Si Electronic-photonic Integrated Circuits for Realization of Single-chip Optical Single-sideband Modulators

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Abstract— Microwave photonics can be loosely defined as the technique of using photonics for microwave signal generation, transmission, and processing. With this definition, any realistic implementation of microwave photonic systems requires both photonic components and electronic components. Consequently, in order to fully utilize the power of integration for microwave photonics applications, a hardware platform that can provide monolithic integration of both electronics and photonics is greatly desired. As an example of using such a platform for microwave photonics, a single-chip 30-GHz optical single-sideband (OSSB) modulator (OSSB) has been realized on Si [1].

An OSSB modulator produces only one sideband unlike typical optical modulators which produce double sidebands for intensity modulation. Consequently, it can prevent the frequency- or distance dependent power fading problem which occurs when high-frequency electric signals are delivered in the optical domain over dispersive fiber [2]. Various techniques have been reported for OSSB modulator implementation. However, previous approaches require several different pieces of optical and electrical components, making the resulting OSSBs bulky and expensive. Our single-chip OSSB modulator is realized with IHP's Photonic BiCMOS technology which provides high-performance Si photonic devices and Si BiCMOS circuits on the stand Si platform [3]. The OSSB modulator is composed of parallel dual ring modulators, each of which is modulated with one of two outputs of a quadrature hybrid coupler producing two separate outputs having 90 degree electrical phase difference. A 2×2 multi-mode interferometer (MMI) is used for separating input light into two signals having 90 degree optical phase difference and a 2×1 MMI is used for combining two separately modulated signals into one output. The OSSB modulator produces OSSB signals at 30 GHz with larger than 15 dB suppression for the undesired sidemode. Details of our OSSB modulator structure and its characteristics will be presented.

REFERENCES

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