SPIE. PHOTONICS EUROPE

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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Abstract Due:
19 October 2015

Author Notification:
15 January 2016

Manuscript Due Date:
7 March 2016

Conference Committee

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TUESDAY 5 APRIL Show All Abstracts

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)

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

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

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

Topics

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

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