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The 23rd Opto-Electronics and Communications Conference

OECC 2018

Conference Program & Abstracts

July 2 – 6, 2018

ICC Jeju, Korea

- ***Organized by***

  Optical Society of Korea (OSK)

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OECC 2018 Program

July 02 (Mon.)

		Samda Hall A (Room A)	Samda Hall B (Room B)	301 (Room C)	302 (Room D)	Halla Hall A (Room E)	303 (Room F)	Lobby(3F)
14:00-17:00	180'			Workshop Ⅰ Direct Detection vs. Coherent Detection for Short- and Intermediate-Haul Applications	Workshop Ⅱ Silicon Photonics			Registration (12:00-18:00)
17:00-18:00	60'	-						
18:00-20:00		**Get-Together Party (Ocean View, 5F)**						

July 03 (Tue.)

		Room A	Room B	Room C	Room D	Room E	Room F	Lobby(3F)
08:45-09:00	15'	Opening ceremony						Exhibition
09:00-09:45	45'	Plenary Talk Ⅰ - Roel Baets (Halla Hall, 3F)						
09:45-10:30	45'	Plenary Talk Ⅱ - Masatoshi Suzuki (Halla Hall, 3F)						
10:30-11:00	30'	Coffee Break						
11:00-11:45	45'	Plenary Talk Ⅲ - Sanghoon Lee (Halla Hall, 3F)						
11:45-12:30	45'	Plenary Talk Ⅳ - Chongjin Xie (Halla Hall, 3F)						
12:30-14:00	90'	Lunch						
14:00-15:30	90'	3A1 Mode Division Multiplexing	3B1 Direct-Detection Systems	3C1 Optical Fiber Applications	3D1 Silicon Photonics	3E1 Passive Devices	3F1 [Symposium Ⅰ] 10Giga Internet and Broadband Access	
15:30-16:00	30'	Coffee Break						
16:00-17:30	90'	3A2 Photonic Signal Processing 1	3B2 Capacity-Approaching Techniques	3C2 Specialty Fibers	3D2 Optical Transmitter 1	3E2 Integrated Photonics 1	3F2 [Symposium Ⅰ] 10Giga Internet and Broadband Access	

July 04 (Wed.)

		Room A	Room B	Room C	Room D	Room E	Room F	Lobby(3F)
08:30-10:00	90'	4A1 Photonic Signal Processing 2	4B1 High Spectral Efficiency	4C1 Fiber Fabrication and Applications	4D1 Optical Transmitter 2	4E1 Integrated Photonics 2	- -	Exhibition
10:00-10:30	30'	Coffee Break						
10:30-12:00	90'	4A2 Short Reach Networks	4B2 Light Propagation in Fiber	4C2 Fiber Amplifiers	4D2 Photonic Crystal	4E2 Silicon Photonics 1	4F2 [Industrial Ⅰ] High Power Fiber Lasers for Industrial Applications	
12:00-13:00	60'	Lunch						
13:00-14:00	60'	Poster Session Ⅰ (Lobby, 3F)						
14:00-15:30	90'	4A3 Optical Access for 5G 1	4B3 Nonlinear Transmission	4C3 Fiber Amplifiers and Light Sources	4D3 Optical Transmitter 3	4E3 Silicon Photonics 2	4F3 [Symposium Ⅱ] Recent Advances in Photonic Packaging Technologies	
15:30-16:00	30'	Coffee Break						
16:00-17:30	90'	4A4 Optical Wireless Access	4B4 SSB DD Systems	4C4 Fiber Lasers	4D4 Optical Receivers	4E4 Silicon Photonics 3	4F4 [Symposium Ⅱ] Recent Advances in Photonic Packaging Technologies	
17:30-18:30		-						-
18:30-20:30		**Banquet**						

July 05 (Thu.)

		Room A	Room B	Room C	Room D	Room E	Room F	Lobby(3F)
08:30-10:00	90'	5A1 Indoor Network	5B1 Polarization Issues & Monitoring	5C1 Optical Fiber Sensors	5D1 Secure & Free-Space Communications	5E1 Sensing Devices	- -	Exhibition
10:00-10:30	30'	Coffee Break						
10:30-12:00	90'	5A2 High Speed PON	5B2 Space Division Multiplexing	5C2 Nonlinear Interaction of Light	5D2 Photonic Integrated Circuits	5E2 Fiber Devices	5F2 [Industrial Ⅱ] 5G and Photonics	
12:00-13:00	60'	Lunch						
13:00-14:00	60'	Poster Session Ⅱ (Lobby, 3F)						
14:00-15:30	90'	5A3 Signal Processing for Access Network	5B3 High Capacity Transmission	5C3 Optical Fibers for SDM	5D3 Quantum Communication Devices	5E3 Photonic Devices 1	5F3 [Symposium Ⅲ] State of the Art in Distributed Fiber Sensors	
15:30-16:00	30'	Coffee Break						
16:00-17:30	90'	5A4 Optical Access for 5G 2	5B4 Transceiver Technologies	5C4 Specialty Fibers for High Power Lasers	5D4 Advanced Optical Devices 1	5E4 Photonic Devices 2	5F4 [Symposium Ⅲ] State of the Art in Distributed Fiber Sensors	
17:30-18:00		-						-
18:00-19:00	60'	PDP Session						

July 06 (Fri.)

		Room A	Room B	Room C	Room D	Room E	Room F	Lobby(3F)
08:30-10:00	90'	6A1 Novel Algorithm for Optical Network	6B1 Performance Monitoring	6C1 Distributed Fiber Sensing	6D1 Advanced Optical Devices 2	6E1 Photonics Devices 3	- -	-
10:00-10:30	30'	Coffee Break						
10:30-12:00	90'	6A2 Visible Light Communication	6B2 Technologies for Datacenter Applications	6C2 Access Network Technologies	6D2 Digital Signal Processing	-	-	

Tuesday, July 3

Room D (302)

[3D2] 16:00-17:30
Optical Transmitter 1
Session Chair : Nicola Calabretta (TU/e)

3D2-1 16:00-16:30 (30') Invited
Modeling Depletion-Type Si Ring Modulators
Woo-Young Choi[1], Minkyu Kim[1], Myungjin Shin[1], Byung-Min Yu[1], Christian Mai[2], Stefan Lischke[2], and Lars Zimmermann[2].
[1]Yonsei Univ., Korea, [2]IHP, Germany
For achieving monolithic integration of Si electronics and photonics, accurate and convenient-to-use models for Si photonic devices are very important. We present such amodel for depletion-type Si ring modulators.

3D2-2 16:30-17:00 (30') Invited
Ultra-Low-Power Microring Modulators for PAM and WDM Links
Wei Shi and Yelong Xu
Université Laval, Canada
We review our recent results on low-power microring modulators for pulse-amplitude modulation and high-quality frequency comb generation. This single-laser WDM solution is promising for next-generation optical interconnects.

3D2-3 17:00-17:15 (15')
A Wavelength Stabilization Integrated Circuit for 25-Gb/s Si Micro-Ring Modulator
Min-Hyeong Kim[1], Lars Zimmermann[2], and Woo-Young Choi[1]
[1]Yonsei Univ., Korea, [2]IHP, Germany
We demonstrate wavelength stabilization of Si micro-ring modulator (MRM) with an integrated circuit custom-designed in 0.25-μm BiCMOS technology. Our circuit controls the MRM temperature so that it can have the maximum optical modulation amplitude with 25-Gb/s modulation.

3D2-4 17:15-17:30 (15')
An Actively Mode-Locked Laser based on a 5th Order Micro-Ring Resonator
Qihong Wu[1], Yuhua Li[2], Shaohao Wang[3], Qian Li[1], and Sai Tak Chu[2]
[1]Peking Univ., China, [2]City Univ. of Hong Kong, China, [3]Fuzhou Univ., China
We present a mode locked laser configuration with an integrated 5th order micro-ring resonator, where highly stable pulse trains with single and multiple pulses per period have been achieved.

Room E (Halla Hall A)

[3E2] 16:00-17:30
Integrated Photonics 1
Session Chair : Benjamin J. Eggleton (The Univ. of Sydney)

3E2-1 16:00-16:30 (30') Invited
Silicon Nitride (TriPleX™) based Photonic Integrated Circuits for a Broad Range of Application Modules
Arne Leinse
LioniX Int'l, Netherlands
An overview of recent developments of the SiN based TriPleX™ Photonic-Integrated-Circuit technology is given. The unique features of the technology are explained and application examples in avariety of wavelength ranges are shown.

3E2-2 16:30-17:00 (30') Invited
Integrated Polarization Diversity Devices
Kyong Hon Kim[1], Yudeuk Kim[1], Yoohan Kim[1], Dong Wook Kim[1], and Moon Hyoek Lee[2]
[1]Inha Univ., Korea, [2]Heinrich Hertz Inst., Germany
Integrated polarization diversity devices, such as polarization beam splitter, polarization rotator, and polarizer, are very important in silicon-based photonic integrated circuits. The integrated polarization diversity devices are introduced, and experimentally demonstrated results are reported.

3E2-3 17:00-17:15 (15')
Two- and Three-Dimensional Polymer Directional Coupler for High-Density Optical Interconnects at 1550 nm
Xiao Xu, Lin Ma, and Zuyuan He
Shanghai Jiaotong Univ., China
We demonstrate two- and three-dimensional single-mode polymer directional coupler directly inscribed using a micro-dispenser. We successfully fabricated two-core couplers with splitting ratios of 0.95 and 0.52 and three-dimensional couplers operating at 1550 nm.

3E2-4 17:15-17:30 (15')
Analytical Investigation of Generic Form Expressing Adaptive Dispersion of Optical Fractional Fourier Transform Circuit
Tomohiro Naganuma and Hiroyuki Uenohara
Tokyo Inst. of Tech., Japan
We clarified the regularity of the dispersion performance of an optical fractional Fourier transform circuit, realizing variable dispersion compensation in an optical OFDM system. The generic form of dispersion performance is presented.

Room F (303)

[3F2] 16:00-17:30 [Symposium 1]
10Giga Internet and Broadband Access
Session Chair : Xiang Liu (Huawei)
T. Nirmalathas (The Univ. of Melbourne)

3F2-1 16:00-16:30 (30') Invited
State of Broadband Access and High Speed PON
Hyung Jin Park
KT, Korea

3F2-2 16:30-17:00 (30') Invited
Broadband Access in Japan and Flexible Optical Access
Sangyeup Kim
NTT Corp., Japan

3F2-3 17:00-17:30 (30') Invited
Deployment of 10G Internet and Broadband Access: Korean Story
Sung-uk Rha
NIA, Korea

Modeling Depletion-Type Si Ring Modulators

Woo-Young Choi, Minkyu Kim, Myungjin Shin, Byung-Min Yu,

Christian Mai*, Stefan Lischke*, and Lars Zimmermann*.

Department of Electrical and Electronic Engineering, Yonsei University, Seoul Korea

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Abstract

For achieving monolithic integration of Si electronics and photonics, accurate and convenient-to-use models for Si photonic devices are very important. We present such a model for depletion-type Si ring modulators.

Depletion-type Si ring modulators (RMs) have a very large potential for applications in high-performance optical interconnect systems, since they have the large modulation bandwidth and the small size [1, 2]. For optimal design of electronic-photonic ICs containing both Si RMs and electronic circuits, such Si RM models are required that are easy to use and compatible with standard IC design tools. In addition, the extraction of model parameters should be simple and straight-forward.

Various models for Si RM have been reported [3-5]. However, they either require a substantial amount of computation time or not very compatible with the standard IC design tools. A new approach that overcomes these problems has been proposed [6].

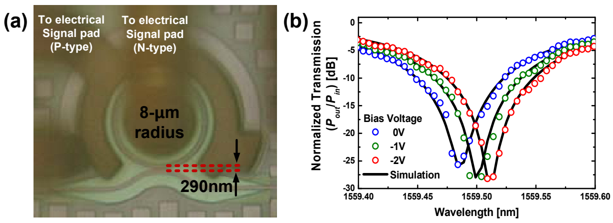

Fig. 1 (a) Chip photo of a fabricated Si RM and (b) Measured and simulated transmission characteristics at different V_{Bias}. [6]

Fig. 1(a) shows the structure of a Si RM used for the present investigation. It is fabricated by IHP Si photonics foundry service. Its characteristics can be accurately modeled by the coupled-mode equations [7]:

$$\frac{d}{dt}a(t) = \left(j\omega_r - \frac{1}{\tau}\right)a(t) - j\sqrt{\frac{2}{\tau_e}}E_i(t), \qquad (1)$$

$$E_o(t) = E_i(t) - j\sqrt{\frac{2}{\tau_e}}a(t). \qquad (2)$$

In the above equations, *a(t)* is the optical energy amplitude stored in the ring resonator, $E_i(t)$ and $E_o(t)$ are the input and the output optical field, respectively. ω_r is the ring resonance angular frequency given as ω_r = $2\pi mc/n_{res}L$, where m is an integer representing the resonance mode number, c is the velocity of light in vacuum, L is the ring circumference, and n_{res} is the effective index of the ring waveguide at the resonance. τ is the decay time constant for a(t), given as $1/\tau = 1/\tau_e + 1/\tau_l$ where τ_e and τ_l, represent the decay time constant in a(t) due to the coupling loss and input optical field, respectively.

If numerical values of three parameters (n_{eff}, τ_l, and τ_e) are known, the RM characteristics can be well modeled. For the extraction of these values, the minimum mean square error method is used for fitting the steady-state equation to the measured transmission characteristics. Fig. 1(b) shows the measured normalized transmission characteristics at three different bias voltages. Dots are measured results and solid lines are fitted results with extracted values.

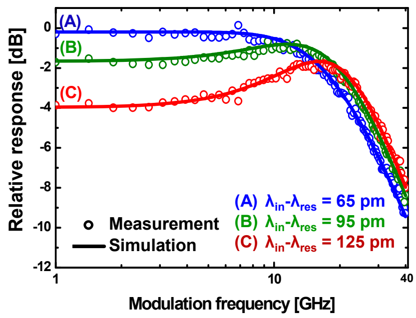

Fig. 2. Measured and simulated E/O frequency responses for different detuning values. [8]

With these parameters, the Si RM small-signal modulation frequency response in the s-domain can be derived from the couple-mode equations as [8]

$$G \cdot \frac{s + 2/\tau_l}{s^2 + (2/\tau)s + D^2 + 1/\tau^2} \qquad (3)$$

where D represents how much the input light angular frequency is detuned from the resonance angular frequency, G is the response gain given in terms of n_{eff}, τ_e, τ_l and D. Fig. 2 confirms the accuracy of this small-signal model with the measured results.

In order to implement the large-signal RM model which can provide the RM transient modulation characteristics, the coupled-mode equations can be

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numerically solved in Verilog-A [5]. However, this approach has limitation in that its simulation takes quite a long time for achieving high accuracy. A piece-wise linear model based on the equivalent circuit representing Eq. 3 can provide much fast computation in SPICE environment [6].

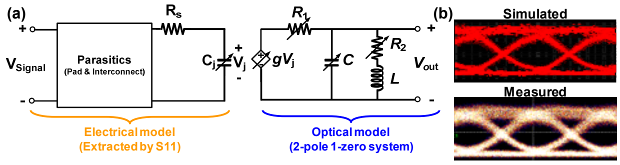

Fig. 3(a) A large-signal equivalent circuit model of Si RM and (b) Simulated (upper) and measured (lower) eye-diagrams for 2-V_{pp}, 25-Gbps, 2^{31}-1 PRBS input signal. [6]

Fig. 3(a) shows the equivalent circuit. It contains a block for parasitic components due to interconnects and pads, another for the electrical elements of the core p-n junction (R_s and C_j), and the third for a lossy LC tank emulating the Si RM small-signal modulation frequency response. Numerical values for the parasitic components as well as R_s and C_j can be easily determined by the standard electrical s-parameter measurement. Numerical values for R_1, R_2, C and L are determined from τ_l, τ and D. g is a unit-converting scaling factor. Varactors and variable resistors are used for accounting for bias-voltage dependence of these parameters. Fig. 3(b) shows the simulated eye-diagram (upper) and the measured result (lower), confirming the accuracy of our model.

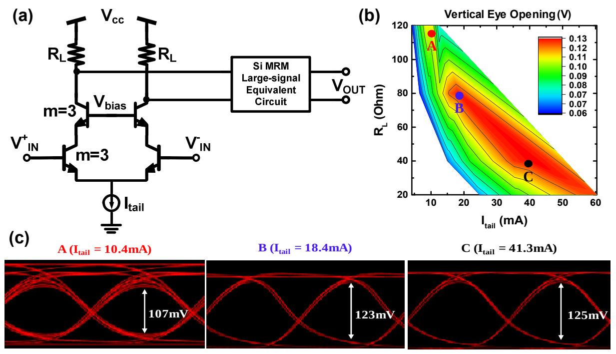

Fig. 4(a) Si Photonic transmitter based on Photonic BiCMOS technology, (b) Vertical eye opening for various R_L and Itail values, and (c) Simulated eye-diagrams at different I_{tail} and R_L combination. [6]

This new model can be very easily used for co-simulation of electronic circuits and Si RMs. Fig. 4(a) shows a schematic diagram for an integrated 25-Gbps Si photonic transmitter (Si RM and driver). Such an electronic-photonic integrated circuit can be fabricated monolithically with IHP's Photonic BiCMOS technology, which provides high-performance 0.25-µm SiGe BiCMOS circuits and Si photonic components on the same Si platform [9]. Fig. 4(b) shows the simulated vertical eye opening normalized to input optical power at different values of I_{tail} and R_L, two key parameters in the driver design that determine eye-opening, power consumption, and bandwidth. Fig. 4(c) shows simulated eye-diagrams at three different conditions represented by point A, B, C in Fig. 4(b). Clearly, the optimal combination of I_{tail} and R_L can be easily determined.

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