Title: Optically pumped broadband LED emission coupled to SOI waveguides

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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
- resonant, photonic crystals, plasmonic sensors
- integrated waveguide sensing
- building blocks for telecommunication

List of invited speakers (confirmed):

- Ryan Bailey (University of Illinois, Urbana, USA)
- Sivle Christensen (Helmholtz Center for Materials and Energy, Berlin, Germany); "Three-dimensional silicon based nano-architectures for energy conversion and sensing"
- Philippe Fauchet (University of Pennsylvania, USA); "Photonic crystals for sensors"
- Ericd Verheugen (FOM Institute, The Netherlands); "Nano-optomechanical sensing with subwavelength light fields"
- Roman Gudaitis (GFO - The Institute of Photonic Sciences, Spain); "Nanoplastics for biosensing"
- Gertjan Roelkens (University of Ghent, Belgium); "W-V on silicon electronic integrated circuits for optical communication and sensing"
- Ioannis Repas (Institute of Nanosciences & Nanotechnologies, IONN, NCSR Demokritos, Greece)
- Markus Schmidt (IPHT Jena, Germany); "Hybrid fibers: a new base for plasmonic nanophotonics and optofluorescent nanoparticle sensing"
- Pat van der Putte (IMEC, Belgium)
- Ralf T. Wiesendanger (Fraunhofer Institute, Germany); "Stable field-enhanced emission and surface waves from silicon nano-IP arrays"

List of scientific committee:

- Katerina Dehmova - University of Amsterdam, The Netherlands
- Eulogio Carrió - Universitat de Barcelona, Spain
- Peter Musher - Naval Postgraduate School, Canada
- Damiel Navarro - CNR NEST, Italy
- Alina Nazarov - NAS Ukraine, Kiev
- Lorenzo Pavese - University of Trento, Italy
- Joerg Schirmer - University of Stuttgart, Germany
- Rosa B. Simó - Instituto de Optica, CSIC, Spain
- Anazay Zayats - King's College, England

Publications:
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Resume: Silicon photonics, widely used for applications in telecommunication and datacom, has been recently proposed as an emerging platform also for bio-sensing. Among the main advantages of silicon photonics circuitry is 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 this, silicon waveguides allow broadband operation in the visible and near-IR spectral region, thus permitting sensing at various wavelengths. However, silicon still suffers from 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, all of which met with limited success. In this paper, we present the integration of a thin-film polymer (TFP-based) membrane SOI waveguide in an SOI waveguide in order to create an efficient optically pumped LED. The membrane is obtained by physically attaching a TFP atom on top of 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 TFP membrane in such a way...
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