitted over 5 km of standard single mode fiber.

We also investigated a microwave photonic up-converter/transmitter based on a compact silicon photonic structure consisting of two high-bandwidth GeSi EAMs placed in a MZI configuration. The structure is similar to the work presented in [1] and also uses carrier-supression to achieve improved link-gain. The full circuit is smaller than 2 mm^2 and many of these transmitters can be integrated on the same chip allowing for dense multiplexing. The MZI structure is realized on-chip using low-loss silicon waveguides, splitters and couplers. Furthermore integrated micro-heaters are used to control the static bias of the MZI structure. The EAMs have a 3 dB modulation bandwidth exceeding 65 GHz and a on-chip matching resistor provides a return loss higher than 10 dB from 0 to 65 GHz. To analyze the microwave photonic up-converter/transmitter functionality of the structure we up-converted data on a 1.5 GHz IF to a 15-26 GHz RF carrier from with less than 3 dB ripple. We transmitted 64-QAM data with minimal EVM degradation over 2 km of standard single mode fiber. Finally we developed a high-power SOA which is ideally suited for analogue photonic links, as the link gain is often dominated by the optical power received by the photodiode.

REFERENCES

1. Haas, B. M., McKinney, J. D., "Characterization of a Downconverting, Phase-Modulator RF-Over-Fiber Link With a Single Modulator," *IEEE Photonics Journal*, Vol. 10, No. 4, 1–7, 2018.