High-speed signal processing with silicon-organic hybrid devices

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A silicon-organic hybrid (SOH) platform combines CMOS technology with nonlinear organic cover materials. While strong light confinement is provided by silicon, its free-carrier limitations are avoided. We show 40 Gbit/s electro-optic modulation, all-optical 170 Gbit/s OTDM demultiplexing, and 56 Gbit/s DQPSK wavelength conversion.

Silicon-on-insulator (SOI) photonics opens a cost-effective CMOS-compatible route for fabricating optical devices. Because the third-order nonlinear susceptibility $\chi^{(3)}$ of Si is 200 times that of glass, and because the tight light confinement in Si waveguides with high refractive index contrast enhances the nonlinear response, on-chip optical signal processing would be feasible [1]. However, free carriers generated by two-photon absorption (TPA) in Si limit the maximum useable input power. To provide a $\chi^{(3)}$-nonlinearity without TPA, and to make second-order $\chi^{(2)}$-nonlinearities available, which do not exist in mono-crystalline silicon [2], we cover SOI waveguides with highly nonlinear organic materials. Such silicon-organic hybrid (SOH) systems show the strengths of both materials. Examples for waveguides with large $\chi^{(3)}$-nonlinearities were shown [3,4].

Here, we first demonstrate an SOH phase modulator with a bandwidth > 40 GHz, driven by 42.7 Gbit/s data, Fig. 1. An SOH slow-light Mach-Zehnder modulator was proposed recently [5]. Next, we show demultiplexing a 170.8 Gbit/s OTDM signal to its four 42.7 Gbit/s tributaries [6] via four-wave mixing (FWM). Finally, we discuss results on wavelength conversion with FWM [7,8], Fig. 2, and cross-phase modulation [9].

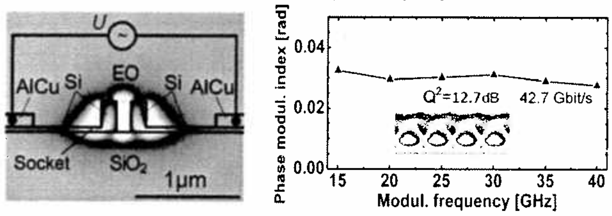

Fig. 1 SOH phase modulator (left) Socket waveguide cross-section, quasi-TE electric field magnitude. Slot filled with $\chi^{(2)}$-nonlinear electro-optic (EO) organic material (right) Phase modulation index vs. frequency with eye diagram for receiving 42.7 Gbit/s DPSK data

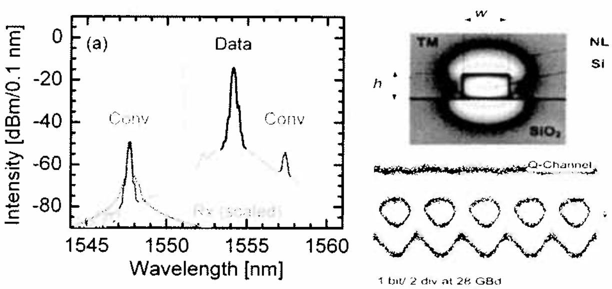

Fig. 2 FWM wavelength conversion of 56 Gbit/s NRZ-DQPSK data (left) Spectra (upper right) Strip waveguide covered with $\chi^{(3)}$-nonlinear organic material, quasi-TM electric field magnitude (lower right) Eye diagram of quadrature signal with BER = 10^{-5}

References

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[6] C. Koos et al., Nature Photon., **3**, 216-219, 2009
[7] T. Vallaitis et al., OFC, 2009. Paper OWS3
[8] T. Vallaitis et al., OFC, 2010. Paper OTuN1
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Room: Huygens — TOM 5

Amphithéâtre Fresnel — TOM 6

16:45

Experimental and numerical analysis of image wavelength conversion with a hydrogen Raman shifter

G.G. Manahan[1], M.L.Y. Torres-Mapa[1,2], W.O. Garcia[1]; [1]Univ. of the Philippines, National Institute of Physics (PH), [2]University of St. Andrews (UK).

We investigate the transfer of two dimensional image carried by the 2nd harmonics (532 nm) of the Nd:YAG laser to the first Stokes (683 nm) wavelength using a hydrogen Raman shifter. [3538]

Room: Maiman — TOM 7

16:45

Dimpled planar lightguide solar concentrators

B.L. Unger[2], G.R. Schmidt[2], D.T. Moore[1,2]; [1]ICO Elected Vice-President, Chair of the ICO Committee for Regional Development (US); [2]University of Rochester (US).

Lightguide concentrators show tremendous promise for thin form-factor, lightweight, and inexpensive replacements for the current generation of refractive and reflective solar concentrators. We propose a new type of structure for reducing optical losses and dramatically increasing the practical upper limit concentration within micro-structured lightguide concentrators. [3589]

Notes

17:00 - 17:30 coffee break (Bar terrasse)

17:30 — **INVITED TALK**

High-speed signal processing with silicon-organic hybrid devices

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17:30 — **INVITED TALK**

Solitonic supermodes and resonant radiation in subwavelength silicon-on-insulator waveguide arrays

A.V. Gorbach[1], W. Ding[1], O.K. Staines[1], C.E. de Nobriga[1], G.D. Hobbs[1], W.J. Wadsworth[1], J.C. Knight[1], D.V. Skryabin[1], A. Samarelli[2], M. Sorel[2], R.M. De La Rue[2]; [1]Centre for Photonics and Photonic Materials, Department of Physics, University of Bath (UK), [2]Department of Electronics and Electrical Engineering, University of Glasgow (UK).

We report theoretical and experimental investigation of resonant radiation by solitonic supermodes in an array of three silicon-on-insulator subwavelenth waveguides. Adjusting the input pulse position across the array, we observe different patterns in the radiation spectra corresponding to the different superpositions of solitonic supermodes. [3347]

17:30 - 17:45 ICO PRIZE AND GALILEO GALILEI AWARD CEREMONIES

For the ICO PRIZE AND GALILEO GALILEI AWARD CEREMONIES please see page 7.

Notes

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