First fabrication with optical measurements of a 2D photonic crystal in operation in the near infra-red, 1996

Two-dimensional photonic-bandgap structures operating at near-infrared wavelengths

Thomas F. Krauss*, Richard M. De La Rue* & Stuart Brand†

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NATURE · VOL 383 · 24 OCTOBER 1996 pp. 699-702
From the forbidden bandgap to Bloch modes, 1996 - 2000
(or 25 years after R. Zengerle)
Highly dispersive photonic band-gap prism

Shawn-Yu Lin, V. M. Hietala, Li Wang, and E. D. Jones
November 1, 1996 / Vol. 21, No. 21 / OPTICS LETTERS 1771


Self-collimating phenomena in photonic crystals
Hideo Kosaka, Takayuki Kawashima, Akhisa Tomita, Masaya Notomi, Toshiaki Tamamura, Takashi Sato, and Shojiro Kawakami

Photonic crystals for micro lightwave circuits using wavelength-dependent angular beam steering
Hideo Kosaka, Takayuki Kawashima, Akhisa Tomita, Masaya Notomi, Toshiaki Tamamura, Takashi Sato, and Shojiro Kawakami

Ecole doctorale 2009
but especially, 1999

Two-Dimensional Photonic Band-Gap Defect Mode Laser

O. Painter,¹ R. K. Lee,¹ A. Scherer,¹* A. Yariv,¹ J. D. O’Brien,²
P. D. Dapkus,² L. Kim²

Science  Vol 284  11 June 1999  pp. 1819-1821

- Laser
- Design
  + high-Q cavities
  + small modal volume
- Membrane structure

Fig. 5. L-L curve showing the power at the laser wavelength versus the incident pump power. The sample was cooled to 143 K and pumped with 10-ns pulses (4% duty cycle). The actual absorbed pump power is difficult to estimate for a structure with this geometry.
Fabrication of 3D structures in the near infra-red, 1996 - present


Nanofabricated Three Dimensional Photonic Crystals Operating at Optical Wavelengths

C. C. Cheng,1 V. Arbet-Engels,2 A. Scherer1 and E. Yablonovitch2

A three-dimensional photonic crystal operating at infrared wavelengths


Fabrication of 3D structures in the near infra-red, 1996 - present

Full Three-Dimensional Photonic Bandgap Crystals at Near-Infrared Wavelengths
Susumu Noda, 1* Katsuhrio Tomod, 1 Noritsugu Yamamoto, 2 Alongkarn Chutinan 3
28 JULY 2000 VOL 289 SCIENCE pp. 604-606

Fabrication of photonic crystals for the visible spectrum by holographic lithography
M. Campbell*, D. N. Sharp*, M. T. Harrison*,†, R. G. Denning†, & A. J. Turberfield*
NATURE| VOL 404 | 2 MARCH 2000 | pp. 53-56
Fabrication of 3D structures in the near infra-red, 1996 - present

Microassembly of semiconductor three-dimensional photonic crystals

KANNA AOKI**,1 HIDEKI T. MIYAZAKI1, HIDEKI HIRAYAMA1, KYOJI INOSHITA1, TOSHIHIKO BABA3, KAZUAKI SAKODA4, NORIO SHINYA2 AND YOSHINOBU AOYAGI1

nature materials | VOL 2 | FEBRUARY 2003 | pp. 117-121

A three-dimensional optical photonic crystal with designed point defects

Minghao Qi, Elefterios Lidorikis, Peter T. Rakich, Steven G. Johnson, J. D. Joannopoulos, Erich P. Ippen & Henry I. Smith

NATURE | VOL 429 | 3 JUNE 2004 | pp. 538-542
Endlessly single-mode photonic crystal fiber

T. A. Birks, J. C. Knight, and P. St. J. Russell

July 1, 1997 / Vol. 22, No. 13 / OPTICS LETTERS 961

Photonic Band Gap Guidance in Optical Fibers

J. C. Knight, J. Broeng,* T. A. Birks, P. St. J. Russell


Single-Mode Photonic Band Gap Guidance of Light in Air

R. F. Cregan,¹ B. J. Mangan,¹ J. C. Knight,¹ T. A. Birks,¹
P. St. J. Russell,¹* P. J. Roberts,² D. C. Allan³

3 SEPTEMBER 1999 VOL 285 SCIENCE pp. 1537-1539

hollow-core fiber
Quantitative Measurement of Transmission, Reflection, and Diffraction of Two-Dimensional Photonic Band Gap Structures at Near-Infrared Wavelengths


pp. 4147-4150
Fast development of opals fabrication, 1997 - 2001

Photonic crystal properties of packed submicrometric SiO₂ spheres

H. Míguez, C. López, F. Meesequer, A. Blanco, L. Vázquez, and R. Mayoral
Instituto de Ciencia de Materiales de Madrid (CSIC), Cantoblanco, 28049 Madrid, Spain, and
Dep. Física Aplicada., Unidad Asociada (CSIC-UPV), 46022 Valencia, Spain

M. Ocaña
Instituto de Ciencia de Materiales de Sevilla (CSIC), 41012 Sevilla, Spain

V. Fornès and A. Mifsud
Instituto de Tecnología Química (UPV-CSIC), 46022 Valencia, Spain

and inverted opals, 1998

Preparation of Photonic Crystals Made of Air Spheres in Titania

Judith E. G. J. Wijnhoven and Willem L. Vos

7 AUGUST 1998 VOL 281 SCIENCE pp. 802-804

Fig. 2. Scanning electron micrographs (SEMs) of crystals of air spheres in TiO₂, taken with an ISI DS-130 scanning electron microscope. (A) A crystal of air spheres with radii of 987 ± 20 nm. The Fourier transform of this image (inset) and of that in (C) shows the long-range order of this single crystal. (B) Details of an air-sphere crystal of spheres with radii of 987 ± 20 nm. The left arrow points to one of the holes that connect the air spheres. Small openings are apparent in the TiO₂ structure (right arrow). These occur at regular intervals because of incomplete filling of the opal templates. (C) A crystal of spheres with radii of 172 ± 8 nm. The material lying on the air spheres is TiO₂, left over from the preparation of the samples for the SEM.

Carbon Structures with Three-Dimensional Periodicity at Optical Wavelengths

Anvar A. Zakhidov, Ray H. Baughman, Zafar Iqbal, Changxing Cui, Ilyas Khayrullin, Socrates O. Dantas, Jordi Martí, Victor G. Ratchenko

30 OCTOBER 1998 VOL 282 SCIENCE pp. 897-901
Fast development of opals fabrication, 1997 - 2001

On-chip natural assembly of silicon photonic bandgap crystals

Yuri A. Vlasov†, Xiang-Zheng Bo‡, James C. Sturm‡ & David J. Norris*

NATURE | VOL 414 | 15 NOVEMBER 2001 | pp. 289-293

inverted structure

Ecole doctorale photonique, Photonic crystals, PO-014, Romuald Houdré, Summer semester 2009
Fast development of opals fabrication, 1997 - 2004
Modification of spontaneous emission, where everything started from

Spontaneous emission from fluorescent molecules embedded in photonic crystals consisting of polystyrene microspheres
Takashi Yamasaki and Tetsuo Tsutsui

CdS photoluminescence inhibition by a photonic structure
A. Blanco, C. López, R. Mayoral, H. Miguez, and F. Meseguer
Instituto de Ciencia de Materiales de Madrid (CSIC), Cantoblanco 28049 Madrid, Spain and Departamento Física Aplicada, Unidad Asociada CSIC-UPV, 46022 Valencia, Spain
A. Mifsud
Instituto de Tecnología Química (CSIC-UPV), 46022 Valencia, Spain
J. Herrero
Departamento de Energías Renovables (CIEMAT), E-28040 Madrid, Spain

Observation of inhibited spontaneous emission and stimulated emission of rhodamine 6G in polymer replica of synthetic opal
K. Yoshino, S. B. Lee, S. Tatsumma, Y. Kawagishi, and M. Ozaki
Department of Electronic Engineering, Faculty of Engineering, Osaka University, 2-1 Yamada-Oka, Suita, Osaka 565-0871, Japan
A. A. Zakhidov
Department of Thermophysics, Uzbek Academy of Science, Tashkent, Uzbekistan

And also, 2004

Controlling the dynamics of spontaneous emission from quantum dots by photonic crystals
Peter Lodahl, A. Floris van Driel, Ivan S. Nikolaev, Arie Iman, Karin Overgaag, Daniël Vanneste and Willem L. Vos
NATURE [VOL 430] 5 AUGUST 2004 pp. 654-657

CdSe nanocrystals in inverted opal
Ecole doctorale photonique, Photonic crystals, PO-014, Romuald Houdré, Summer semester 2009
Photonic crystals, present time
Spectacular technological progresses allow the development of innovative integrated optics devices

Trapping and emission of photons by a single defect in a photonic bandgap structure

Susumu Noda, Alongkarn Chutinan & Masahiro Imada
NATURE | VOL 407 | 5 OCTOBER 2000 | pp. 608-610
Spectacular technological progresses allow the development of innovative integrated optics devices

**Ultrasmall multi-port channel drop filter in two-dimensional photonic crystal on silicon-on-insulator substrate**

Akihiko Shinya, Satoshi Mitsugi, Elichi Kuramochi, and Masaya Notomi

11 December 2006 / Vol. 14, No. 25 / OPTICS EXPRESS 12394

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**Fabrication and Characterization of Photonic Crystal-Based Symmetric Mach–Zehnder (PC-SMZ) Structures Based on GaAs Membrane Slab Waveguides**

IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS, VOL. 23, NO. 7, JULY 2005 pp. 1308-1314

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**FESTA project, Japan**

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Ecole doctorale photonique, Photonic crystals, PO-014, Romuald Houdré, Summer semester 2009
Design, topology optimisation, inverse problem

Wider bandwidth with high transmission through waveguide bends in two-dimensional photonic crystal slabs

Alongkarn Chutinan, a) Makoto Okano, b) and Susumu Noda b), c)


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Topology optimization and fabrication of photonic crystal structures

P. I. Borel, A. Harpøth, L. H. Frandsen, M. Kristensen
P. Shi
J. S. Jensen and O. Sigmund

3 May 2004 / Vol. 12 No. 9 / OPTICS EXPRESS 1996

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Ecole doctorale photonique, Photonic crystals, PO-014, Romuald Houdré, Summer semester 2009
Self-collimation

Achieving centimetre-scale supercollimation in a large-area two-dimensional photonic crystal

PETER T. RAKICH*, MARCUS S. DAHLEM*, SHEILA TANDON, MIHAI IbaneSCU, MARIN SolaJCIC, GALE S. PETRICH, JOHN D. JOANNOPoulos, LESLIE A. KoloDziejski AND ERICH P. IPPEN


losses = 3.6 dB/mm
Low propagation loss of 0.76 dB/mm in GaAs-based single-line-defect two-dimensional photonic crystal slab waveguides up to 1 cm in length

Yoshimasa Sugimoto, Yu Tanaka, Naoki Ikeda, Yusui Nakamura, Kiyoshi Asakawa
22 March 2004 / Vol. 12, No. 6 / OPTICS EXPRESS 1090

7.6 dB/cm
**Propagation losses in photonic crystal fibres**

**Low-loss hollow-core silica/air photonic bandgap fibre**

Charlene M. Smith, Natesan Venkataraman, Michael T. Gallagher, Dirk Müller, James A. West, Nicholas F. Borrelli, Douglas C. Allan & Karl W. Koch

Nature | Vol 424 | 7 August 2003 | pp. 657-659

**Ultimate low loss of hollow-core photonic crystal fibres**

P. J. Roberts, F. Cuny, H. Sabert, B. J. Mangan, D. P. Williams, L. Farr, M. W. Mason and A. Tomlinson

Blaze Photonics Ltd, University of Bath Campus, Claverton Down, Bath BA2 7AY, United Kingdom

T. A. Birks, J. C. Knight and P. St.J. Russell

Department of Physics, University of Bath, Claverton Down, Bath BA2 7AY, United Kingdom

10 January 2005 / Vol. 13, No. 1 / OPTICS EXPRESS 236

13 dB/km

1.2 dB/km

**Fig. 1.** (a) Scanning electron micrograph (SEM) of the 1.7 dB/km HC-PCF with a 20 μm diameter core (the 1.2 dB/km fibre discussed in the text was very similar), (b) a digitised representation used for modelling and (c) a similar but idealised structure with lower predicted loss.

**Limité par la thermodynamique de la rugosité de surface**

Ecole doctorale photonique, Photonic crystals, PO-014, Romuald Houdré, Summer semester 2009
Real-Space Observation of Ultraslow Light in Photonic Crystal Waveguides

H. Gersen,¹,* T. J. Karle,² R. J. P. Engelen,¹ W. Bogaerts,³ J. P. Korterik,¹ N. F. van Hulst,¹ T. F. Krauss,² and L. Kuipers¹,4,†

Time resolved
Development of connected topics, metamaterials, plasmonics...

Extraordinary optical transmission through sub-wavelength hole arrays

T. W. Ebbesen†, H. J. Lezec†, H. F. Ghaemi†, T. Thio† & P. A. Wolff†

NATURE | VOL 391 | 12 FEBRUARY 1998

pp. 667-669


followed by a lengthy literature

Waveguiding in Surface Plasmon Polariton Band Gap Structures

Sergey I. Bozhevolnyi*

Institute of Physics, Aalborg University, Pontoppidanstræde 103, DK-9220 Aalborg Øst, Denmark

John Erland, Kristian Leosson, Peter M. W. Skovgaard, and Jørn M. Hvam

Research Center COM, Technical University of Denmark, Building 345v, DK-2800 Kongens Lyngby, Denmark

VOLUME 86, NUMBER 14

2 APRIL 2001

pp. 3009-3011
Development of connected topics, metamaterials, plasmonics ...

Experimental Verification of a Negative Index of Refraction
R. A. Shelby, D. R. Smith, S. Schultz

Controlling Electromagnetic Fields
J. B. Pendry, D. Schurig, D. R. Smith

Cloak of invisibility

Negative index of refraction in optical metamaterials
Vladimir M. Shalaev, Wenshan Cai, Uday K. Chettiar, Hsiao-Kuan Yuan, Andrey K. Sarychev, Vladimir P. Drachev, and Alexander V. Kildishev

Metamaterials in the visible range
Controlling the Spontaneous Emission Rate of Single Quantum Dots in a Two-Dimensional Photonic Crystal

Dirk Englund,1 David Fattal,1 Edo Waks,1 Glenn Solomon,1,2 Bingyang Zhang,1 Toshihiro Nakaoka,3 Yasuhiro Arakawa,3 Yoshihisa Yamamoto,1 and Jelena Vučković1

Efficient Single-Photon Sources Based on Low-Density Quantum Dots in Photonic-Crystal Nanocavities

Wen-Hao Chang,1 Wen-Yen Chen,1 Hsiang-Szu Chang,1 Tung-Po Hsieh,2 Jen-Inn Chyi,2 and Tzu-Min Hsu1,*
Vacuum Rabi splitting with a single quantum crystal dot in a photonic crystal nanocavity

T. Yoshie, A. Scherer, J. Hendrickson, G. Khitrova, H. M. Gibbs, G. Rupper, C. Eli, O. B. Shchekin, & D. G. Deppe


Also in micro-pillars

Strong coupling in a single quantum dot–semiconductor microcavity system

J. P. Reithmayer, G. Sök, A. Löffler, C. Hofmann, S. Kuhn, S. Reitzstein, L. V. Keldysh, V. D. Kulakovskii, T. L. Reinecke, & A. Forchel


And

Deterministic Coupling of Single Quantum Dots to Single Nanocavity Modes

Antonio Badolato, Kevin Hennessy, Mete Atatüre, Jan Dreiser, Evelyn Hu, Pierre M. Petroff, & Atac Imamoğlu

Science, Vol. 308, 20 May 2005, pp. 1158-1161

Ecole doctorale photonique, Photonic crystals, PO-014, Romuald Houdré, Summer semester 2009
Two hot topics
Why do we need slow light?
High-Q cavities

Analysis of the experimental $Q$ factors
( ~ 1 million) of photonic crystal nanocavities

Takashi Asano, Bong-Shik Song, Susumu Noda
6 March 2006 / Vol. 14, No. 5 / OPTICS EXPRESS 1996

$Q_{th} = 16.10^6$, $Q_{exp} \approx 1.10^6$