



## FIBER DEVELOPMENT

### **Few Mode Transmission Fiber with low DGD, low Mode Coupling, and low Loss**

Lars Grüner-Nielsen, Yi Sun, Jeffrey W. Nicholson, Dan Jakobsen, Kim Jespersen, Robert. Lingle Jr, and Bera Pálsdóttir

Journal of Lightwave Technology, 30 (23), 3693-3698, 2012

### **Development of low loss, wide bandwidth hollow core photonic bandgap fibers**

M.N.Petrovich, N.K.Baddela, N.V.Wheeler, E.Numkam Fokoua, R.Slavík, D.R.Gray, J.R.Hayes, J.P.Wooler, F.Poletti, D.J.Richardson

OFC 2013, (Invited) paper OTh1J.3

### **Robust low loss splicing of hollow core photonic bandgap fiber to itself**

J.P.Wooler, D.Gray, F.Poletti, M.N.Petrovich, N.V.Wheeler, F.Parmigiani, D.J.Richardson

OFC 2013, paper OM3I.5

### **First demonstration of a broadband 37-cell hollow core photonic bandgap fiber and its application to high capacity mode division multiplexing**

Y.Jung, V.A.J.M.Sleiffer, N.Baddela, M.N.Petrovich, J.R.Hayes, N.V.Wheeler, D.R.Gray, E. Numkam Fokoua, J.P.Wooler, H.H.-L.Wong, F.Parmigiani, S.-U.Alam, J.Surof, M.Kuschnerov, V.Veljanovski, H.de Waardt, F.Poletti, D.J.Richardson

OFC 2013, (Postdeadline) paper PDP5A.3

F.Poletti, N.V.Wheeler, M.N.Petrovich, N.Baddela, E.Numkam Fokoua, J.R.Hayes, D.R.Gray, Z.Li, R.Slavík, D.J.Richardson, "Towards high-capacity fibre-optic communications at the speed of light in vacuum", Nature Photonics, 7 (4), 279-284, 2013

### **Hollow core fibres for high capacity data transmission**

F.Poletti, M.N.Petrovich, N.V.Wheeler, N.K.Baddela, E.Numkam Fokoua, J.P.Wooler, D.R.Gray, S.R.Sandoghchi, J.R.Hayes, Y.Jung, R.Slavík, S.-U.Alam, V.A.J.M.Sleiffer, M.Kuschnerov, D.J.Richardson,

OECC 2013 Kyoto, Japan 30 Jun-4 July 2013, (Invited) paper TuS4-1

### **Recent advances in photonic bandgap fiber technology**



F.Poletti, N.V.Wheeler, N.K.Baddela, Y.Jung, J.P.Wooler, D.R.Gray, E.Numkam Fokoua, J.R.Hayes, R.Slavík, S.-U.Alam, S.R.Sandoghchi, V.A.J.M.Sleiffer, M.Kuschnerov, M.N.Petrovich, D.J.Richardson

IEEE Summer Topicals Waikoloa, Hawaii 8-10 July 2013, (Invited) paper TuC4.4

**First Demonstration of a Low Loss 37-cell Hollow Core Photonic Bandgap Fiber and its Use for Data Transmission**

N.K.Baddela, M.N.Petrovich, Y.Jung, J.R.Hayes, N.V.Wheeler, D.R.Gray, N.Wong, F.Parmigiani, E.Numkam, J.P.Wooler, F.Poletti, D.J.Richardson

Conference on Lasers and Electro Optics (CLEO 2013) San Jose, CA 9-14 June 2013, paper CTu2K.3

**Overcoming the Challenges of Splicing Dissimilar Diameter Solid-Core and Hollow-Core Photonic Band Gap Fibers**

J.P.Wooler, S.R.Sandoghchi, D.R.Gray, F.Poletti, M.N.Petrovich, N.V.Wheeler, N.Baddela, D.J.Richardson

Workshop on Speciality Optical Fibres and their Applications (WSOF) Sigtuna, Sweden 28-30 August 2013

**Transmitting data inside a hole: Recent advances in hollow core photonic bandgap technology**

F.Poletti, J.P.Wooler, N.V.Wheeler, N.K.Baddela, D.R.Gray, E.Numkam Fokoua, J.R.Hayes, Y.Jung, S.-U.Alam, S.R.Sandoghchi, V.A.J.M.Sleiffer, M.Kuschnerov, M.N.Petrovich, D.J.Richardson

Workshop on Speciality Optical Fibres and their Applications (WSOF) Sigtuna, Sweden 28-30 August 2013 (Invited paper)

**Data transmission over 1km HC-PBGF arranged with microstructured fiber spliced to both itself and SMF**

J.P.Wooler, F.Parmigiani, S.R.Sandoghchi, N.V.Wheeler, D.R.Gray, F.Poletti, M.N.Petrovich, D.J.Richardson,

ECOC 2013, Paper Tu.3.A.3

**Gamma irradiation of minimal latency hollow-core photonic bandgap fibres**

L.J.Olantera, C.Sigaud, J.Troska, C.Soos, F.Vasey, M.N.Petrovich, J.Wooler, N.Wheeler, F.Poletti, D.J.Richardson

TWEPP 2013- Topical Workshop on Electronics for Particle Physics Perugia Italy 23-27 Sep 2013.

**Advances in Photonic Bandgap Fiber Technology for Optical Communications**



D.J. Richardson , N. V. Wheeler, N. K. Baddela, J.R. Hayes, Y. Chen, E. N. Fokoua, S.R. Sandoghchi, D. Gray, J.P. Wooler, Y. Jung , S. Alam; V. Sleiffer; M. Kuschnerov, M. N. Petrovich, F. Poletti

EXAT Symposium 2013, Hokkaido, Japan 7/8 Nov 2013 (Plenary).

**Emerging Fibers and Amplifiers For Next Generation Communications and Laser Applications**

D.J. Richardson

ISUPT 2013, Rochester USA, 21/22 Oct 2013 (Invited).

**Enabling Space Division Multiplexed Communications in Optical Fibre: Methods, Progress and Future Prospects**

D.J. Richardson

CNRS/INSIS Workshop Fibre Optique, Paris France 14 October 2013, (Invited).

**Unleashing the Spatial Domain in Optical Fiber Communications**

D.J. Richardson

IEEE Summer Topicals 2013 - Space Division Multiplexing for Optical Systems and Networks  
Waikoloa, Hawaii 8-10 Jul 2013 (Plenary).

**The World Wide Web of Glass: The Past, Present and Future of Fibre Optics Topical Workshop on Electronics for Particle Physics-12**

D.J. Richardson

Oxford, 16th–19th Sept 2012 (Plenary)

**Ultrahigh Capacity Transmission Fibres for Telecommunications**

D.J. Richardson

Asia Communications and Photonics Conference (ACP), Guazhong, China 7-10 Nov, 2012. (Tutorial).

**Hollow-core photonic bandgap fibers: technology and applications**

F. Poletti, M.N. Petrovich, DJ Richardson

<http://www.degruyter.com/view/j/nanoph.2013.2.issue-5-6/issue-files/nanoph.2013.2.issue-5-6.xml>

**First Demonstration of 2 $\mu$ m Data Transmission in a Low-Loss Hollow Core Photonic Bandgap Fiber**



M. N. Petrovich, F. Poletti, J. P. Wooller, A. M. Heidt, N. K. Baddela, Z. Li, D. R. Gray, R. Slavík, F. Parmigiani, N. V. Wheeler, J. R. Hayes, E. Numkam, L. Grúner-Nielsen, B. Pálsdóttir, R. Phelan, B. Kelly, M. Becker, N. MacSuihbhne, J. Zhao, F.C. Garcia Gunning, A. D. Ellis, P. Petropoulos, S. U. Alam and D. J. Richardson

ECOC 2012, postdeadline paper Th.3.A.5

*The first demonstration of a hollow core photonic bandgap fiber suitable for high-rate data transmission at 2 $\mu$ m is presented. Using a custom built Thulium doped fiber amplifier, error-free 8Gbit/s transmission in an optically amplified data channel at 2008nm is reported for the first time.*

### **Hollow Core Photonic Bandgap fibers for Telecommunications: Opportunities and Potential Issues**

Francesco Poletti, Eric Numkam Fokoua, Marco N. Petrovich, Natalie V. Wheeler, Naveen Baddela, John R. Hayes, and David J. Richardson,

OFC 2012 paper OTh1H.3

*We discuss the potential advantages that hollow core photonic bandgap fibers may ultimately have over conventional all solid fibers and review the state-of-the-art, fundamental physical limits and the many technological challenges to be overcome.*

<http://eprints.soton.ac.uk/335750/1/5359.pdf>

### **Dipole radiation model for surface roughness scattering in hollow-core fibers**

E.Numkam, F.Poletti, D.J.Richardson

OFC '12, JW2A.18 (poster, grand prize winner of the 2012 Corning Outstanding Student Paper competition)

*We propose a physical model based on dipole radiation to estimate surface roughness scattering loss in microstructured and hollow-core photonic bandgap fibers. Angular distribution of scattered power and overall loss values can be calculated.*

<http://www.opticsinfobase.org/abstract.cfm?URI=OFC-2012-JW2A.18>

### **Wide-bandwidth, low-loss, 19-cell hollow core photonic band gap fiber and its potential for low latency data**

N. V. Wheeler, M. N. Petrovich, R. Slavík, N. Baddela, E. Numkam, J. R. Hayes, D. R. Gray, F. Poletti and D. J. Richardson

OFC 2012 paper PDP5A.2



*A record low loss (3.5dB/km) for a wide operating bandwidth HC-PBGF is reported. Detailed time-of-flight measurements are also presented, enabling first measurements of latency and differential group delay between mode groups in HC-PBGF.*

<http://eprints.soton.ac.uk/336255/1/5379.pdf>

#### **Few Mode Transmission Fiber with low DGD, low Mode Coupling and low Loss**

L. Grüner-Nielsen, Y. Sun, J. W. Nicholson, D. Jakobsen, R. Lingle Jr, and B. Pálsdóttir

OFC 2012 paper PDP5A.1

*A transmission fiber for mode division multiplexing supporting LP01 and LP11 modes, with low differential group delay, low mode coupling and low loss for both modes is presented. S2 imaging is used for characterization.*

<http://www.opticsinfobase.org/abstract.cfm?URI=OFC-2012-PDP5A.1>

#### **Gas Absorption between 1.8 and 2.1 $\mu\text{m}$ in Low Loss (5.2 dB/km) HC-PBGF**

N. V. Wheeler, M. N. Petrovich, N. K. Baddela, J. R. Hayes, E. Numkam Fokoua, F. Poletti and D. J. Richardson

CLEO 2012 paper CM3N.5

*19-cell defect HC-PBGF is fabricated with record low loss (5.2 dB/km) at 2  $\mu\text{m}$ . Gas absorption lines present in the fiber post-fabrication are quantified with initial conclusions on the origin and removal of relevant species.*

<http://www.opticsinfobase.org/abstract.cfm?URI=CLEO:%20S%20and%20I-2012-CM3N.5>

#### **Development of low loss, wide bandwidth hollow core photonic bandgap fibres for telecom applications**

Petrovich, M. N.; Wheeler, N. V.; Baddela, N. K.; Poletti, F.; Fokoua, E. Numkam; Hayes, J. R.; Gray, D. R.; Richardson, D. J.

2012 14th International Conference on Transparent Optical Networks (ICTON) 2012

*Hollow core Photonic Bandgap Fibres (PBGFs) with a 19-cell core geometry and displaying ultralow loss over record 3 dB transmission bandwidths have been developed. In particular, we demonstrate PBGFs with as low as 4.5 dB/km loss at 2  $\mu\text{m}$  and over  $>$ ;150 nm wide sub-10 dB/km transmission. Absorbing gas species present in our fibres were identified and their loss contribution quantified. An initial explanation on the origin of CO<sub>2</sub> absorption around 2  $\mu\text{m}$  is formulated along with possible means for its removal.*



<http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6253894>