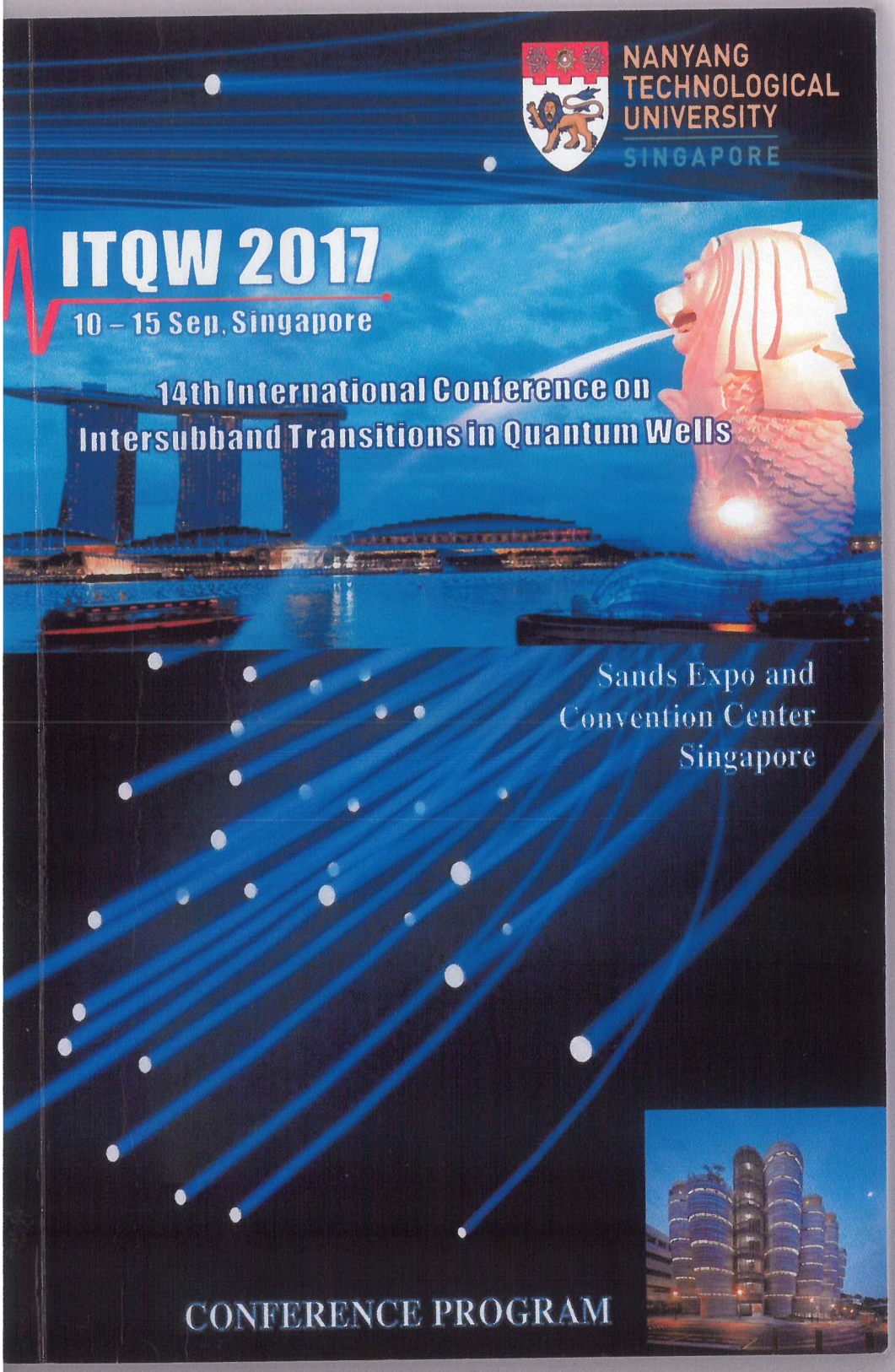
NANYANG
TECHNOLOGICAL
UNIVERSITY
SINGAPORE
ITQW 2017
10 – 15 Sep, Singapore
14th International Conference on
Intersubband Transitions in Quantum Wells
Sands Expo and
Convention Center
Singapore
CONFERENCE PROGRAM

15:30 – 16:00 Tea break

Session 12 Interband Cascade Lasers-Chair: Dan Botez

16:00 – 16:30 **Igor Vurgaftman (Naval Research Laboratory) - Invited talk**
Interband cascade lasers in the mid-IR

16:30 – 16:45 Alireza Mottaghizadeh (University Paris Diderot- Paris 7)
Ultra-fast modulation of mid infrared buried heterostructure quantum cascade lasers

16:45 – 17:00 Sukhdeep Dhillon (Laboratoire Pierre Aigrain)
Multi-THz Sideband Generation on an optical telecom carrier at room temperature using InP-based Quantum Cascade Lasers

17:00 – 17:15 Martin Holzbauer (Technische Universität Wien)
Ring Cavity interband cascade lasers

17:15 End of day four

Friday 15 September 2017

Session 13 Intersubband Devices and applications-Chair: Benjamin Williams

09:00 – 09:30 **Claire F. Gmachl /Yasin Kaya (Princeton University) - Invited talk**
II-VI and II-VI/III-V hybrid intersubband devices

09:30 – 09:45 Martin Wienold (German Aerospace Center)
Doppler-free spectroscopy with a terahertz quantum-cascade laser

09:45 – 10:00 Rolf Szedlak (Technische Universität Wien)
Commutable Monolithic QC Laser/Detector System for Remote Sensing

10:00 – 10:15 Bernhard Lendl (Technische Universität Wien)
New sensing approaches employing QCLs

10:15 – 10:45 Tea break

Session 14 Metasurfaces-Chair: Yasin Kaya

10:45 – 11:30 **Federico Capasso (Harvard University) - Plenary talk**
Metasurface

11:30 – 12:00 **Benjamin Williams (University of California Los Angeles) - Invited talk**
THz metasurface

12:00 – 12:15 Matias Katz (Technion-Israel Institute of Technology)
Vacuum-field Rabi Splitting at SWIR in Photocurrent of Quantum Cascade Infrared Photodetectors Coupled to Metamaterial Nano-antennas

12:15 – 12:30 Lorenzo Bosco (ETH Zurich)
High power surface emitting single mode Terahertz Quantum Cascade Laser

12:30 – 12:45 Moritz Wenclawiak (Technische Universität Wien)
Controlling the radiative response of plasmonic resonators in the terahertz regime

12:45 – 14:00 Lunch

14:00 – 17:00 NTU-visit

Poster Sessions

Monday 11 to Tuesday 12 September 2017 (10 am – 5 pm)

Poster Session 1

P1 **Xiaoyong He** (Shanghai Normal University)
Investigation of tunable manipulation terahertz waves based on graphene patterns

P2 **Hiroaki Yasuda** (National Institute of Information and Communications Technology)
Calculation of performance of InGaSb-based terahertz quantum cascade lasers

P3 **Wenjian Wan** (Shanghai Insititute of Microsystem and Information Technology)
Homogeneous spectral broadening of pulsed terahertz quantum cascade lasers with radio frequency modulation

P4 **Wenqi Wei** (IOP CAS)
C/L-band emission of InAs QDs monolithically grown on a CMOS compatible Ge platform

P5 **Sebastian Schoenhuber** (Technische Universität Wien)
Frequency resolved far fields of terahertz quantum cascade lasers

P6 **Jianbin Kang** (Microsystem & Terahertz Research Center)
Strain dependent intersubband transition in GaN/AlGaN single quantum well on different crystal planes

P7 **Sumit Saha** (IIT (ISM), Dhanbad)
Optical analysis of non-polar, m-plane GaN/AlGaN quantum cascade structures

P8 **Y. Zhang** (University of Tokyo)
Intersubelvel transitions in zero-dimensional nanomaterials probed by terahertz photocurrent spectroscopy

P9 **Xiaoqiong Qi** (The University of Queensland)
Dynamic modelling of coupled-cavity Terahertz Quantum Cascade lasers with optical feedback

P10 **She Han** (The University of Queensland)
Analysis of Granular Materials using a THz QCL operating as a Laser Feedback Interferometer

P11 **Yuanyuan Li** (Institute of Semiconductors, CAS)
High-power single-mode terahertz quantum cascade lasers

P12 **Holger T. Grahn** (Paul-Drude-Institut fuer Festkoerperelektronik)
Two-section, single-frequency terahertz quantum-cascade lasers with continuous frequency tuning by external illumination

P13 **Ke Wang** (Quantum Device Group, RIKEN at Sendai)
Waveguide design for GaN/AlGaN terahertz quantum cascade lasers

P14 **Moritz Wenclawiak** (Technische Universität Wien)
Efficient frequency conversion in THz metal-insulator-metal disk resonators loaded with semiconductor quantum wells

P15 **Roland Teissier** (University of Montpellier)
A comparative study of a three-well active region in double metal and single plasmon THz QCLs

P16 **Yue Zhao** (Institute of Semiconductors, CAS)

Ring cavity interband cascade lasers

Martin Holzbauer[1,*], Borislav Hinkov[1], Rolf Szedlak[1], Hermann Detz[2], Robert Weih[5], Sven Höfling[3,4], Werner Schrenk[1], Erich Gornik[1], Johannes Koeth[5], and Gottfried Strasser[1]

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Interband cascade lasers (ICLs) [1,2] combine the long upper-level recombination lifetimes of laser diodes with the voltage-efficient electron-recycling architecture of quantum cascade lasers. These hybrid devices rely on interband-transitions in type-II quantum wells and cover the spectral region of 3 - 6µm [3]. Their low power consumptions make them very attractive for portable systems used for spectroscopy, process control or medical applications. To date, light outcoupling towards the surface has been demonstrated for vertical-cavitysurface-emitting lasers in pulsed operation at an emission wavelength of 3.4µm [4].

We demonstrate ring cavity [5] interband cascade lasers that emit light vertically through the substrate. Our approach does not require epitaxial grown Bragg mirrors for light outcoupling. Instead we use a distributed feedback grating etched into the upper cladding layer. Afterwards the grating is covered by a metal layer, ensuring a good coupling and at the same time improving the thermal heatsinking. The ring ICLs we fabricated emit light around 4.37 µm (see Fig. 1(b)) facilitating threshold current densities of ~1kA/cm² (see Fig. 1(a)).

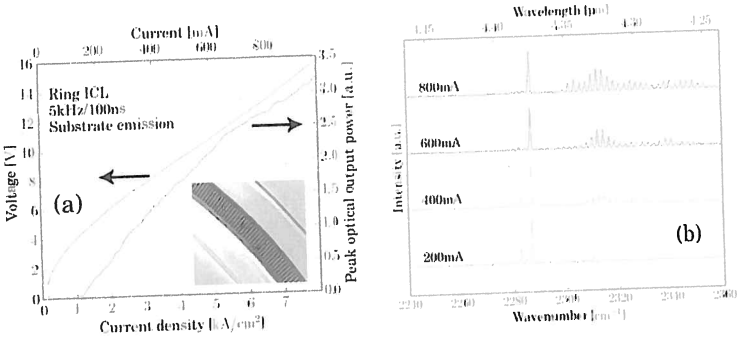

Fig. 1: (a) Light-current-voltage characteristic together with (b) the emission spectra of a typical 2nd-order DFB ring ICL. A strong peak is centred at 4.37µm while additional modes can be observed around 4.32 µm and the emitted light is collected from the substrate side.

References

[1] R. Q. Yang, Superlattices Microstruct. 17, 77 (1995)

[2] I. Vurgaftman, R. Weih, M. Kamp, J. R. Meyer, C. L. Canedy, C. S. Kim, M. Kim, W. W. Bewley, C. D. Merritt, J. Abell and S. Höfling,"Interband cascade lasers", J. Phys. D: Appl. Phys. 48, 123001 (2015).

[3] R. Weih, L. Nähle, S. Höfling, J. Koeth, and M. Kamp, „Single mode interband cascade lasers based on lateral metal gratings", Appl. Phys. Lett. 105, 071111 (2014).

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