Smart Photonics

Coherent photonic transmitters: what, how and when?

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Abstract
As capacity demands in optical communications continues to increase, and with standard single mode optical fibres (SMF) still prevailing as the main communications channel, techniques to maximise the spectral efficiency of SMF's available bandwidth are now moving from research to implementation. While DSP and higher order modulation formats are becoming widely available commercially, in particular for 400G-600G approaches, Tb/s capacities per transponder are likely to be achieved with multi-carrier schemes. In this talk, we will review the need for multi-carrier coherent transmitters, what they are and show potential configurations, discuss how to overcome foreseenble challenges, and especulate when this technology will be potentially ready.

Biography
Dr Gunning is a Senior Staff researcher and Head of Graduate Studies at Tyndall National Institute, and Senior Research Fellow at the Physics Department, University College Cork, Ireland. She worked previously at Corning Research Centre in UK, had several internships at British Telecom at Adastral Park in UK, and holds a Master and PhD degrees in Physics from Pontifícia Universidade Católica do Rio de Janeiro, Brazil. She was part of the team pioneering on Optical Coherent Wavelength Division Multiplexing (also known as “superchannels” or coherent transmitters) at Tyndall. Her current research focus on the development novel devices for high capacity systems at 1.5 and 2 microns wavelengths, and on incorporating adaptive physical layer solutions with Software Defined Networks for network efficiency, control and management. Dr Gunning collaborates closely with Tyndall’s semiconductor devices team on the next generation of integrated photonic devices, and incorporates high-speed testing at chip level in the lab. She also volunteers and leads initiatives to promote *Science in the community*, and in particular efforts to increase gender representation in Physics and Engineering at all levels. She’s the acting chair for Empowering Women Committee @ Tyndall, participates in UCC’s Athena Swan focus groups, champions Tyndall’s Centre of Integrated Photonics (IPIC) gender action plan and the IEEE Photonics Society as AVP for Multicultural Outreach.

Si and SiN High-Q microresonators for quantum and nonlinear optics applications

E. Pargon
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Abstract

Silicon is an attractive platform for correlated photon pairs sources that can be used for quantum cryptography and computing, while SiN On Insulator is promising for Kerr frequency comb source proposed in many nonlinear optics applications, such as on-chip spectroscopy, and terabit coherent communications. In both cases, high-Quality factor microresonators are required to get power-efficient nonlinear sources. The quality factor of the ring is directly correlated to the optical propagation losses caused by the material bulk or surface absorption, or scattering losses generated by roughness. In this work, we report on the fabrication and testing of Si and SiN microresonators with record values of quality factor.

In sub-micrometric Si waveguides, scattering loss is the primary source of optical propagation losses. High temperature H_2 annealing treatment was introduced in the fabrication process flow to minimize the Si sidewalls roughness at the atomic scale, enabling the fabrication of high intrinsic Q (>6 x 10^5) Si micro-resonators for on-chip heralded single photon quantum sources by spontaneous four-wave mixing. On the other hand, the absorption loss due to residual NH bonds in the SiN is the limiting factor for achieving low loss SiN waveguide. By introducing high temperature N_2 annealing treatment in the process fabrication, we demonstrate critically coupled SiN resonators with intrinsic quality factors of $Q > 6x10^6$ using high-confinement waveguide dimensions (1.7-µm-wide, 820-nm-thick) with corresponding optical losses approaching 5 dB/m. The statistical study performed on 200mm wafer shows a variability of the optical results of 0.8% which proves the high reproducibility of the fabrication process. Using such high-quality factor devices, we report the possibility to generate Kerr frequency combs at sub-mW input powers coupled into the bus high-confinement waveguide.

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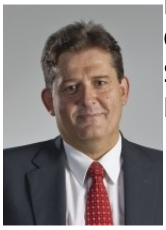
Biography

Erwine Pargon is currently associate researcher at the “Laboratoire des Technologies de la Microélectronique” (LTM), a joint academic unit of the CNRS and Grenoble Alpes University in Grenoble, France. She received her M.S. in 2001 and Ph. D. in 2004 in Material Sciences from the University of Grenoble-Alpes. After a year of research at the Chemical Engineering department of UC Berkeley in USA, she joined in 2006 the LTM/CNRS located on the CEA/LETI site of Grenoble. At LTM, she has the capability to conduct applied research in a professional environment allowing unique partnerships with key players of the Microelectronics industry. Her research focuses on the development and characterization of plasma etching processes involved in the elaboration of advanced devices for microelectronic, photonics and photovoltaics applications. The common objective of her research work is the development of damage free plasma etching processes. In particular, she worked on an important issue in plasma patterning, the pattern sidewalls roughness, that affects device performances whatever the targeted applications. She proposed methods to characterize it accurately and to minimize it. She has co-authored more than 70 papers in peer reviewed journals and has participated to about 30 invited talks at international conferences. In 2010, she was awarded the Bronze Medal of CNRS for her research achievements. She led the LTM etch team from 2008 to 2010. She is a regular reviewer of several international journals (JVST, Plasma process and polymer, Microelectronic engineering..). She is a committee member of the “Advanced Etch Technology for Nanopatterning” conference of the SPIE since 2012, of the Plasma Etch and Strip in Microelectronics (PESM) workshop since 2013 and of the Plasma Science Technology Division of the AVS Symposium since 2017.

COMMUNICATE, SENSE WITH LIGHTGenerating, Modulating, Routing, Filtering, and Detecting Light on Siliconwith Mass Manufacturable Semiconductor Integrated Circuit



P. Langlois
Chairman of the board and Deputy CEO
Scintil Photonics SAS, Management, Grenoble, France

Abstract
Leveraging Silicon photonics and 3D technologies developed at CEA-Leti over the past 15 years, SCINTIL Photonics was created to industrialize and commercialize the next generation of high-speed optical interconnects.
With unique fully integrated photonic solutions, SCINTIL Photonics will boost big ASICs with multi-terabit per second (Tbps) I/O bandwidth for Cloud demanding applications like Machine learning and Artificial Intelligence.
While 'Silicon Photonics technology' is now a best seller for 100 Gigabit per second (Gbps) optical interconnects in Data centers, the lack of integrated lasers on Silicon prevents the solutions from scaling to higher bit rates with Wavelength Division Multiplexing (WDM). Indeed, Silicon Photonics technology still requires Indium Phosphide (InP) based laser sources to be individually and precisely packaged to the silicon photonic circuit, making it difficult to use several lasers.
In addition, next generation interconnects need to get closer to the host ASICs for speed purposes and therefore need to be co packaged with them. Solutions coming into the form of fully integrated circuits that can be packaged with advanced 3D integration technologies are highly awaited.
SCINTIL combines the best of Si and InP materials using wafer-scale bonding of InP on Si and Relying on existing Commercial Silicon foundry processes.
SCINTIL technology will be presented, with mass production capability of photonic fully Integrated Circuits for 800 Gbit/sec and above transceivers.
through WDM 400G, 800G, 1600G - and complex modulation.
Scintil Photonics can also make technology and supply chain available for realization of lidar, cryptography devices and chip to chip optical interconnect which is vital for Hpc and AI

Biography
Pascal LANGLOIS cofounded Scintil Photonics on November 2018 with Doctor Sylvie Menezo CEO .
He is serving as Chairman of the board and deputy CEO. Most recently, Langlois was President and CEO of Tronics Microsystems, a Mems company he successfully introduce on Euronext Stock market in February 2015 and which was acquired by TDK Group end of 2016. Prior to that he was Chief Sales and Marketing Officer at ST-Ericsson and from 2006, Founder of NXP and part of the executive management team responsible for global commercial operations. He was previously with Philips Semiconductors BV, where he served in various capacities, including Senior Vice President of Sales and Marketing for multimarket products and Vice President/General Manager of the automotive global market segment. He also worked with National Semiconductors, and VLSI Technology, where he held various executive management positions.
Pascal graduated with a Bachelor in technology from the University of Paris, and attended strategy and organization executive program from Stanford University.

High performance photonic technologies for communication and sensing applications

A. Mai
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Abstract
Photonic integrated circuits (PICs) have been subject of intense research and gained increased attention during last decades. Different wafer level technologies based on silicon-on-insulator offer platforms for novel advanced application areas as high data rate communication and photonic
bio-sensing. Silicon photonic devices have the advantage that they are highly capable of being integrated, which allows an efficient combination of electronic and photonic devices with digital and analogue devices in electronic-photonic-integrated circuit (EPIC) technologies. However, silicon has drawbacks in terms of material properties and therefore in performance. In this talk, we present current progress in joint module developments of SiGe heterojunction bipolar transistors and related BiCMOS technologies in conjunction with monolithic integrated silicon photonic components. Moreover, recent results of novel integration concepts will be presented showing the potential to overcome material limitation of silicon in terms of electro-optic effects. This is followed by a brief overview of silicon-based photonic sensors for biochemical sensing. We discuss integration concepts, which are compatible to standard CMOS technologies showing the potential for future high performance silicon photonic technologies.

Biography
Prof. Dr. rer. nat. Andreas Mai received his diploma degree in physics from the Technical University of Brandenburg jointly with AMD Saxony in 2006 and his PhD in 2010. He joined the “Process Integration” group of IHP Technology Department in 2006 and he focused on the development of a 130nm SiGe-BiCMOS technology for mm-wave applications and the integration of RF-LDMOS transistors. He became group leader of the “Process Integration” team at IHP in 2012 and Head of the “Technology-Department” in 2015. Since 2018 he hold a professorship at the technical University of Applied Science Wildau for “Micro- and Nanoelectronics”. He is an IEEE member, Chair of the “ECS-SiGe Processing” symposia and head of the Joint-Lab between University of Applied Sciences Wildau and IHP.

Micron-scale low-loss silicon photonics for communication and sensing

T. Aalto
VTT, Espoo, Finland

Abstract
This presentation gives an overview of the micron-scale silicon waveguide platform at VTT. This includes low-loss and polarization independent waveguides, components and photonic integrated circuits. Photonic integrated circuits (PICs) are primarily based on 3 μm thick silicon-on-insulator (SOI) waveguides, while some work is also done with 12 μm thick SOI waveguides. Latest results are provided about power-efficient switches and phase modulators, polarization splitters and rotators, and monolithic Ge photodiodes (up to 40 GHz). A path towards monolithically integrated, broadband isolators and high-speed modulators is shown. Some examples of III-V hybrid integration on SOI and optical I/O coupling are also given. This includes up-reflecting mirrors, which support wafer-level testing and packaging, as well as broadband anti-reflection coatings. Main focus will be on concepts that support dual-polarization and high-power operation over the continuous wavelength range from 1.2 to 1.8 μm, and also mid-infrared operation up to 5 μm wavelength.

Biography
Dr. Timo Aalto has worked at VTT since 1997 with the primary research focus on silicon photonics. He received his M.Sc. and D.Sc. degrees in optoelectronics technology from the Helsinki University of Technology in 1998 and 2004, respectively. He leads the Photonics Integration team that is the key user of VTT's clean room facilities in Espoo (Micronova) and Oulu. He has ~80 peer-reviewed journal and conference publications. He has reviewed EU projects, journal articles and theses, and written one book chapter. He has coordinated several large projects funded by EU, the European space agency, national funding organizations and industry.

Foundry model for low-cost versatile photonic integrated circuits

L. Augustin
CTO
SMART Photonics, Eindhoven, Netherlands

Abstract
InP based photonic components have been around for some time and have proven to be a reliable source for communication systems. InP offers the possibility to monolithically integrate high performance active and passive components. These aspects, and the introduction of generic platforms: highly standardized industrial photonic integration processes that enable realization of a broad range of applications, will lead to a dramatic reduction of the development costs of PICs which will bring them within reach for many. This talk will address the integration platform from a foundry perspective: the integration technology, the opportunities and the scale-up to large volumes.

Biography
Luc Augustin received the M.Sc. and Ph.D. degree in Electrical Engineering from Eindhoven University of Technology, The Netherlands. After his graduation, he went to industry, to work at Cedova, and Philips Research, and later in photovoltaics at Solland Solar. He returned to the field of integrated photonics at TU Eindhoven to become part of the founding team of SMART Photonics where he is the CTO. He has been active in the development, (pilot) production and optimization of innovative technologies.
He is member of the steering commitee at JePPIX, the Joint European Platform for Photonic Integrated Circuits and board member of IEEE Photonic Benelux society. He is (co-)author of more than 70 papers.