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43RD FREIBURG INFRARED COLLOQUIUM ABSTRACT BOOKLET

FREIBURG INFRARED COLLOQUIUM

MARCH 14 – 15, 2017

QCL & ICL

10:30 – 11:00 **6.1** **Invited Paper: Monolithically integrated quantum cascade laser and detection devices**
G. Strasser
Institut für Festkörperelektronik und Zentrum für Mikro- und Nanostrukturen, Technische Universität Wien, Austria

11:00 – 11:30 **6.2** **Invited Paper: New developments in quartz enhanced photoacoustic gas sensing**
V. Spagnolo[1], A. Sampaolo[1,2], P. Patimisco[1,2], H. Zheng[2,3], M. Giglio[1,2], L. Dong[3], F.K. Tittel[2]
[1] Dipartimento Interateneo di Fisica, Politecnico of Bari, CNR-IFN U.O.S. BARI, Italy
[2] Department of Electrical and Computer Engineering, Rice University, Houston, Texas, USA
[3] State Key Laboratory of Quantum Optics and Quantum Optics Devices, Institute of Laser Spectroscopy, Shanxi University, Taiyuan, China

11:30 – 11:45 **6.3** **Low threshold room temperature continuous wave operation of DFB - ICLs in the 4.5 µm range**
R. Weih[1], J. Koeth[1], M. Fischer[1], M. Kamp[2], S. Höfling[2]
[1] nanoplus Nanosystems and Technologies GmbH, Gerbrunn, Germany
[2] Technische Physik, Physikalisches Institut, Universität Würzburg and Wilhelm Conrad Röntgen Research Center for Complex Material Systems, Universität Würzburg, Germany

11:45 – 12:00 **6.4** **Widely tunable DFB QCL arrays for spectroscopic application**
G. Maisons[1], C. Gilles, J. Abautret[1], M. Brun, A. Hangauer[2], A. Popescu[2], R. Strzoda[2], and M. Carras[1]
[1] mirSense, Centre d'intégration NanoInnov, Palaiseau, France
[2] Siemens AG, Corporate Technology, München, Germany

12:00 – 12:15 **6.5** **Design strategies for THz generation in nonlinear quantum cascade lasers**
F. Demmerle, W. Oberhausen, J. Bissinger, H. Schmeiduch, G. Böhm, and M.-C. Amann
Walter Schottky Institut, TU München, Garching, Germany

12:15 – 13:30 **Lunch**

Monolithically integrated quantum cascade laser and detection devices

Gottfried Strasser*,[1]

[1]*Institut für Festkörperelektronik und Zentrum für Mikro- und Nanostrukturen, Technische Universität Wien, Floragasse 7, A-1040 Wien, Austria*

Optical sensors for mid-infrared spectroscopy are widely used in industrial and environmental monitoring as well as medical and biochemical diagnostics. Conventional optical sensing setups include a light source, a light-analyte interaction region and a separate detector. We present a sensor concept, based on a bi-functional quantum cascade heterostructure, for which the differentiation between laser and detector is eliminated. This enables mutual commutation of laser and detector, simplifies remote sensing setups and facilitates a crucial miniaturization of sensing devices.

Liquid sensing utilizing bi-functional quantum cascade lasers/detectors (QCLDs) can be realized on a single chip [1]. A QCL active region design with an additional detection capability at the laser emission wavelength allows a straightforward integration, where different parts of the chip are used for lasers and others for detectors. The performance of such bi-functional designs has been optimized to reach a similar laser performance as conventional QCLs, allowing for high duty cycle operation at room-temperature.

Sensing liquids utilizes surface plasmon polaritons to allow a strong interaction within a short distance. Different distributed-feedback-laser/waveguide/detector units can be combined on a single chip, to use the inherent selectivity of the mid-infrared region.

Typical analyte interaction lengths for gas sensing are in the range of tens of centimeters or more and exceed the common semiconductor chip sizes. Our gas sensing approach incorporates surface-active lasers and detectors [2]. The latest demonstrator consists of two concentric ring QCLDs with second order distributed feedback (DFB) gratings on top of the waveguides. These DFB gratings facilitate vertical light emission [3] and detection in the biased lasing and unbiased detector configuration, respectively. The two rings emit at two different wavelengths, which provides room temperature lasing and detection of two wavelengths monolithically integrated on the same chip.

References:

[1] B. Schwarz, D. Ristanic, P. Reininger, T. Zederbauer, D.C. MacFarland, H. Detz, A.M. Andrews, W. Schrenk, G. Strasser, "High performance bi-functional quantum cascade laser and detector", Appl. Phys. Lett. 107(7), 071104/1-3 (2015)

[2] A. Harrer, R. Szedlak, B. Schwarz, H. Moser, T. Zederbauer, D. MacFarland, H. Detz, A.M. Andrews, W. Schrenk, B. Lendl, G. Strasser, "Mid-infrared surface transmitting and detecting quantum cascade device for gas-sensing applications", Scientific Reports 6, 21795 (2016)

[3] R. Szedlak, A. Harrer, M. Holzbauer, B. Schwarz , J. Waclawek, D. MacFarland, T. Zederbauer, H. Detz, A.M. Andrews, W. Schrenk, B. Lendl, G. Strasser, "Remote sensing with commutable monolithic laser and detector", ACS Photonics 3(10), 1794–1798 (2016)

*Corresp. author: gottfried.strasser@tuwien.ac.at, Phone: +43-1-58801-362-30, Fax: +43-1-58801-362-99