SPIE. PHOTONICS

SQUARE Brussels Meeting Centre Brussels, Belgium

3 - 7 April 2016

# Photonic Crystal Materials and Devices

Tuesday - Thursday 5 - 7 April 2016

# **Conference Sessions** At A Glance

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## **Important Dates**

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- 1: Phonon-Photon Interaction: Optomechanics and SBS Poster Pops
- 2: Quantum Optics in PhC Structures and Light Emission Control
- 3: Photonic Crystal-based Devices and Photonic Integrated Circuits

Hot Topics II

Posters-Tuesday

- 4: Hybrid Photonic Crystal-based Devices
- 5: Nonlinear Optics and Lasers
- 6: Light Control and Confinement in PhC Structures and Cavities I
- 7: Light Control and Confinement in PhC Structures and Cavities II Hot Topics III
- 8: 3D Photonic Crystals and Colloidal Structures
- 9: Plasmonics and Biosensing
- 10: Disorder Effects in Photonic Structures

Author Notification: 15 January 2016

Abstract Oue

19 October 2015

Manuscript Due Date 7 March 2016

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**TUESDAY 5 APRIL** 

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# **Opening Remarks**

Tuesday 5 April 2016 8:25 AM - 8:30 AM

### Session 1:

# Phonon-Photon Interaction: Optomechanics and SBS

Tuesday 5 April 2016 8:30 AM - 10:00 AM

Session Chair: Christelle Monat, Ecole Centrale de Lyon (France)

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SPHE Proceedings | Volume 9885 | Light Control and Confinement in PhC Structures and Cavities I

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Proceedings Article

# In-situ measurement of bound states in the continuum in photonic crystal slabs (Conference Presentation)

Stefan Kalchmair; Roman Gansch; Patrice Genevet; Tobias Zederbauer; Donald MacFarland; Hermann Detz; Aaron Maxwell Andrews; Werner Schrenk; Gottfried Strasser; Federico Capasso; Marko Loncar |+| Author Affiliations

Proc. SPIE 9885, Photonic Crystal Materials and Devices XII, 98850M (April 21, 2016); dol:10.1117/12.2227203

Text Size: A A A

### From Conference Volume 9885

Photonic Crystal Materials and Devices XII Dario Gerace; Gabriel Lozano; Christelle Monat; Sergei G. Romanov Brussels, Belgium | April 03, 2016

#### **Abstract**

### abstract

Photonic crystal slabs have been subject to research for more than a decade, yet the existence of bound states in the radiation continuum (BICs) in photonic crystals has been reported only recently [1]. A BIC is formed when the radiation from all possible channels interferes destructively, causing the overall radiation to vanish. In photonic crystals, BICs are the result of accidental phase matching between incident, reflected and in-plane waves at seemingly random wave vectors [2]. While BICs in photonic crystals have been discussed previously using reflection measurements, we reports for the first time in-situ measurements of the bound states in the continuum in photonic crystal slabs. By embedding a photodetector into a photonic crystal slab we were able to directly observe optical BICs. The photonic crystal slabs are processed from a GaAs/AlGaAs quantum wells heterostructure, providing intersubband absorption in the mid-infrared wavelength range. The generated photocurrent is collected via doped contact layers on top and bottom of the suspended photonic crystal slab. We were mapping out the photonic band structure by rotating the device and by acquiring photocurrent spectra every 5°. Our measured photonic bandstructure revealed several BICs, which was confirmed with a rigorously coupled-wave analysis simulation. Since coupling to external fields is suppressed, the photocurrent measured by the photodetector vanishes at the BIC wave vector, To confirm the relation between the measured photocurrent and the Q-factor we used temporal coupled mode theory, which yielded an inverse proportional relation between the photocurrent and the out-coupling loss from the photonic crystal. Implementing a plane wave expansion simulation allowed us to identify the corresponding photonic crystal modes. The ability to directly measure the field intensity inside the photonic crystal presents an important milestone towards integrated opto-electronic BIC devices. Potential applications range include nonlinear optics, nano-optics, sensing and optical computing. This research was supported by the Austrian Science Fund FWF (Grant No. F2503-N17), the PLATON project 35N, the "Gesellschaft für Mikro- und Nanoelektronik" GMe and the European Research Council (Grant no. 639109). [1] C.W. Hsu et al. "Observation of trapped light within the radiation continuum", Nature 499, 188 (2013) [2] Y. Yang Y et al., "Analytical Perspective for Bound States in the Continuum in Photonic Crystal Slabs", Phys Rev Lett

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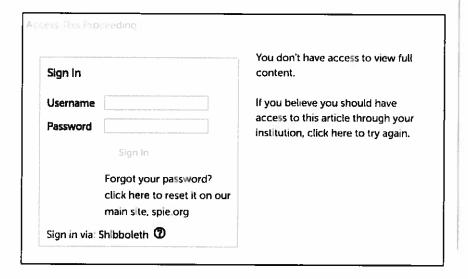
113, 037401 (2014) © (2016) COPYRIGHT Society of Photo-Optical Instrumentation Engineers (SPIE). Downloading of the abstract is permitted for personal use only.

### **Topics**

Photonic crystals ; Radiation ; Simulations ; Photodetectors ; Plane waves ; Phase matching ; Reflection ; Ouantum wells ; Absorption ; Gallium arsenide

Citation Stefan Kalchmair; Roman Gansch; Patrice Genevet; Tobias Zederbauer; Donald MacFarland, et al.

\* In-situ measurement of bound states in the continuum in photonic crystal slabs (Conference Presentation) \*\*, *Proc. SPIE* 9885, Photonic Crystal Materials and Devices XII, 98850M (April 21, 2016); doi:10.1117/12.2227203; http://dx.doi.org/10.1117/12.2227203





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