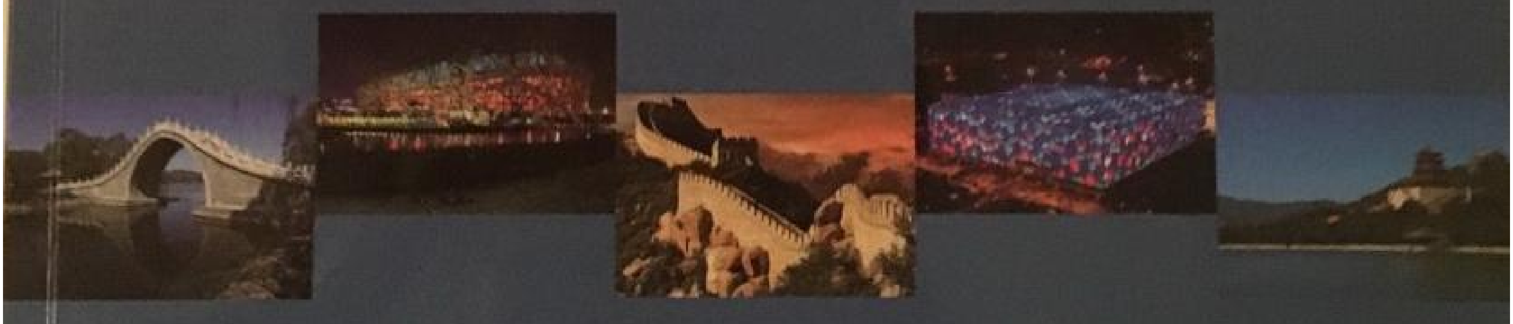
MIOMD-XIII

The 13th International Conference on Mid-IR Optoelectronics: Materials and Devices

September 18th-22th, 2016
Beijing, China

PROGRAM & ABSTRACTS



Conference Chair: Li He

Shanghai Institute of Technical Physics, Chinese Academy of Sciences

Heterogeneous integration of InP-based type-II active devices on silicon for 2 μm wavelength range on-chip spectroscopy

Ruijun Wang[1,2]*, Stephan Sprengel[3], Muhammad Muneeb[1,2], Gerhard Boehm[3], Aditya Malik[1,2], Roel Baets[1,2], Markus-Christian Amann[3], Gunther Roelkens[1,2]

[1] *Photonics Research Group, Ghent University-imec, Technologiepark-Zwijnaarde 15 iGent, 9052 Ghent, Belgium*

[2] *Center for Nano- and Biophotonics (NB-Photonics), Ghent University, Ghent, Belgium*

[3] *Walter Schottky Institut, Technische Universität München, Am Coulombwall 4, 85748 Garching, Germany.*

Silicon photonics has emerged as one of the most prominent integrated photonics platforms as it takes advantage of mature CMOS processes, allowing the fabrication of large scale photonic circuits with low cost. Since many important industrial gases have strong absorption lines in the 2 μm wavelength range, the development of silicon photonic ICs in this wavelength range enables many applications.

Here we present the heterogeneous integration of InP-based type-II active devices on silicon-on-insulator (SOI) waveguide circuits for on-chip spectroscopy. Adhesive bonding technology using a 100 nm thick benzocyclobutene layer as bonding agent is used to integrate III-V devices on SOI. The active region of the heterogeneously integrated III-V devices consists of a "W"-shaped InGaAs/GaAsSb quantum well structure, which was used to realize InP-based type-II lasers for wavelengths up to 2.7 μm. Figure 1(a) shows a microscope image of an InP-based type-II superluminescent light emitting diode (SLED) integrated with an SOI arrayed waveguide grating (AWG). The light is efficiently coupled from the III-V active region to the silicon waveguide using a spot size converter by tapering both the III-V waveguide and silicon waveguide. Broadband light between 2.2 μm and 2.45 μm with peak position around 2.35 μm is coupled to the AWG as shown in Fig. 1(b). The broadband light is filtered by the AWG and coupled to different channels with a channel spacing of 5 nm and free spectral range of 50 nm. The AWG insertion loss and crosstalk is estimated to be 3 dB and -22 dB, respectively. Besides light sources, photodetectors are also one of the key components that should be developed for a functional integrated spectroscopic system. An array of adiabatically-coupled photodetectors is integrated with an SOI AWG spectrometer as shown in Fig. 2(a). The light is coupled from silicon waveguide to photodetector absorbing active region using a similar taper structure as above. The photodetectors show a responsivity of 1.6 A/W at 2.35 μm wavelength and dark current of 10 nA at −0.5 V. With integrated photodetectors, the AWG exhibits an insertion loss of 3dB and crosstalk level of -27dB. The type-II structure used for integrated photodetectors is same to what is used for the SLED, which enables the realization of a fully integrated spectroscopic sensing system.

*corresponding author: ruijun.wang@intec.ugent.be

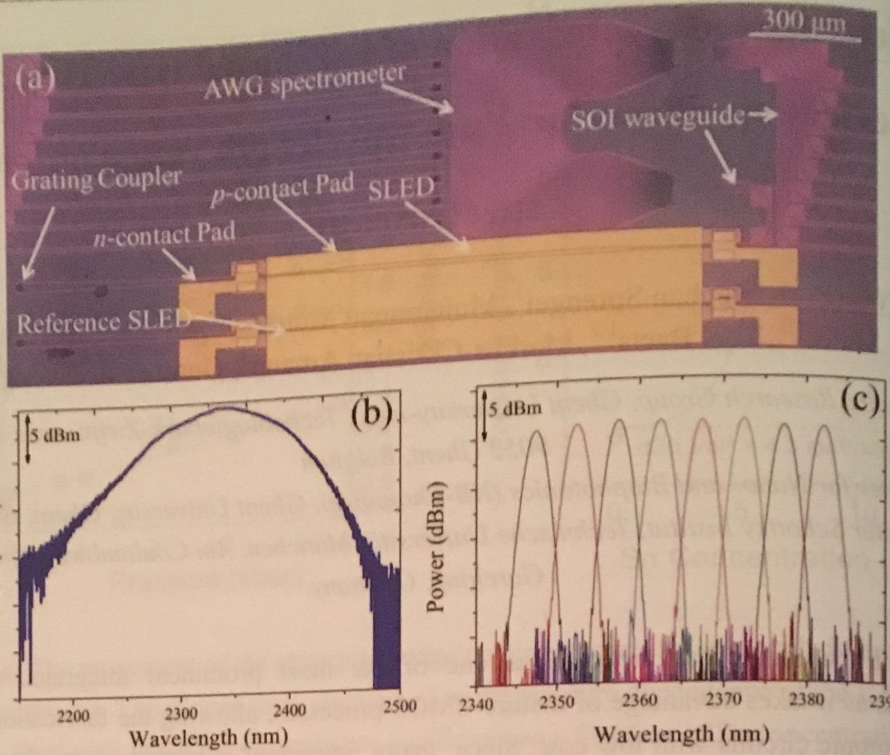


Fig.1. (a) Microscope image of an AWG integrated with an InP-based type-II SLED, (b) fiber-coupled emission spectrum of the heterogeneously integrated SLED, (c) filtered spectrum of the light coupled from SLED to the different channels of the AWG.

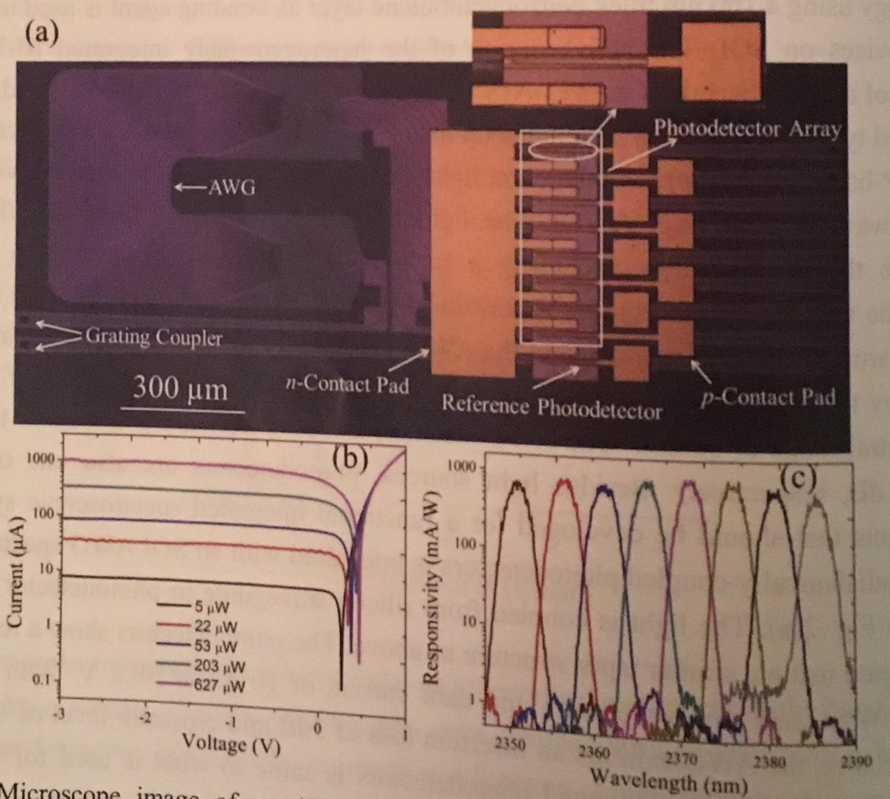


Fig.2. (a) Microscope image of an AWG integrated with InP-based type-II photodetectors, (b) photoresponse of the heterogeneously integrated photodetector under different input power, (c) response of the AWG spectrometer integrated with type-II photodetectors.