mi4sens

international workshop on opportunities and challenges in mid-infrared laser-based gas sensing

15 - 17 May 2017
Wrocław, Poland

Book of abstracts

Monday – 15.05.2017			
8:00	***Reception desk open***		
9:00	9:10	***Opening Address***	
9:10	9:40	**R. Strzoda**	In-line Cascade Laser Spectrometer for Process Control - iCspec Project
SESSION: Sensing systems I			
9:40	10:20	**P. Kaspersen**	Laser-based Spectroscopy – A Success Story?
10:20	11:00	**G. Wysocki**	Interband Cascade Laser-Based Dual-comb Multi-Heterodyne Spectroscopy of Small and Large Molecules
11:00	11:20	***Coffee break***	
SESSION: Sensing systems II			
11:20	11:40	**F. Tittel**	Recent Advances and Applications of Mid-infrared Cavity and Quartz Enhanced Photoacoustic Spectroscopy
11:40	12:00	**P. Kluczyński**	Multi-component Mid-IR Tunable Laser Analyzers for Process Control
12:00	12:20	**K. Krzempek**	Photothermal Spectroscopy of NO at 5.2 μm Using Quantum Cascade Laser and Near-infrared Heterodyne-based Detection
12:20	12:40	**J. Waclawek**	2f-Wavelength Modulation Fabry-Perot Photothermal Interferometry
12:40	13:00	**A. Hudzikowski**	Compact, Low Power Mid-infrared Methane Isotope $^{13}CH_4$ and $^{12}CH_4$ Sensor Using Room-temperature CW Interband Cascade Laser (ICL)
13:00	14:00	***Lunch break***	
SESSION: Detectors & sources in MIR I			
14:00	14:40	**M.-C. Amann**	Single-mode Tunable VCSELs for the 2-4 μm Wavelength Range
14:40	15:20	**J. Piotrowski**	Recent Progress in Development of Mid-IR Detection Modules for Gas Analyzers
15:20	15:40	***Coffee break***	
SESSION: Detectors & sources in MIR II			
15:40	16:00	**F. Kapsalidis**	Stable, High-Power Quantum Cascade Laser Frequency Combs Operating in Room Temperature
16:00	16:20	**A. Pfenning**	GaSb-based Resonant Tunneling Structures with Ternary Prewell Injectors for Room Temperature Mid-Infrared Applications
16:20	16:40	**K. Pierściński**	Analysis of Heat Dissipation Schemes in QCLs
16:40	17:00	**V. Gramich**	Type-II Superlattice Photodetector Developments in the Mid-Infrared Region
17:00	17:20	**R. Wang**	Widely Tunable 2.3 μm InP-based Type-II DFB Laser Array Heterogeneously Integrated on Silicon for Sensing
17:20	17:40	**M. Motyka**	Carrier Dynamics in GaSb-based Quantum Wells Emitting in the 2 μm Range
17:40	***End of the day***		
19:30	***Conference Dinner in Downtown***		

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Widely Tunable 2.3 μm InP-Based Type-II DFB Laser Array Heterogeneously Integrated on Silicon for Sensing

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Recently developed silicon photonics platforms offer possibilities to realize miniature and low-cost optical gas sensors. Although the silicon photonics platform is well-developed for the telecommunication wavelength range, development of silicon photonics integrated circuits (PICs) in 2-3 μm range can have a broad range of applications since most important industrial gases have strong absorption lines in this wavelength range. For an integrated gas sensor based on tunable diode laser absorption spectroscopy technology, a tunable single mode laser on silicon is the key component that should be developed. Here we demonstrate a widely tunable InP-based type-II DFB laser array heterogeneously integrated on silicon.

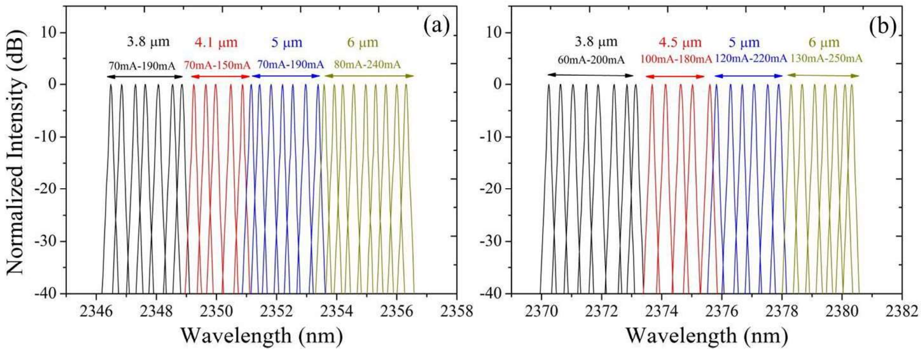

Fig. 1. Emission spectra of heterogeneously integrated DFB laser arrays with grating period of 353 nm (a) and 357 nm (b).

Detailed information about the InP type-II DFB laser device structure can be found in [1]. In continuous-wave (CW) regime, the laser can operate up to 25˚C, achieve an output power of 3 mW and have a threshold current density of 1.6 kA/cm^2 at a heat-sink temperature of 5 ˚C. The CW operated laser array covers a wavelength range from 2.28 μm to 2.43 μm as the DFB grating period (defined in the silicon waveguide layer) varies from 343 nm to 368nm. 1nm change in DFB grating period results in ~ 6 nm shift in lasing wavelength. In order to achieve continuous tuning in the laser array, lasers with different III-V waveguide width are fabricated. Figure 1 shows the normalized emission spectra of two DFB laser arrays with grating period of 353 nm and 357 nm respectively. Each array consists of four lasers with different III-V waveguide width. The spacing (~2.5 nm) of the lasers in the arrays is sufficiently small such that each array can continuously cover a 10 nm wavelength range by tuning the injected current. The DFB laser array can be used to simultaneously detect several gas species with a single III-V-on-silicon sensor.

[1] R. Wang, S. Sprengel, et al., *Appl. Phys. Lett.*, **109**, 221111 (2016).