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Title: Optically pumped broadband LED emission coupled to SOI waveguides

Submitted to symposium M

by Authors : Paolo Cardile (1), Andreas De Groote (2,3), Ananth Z. Subramanian (2,3), Danae Delbeke (2,3), Roel Baets (2,3), Gunther Roelkens (2,3)
Affiliations : (1) Center for Microsystems Technology, Ghent University - IMEC, Ghent, Belgium
(2) Photonics Research Group, Department of Information Technology, Ghent University - IMEC, Ghent, Belgium
(3) Center for Nano- and Biophotonics (NB-Photonics), Ghent University, Ghent, Belgium

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Abstract :
Silicon photonics, widely used for applications in telecom and datacom, has been recently proposed as an emerging platform also for bio-sensing. Among the main advantages of silicon photonics circuitry, we can list the fact of being a low-cost technology, together with the excellent quality of the passive photonics components that can be fabricated in the state-of-the-art CMOS fabs. In addition to that, silicon waveguides allow broadband operations in IR and mid-IR spectral region, thus permitting sensing at various wavelengths. However, silicon is still a material with indirect band-gap, thus it remains a very poor light emitter. Many attempts have been done to integrate an efficient light source onto a silicon waveguide, of which the most preferred solution is the heterogeneous integration of a III-V stack, being III-V a class of materials which can provide excellent light sources (both LEDs and lasers).
For the applications related to bio-sensing, and particular spectroscopic sensing, there is a need of an efficient broadband light source, that can optically probe the analytes and that can be efficiently integrated with the photonic circuitry. Here we propose the integration of a thin III-V (InP based) membrane on top of an SOI waveguide in order to create an efficient optically pumped LED.
The membrane is obtained by physically attaching a III-V stack onto the SOI chip and by various post-processing steps, removing the unnecessary capping layers and creating a certain geometry by optical lithography and wet and dry etching steps.
Simulations demonstrate that it is possible to design the III-V membrane in such a way that light can be efficiently coupled to the SOI waveguides from the membrane and vice-versa. In fact, under a proper excitation pump, a significant fraction of the spontaneous emission from the LED is coupled back into the waveguide. We demonstrated that such a light source is broadband and can be easily demultiplexed, in order to be able to perform on-chip spectroscopy. A correlation between the carrier lifetime and the geometrical parameters of the LED demonstrates the role of the side-walls of the LED and the fabrication-induced defects.

The sessions will include also the following devices and application areas

- light emitters and detectors
- modulators, optical switches
- resonators, photonic crystals plasmonic sensors
- integrated waveguide sensing
- building blocks for telecommunication

List of invited speakers *(confirmed)*:

- Ryan Bailey (University of Illinois Urbana USA)
- Silke Christiansen (Helmholtz-Center for Materials and Energy Berlin -HZB- Germany) *"Three-dimensional silicon based nano-architectures for energy conversion and sensing"*
- Philippe Fauchet (Vanderbilt University USA) *"Photonic crystals for sensors"*
- Ewold Verhagen (FOM Institute The Netherlands) *"Nano-optomechanical sensing with subwavelength light fields"*
- Romain Quidant (ICFO - The Institute of Photonic Sciences Spain) *"Nanoplasmonics for biosensing"*
- Gunther Roelkens (University of Ghent, Belgium) *"III-V on silicon photonic integrated circuits for optical communication and sensing"*
- Ioannis Raptis (Institute of Nanosciences & Nanotechnologies (INN) NCSR "Demokritos", Greece)
- Markus Schmidt (IPHT Jena, Germany) *"Hybrid fibers a new base for plasmonic nanoprobes and optofluidic nanoparticle sensing"*
- Pol Van Dorpe (IMEC, Belgium)
- Ralf B. Wehrspohn (Fraunhofer Institute, Germany) *"Stable field-enhanced emission and surface ionization from silicon nano-tip arrays"*

List of scientific committee:

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- Blas Garrido - Universitat de Barcelona, Spain
- Peter Masher - McMaster University, Canada
- Daniel Navarro Urrios - CNR-NEST, Italy
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Resume : Silicon photonics, widely used for applications in telecom and datacom, has been recently proposed as an emerging platform also for bio-sensing. Among the main advantages of silicon photonics circuitry we can list the fact of being a low-cost technology, together with the excellent quality of the passive photonics components that can be fabricated in the state-of-the-art CMOS fabs. In addition to that, silicon waveguides allow broadband operations in IR and mid-IR spectral region, thus permitting sensing at various wavelengths. However, silicon is still a material with indirect band-gap, thus it remains a very poor light emitter. Many attempts have been done to integrate an efficient light source onto a silicon waveguide, of which the most preferred solution is the heterogeneous integration of a III-V stack, being III-V a class of materials which can provide excellent light sources (both LEDs and lasers). For the applications related to bio-sensing, and particular spectroscopic sensing, there is a need of an efficient broadband light source, that can optically probe the analytes and that can be efficiently integrated with the photonic circuitry. Here we propose the integration of a thin III-V (InP based) membrane on top of an SOI waveguide in order to create an efficient optically pumped LED. The membrane is obtained by physically attaching a III-V stack onto the SOI chip and by various post-processing steps, removing the unnecessary capping layers and creating a certain geometry by optical lithography and wet and dry etching steps. Simulations demonstrate that it is possible to design the III-V membrane in such a way

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