



Complex Photonic Structures and Processes Group



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PhD, inj./P.Eng
Professeur titulaire / Full
Professor PhD, MIT
Physics 2001
MSc, MIT EECS 2000
MSc, McGill Physics 1997
BSc, RIT Physics 1995
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[Résumé](#)

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Chaire de recherche du Canada Tier I en Photonique terahertz omniprésente

Canada Research Chair Tier I in Ubiquitous Terahertz Photonics

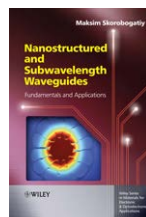
Futurs étudiants:

Les étudiants motivés sont toujours [encouragés à appliquer](#) à mon groupe de recherche pour un programme de maîtrise, de doctorant ou même de bac (stage UPIR ou stage d'été). Nos domaines de la recherche actuels sont micro- et nano-photonique, photonique dans mi-IR et THz, senseurs optiques et textiles intelligents.

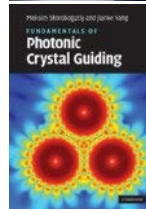
Prospective Students:

Motivated MSc and PhD students are always [welcome to apply](#). Our current focus is in the micro- and nanophotonics, mid-IR and THz photonics, optical sensors and smart textiles.

Livres / Books:



M. Skorobogatiy
[Nanostructured and Subwavelength Waveguides: fundamentals and applications \(Wiley, 2012\)](#)
350p., 80 figs.



M. Skorobogatiy, J. Yang
[Fundamentals of Photonic Crystal Guiding \(Cambridge University Press, 2009\)](#)
ISBN-10: 0521513286
ISBN-13: 978-0521513289
312p., 108 figs., 21 conceptual problems and solutions

Actualités de la recherche / Research news:





[Flexible wire-shaped lithium ion batteries.](#) Here we disclose results obtained in the course of the strategic project sponsored by the NSERC. In particular, we detail a flexible rechargeable wire-shaped lithium ion battery (LIB) fabricated by fusing an electrochemically activated metallic wire (cathode) together with another electrochemically activated metallic wire (anode). An all-solid composite layer functioning both as the electrolyte and battery separator is placed between the two electrodes during packaging. Public release of the detailed information related to this project will appear shortly on this cite.





In this article we detail fabrication of piezoelectric textiles and their various applications in energy harvesting, wearables and sensing:


["Piezoelectric Microstructured Fibers via Drawing of Multimaterial Preforms."](#) Nature Scientific Reports, vol. 7, 2907 (2017);
doi:10.1038/s41598-017-01738-9


 **Invited Review Paper: "Nanotechnology in Textiles,"** ACS Nano, DOI: 10.1021/acsnano.5b08176, Feb. 2016.

 Our article ["Flexible fiber batteries for applications in smart textiles"](#) has been [selected by the Smart Materials and Structures](#) for the 'Highlights of 2015' collection.


 **Étudiante de notre group de recherche Hichem Guerboukha est nommé un lauréat de juin 2015 du concours Étudiants-chercheurs étoiles par le Fonds Nature et Technologies du Québec** pour son travail en conception et applications des guides ondes THz en soie biodégradable (H. Guerboukha, G. Yan, O. Skorobogata, M. Skorobogatiy, ["Silk Foam Terahertz Waveguides,"](#) Advanced Optical Materials, DOI: 10.1002/adom.201400228 (2014)).

 **Nature Photonics - Silk foam waveguides, Research Highlights, Nov. 2014.**

 Nous avons démontré fabrication des guides d'ondes THz en utilisant la mousse de soie purifiée. Les guides d'ondes sont à faible perte et dispersion et ils sont en plus biocompatibles et biodégradables. We have demonstrated low-loss, low dispersion, biocompatible, biodegradable THz waveguides fabricated using purified silk foams. [Advanced Optical Materials: Silk foam THz waveguides, Sep. 2014.](#)


 Notre article a été nommé par la Société Américaine d'Optique comme un parmi les 15 articles le plus cités publiés par JOSA B pendant les 9 dernières années.

Our article was highlighted by the Optical Society of America as one of the 15 most cited articles published in JOSA B over the past 9 years. [A. Hassani and M. Skorobogatiy, "Design criteria for microstructured-optical-fiber-based surface-plasmon-resonance sensors," JOSA B, vol. 24, no 6, 2007, p. 1423-1429\).](#)


 **Étudiante de notre group de recherche Anna Mazhorova est nommée une lauréate de juin 2012 du concours Étudiants-chercheurs étoiles par le Fonds Nature et Technologies du Québec** pour son travail en biodétection des bactéries par les ondes THz (A. Mazhorova, A. Markov, A. Ng, et al., M. Skorobogatiy ["Label-free bacteria detection using evanescent mode of a suspended core terahertz fiber,"](#) Optics Express, vol. 20 (5), pp. 5344-5355, (2012)).

 **Innovation News Daily: 'Smart Clothing' Could Become New Wearable Gadgets.**


[MSNBC: 'Smart clothing' could become wearable gadgets.](#)

 Soft, woven Li-ion battery using thermoplastic solid electrolytes: [New Scientist: Bendy battery gives smart fabrics a charge, Feb. 2012.](#)
[Click here for the demonstration video of a woven lithium battery.](#)
[Click here for the Journal of the Electrochemical Society paper.](#)











 Woven 2D touchpad using soft capacitor fibers drawn from conductive plastics:

 [New Scientist: Stroke your car seat to pump up the volume, Jan. 2012.](#)
[Discovery Channel: Turn up the tunes by touching your car seat, Jan. 2012.](#)

[Click here for the Daily Planet episode, Jan. 12, 2012.](#)
[Click here for the demonstration video of a woven touchpad.](#)
[Click here for the Smart Materials and Structures paper.](#)

 **December 2011 issue of OPN (OSA): Suspended Core Subwavelength Plastic Fibers for THz Guidance.**

 **SPIE Newsroom - Single step fabrication of highly sensitive**

-  [biosensors, Aug. 2010.](#)
 «Des vêtements qui en mettent plein la vue grâce à la fibre optique. (Fr/Eng)»
 In this Code Chastenay documentary Profs. J. Berzowska and M. Skorobogatiy talk about photonic band-gap fibers and their textile applications. Feb. 2010.
-  Karma Chameleon project. Smart textiles, Photonic Bandgap textiles, Feb. 2009.
-  Nature Photonics - Colour-tunable textiles, News and Views, Nov. 2008.
-  Physics Today - Photonic fabric, Back Scatter, Oct. 2008, page 108, © AIP 2008.
-  Laser Focus World - Low-loss porous terahertz fibers would turn tight corners, Apr. 2008.
-  Laser Focus World - Photonic-crystal fibers become biocompatible, Feb. 2007.
-  Photonics Spectra - Biodegradable Holey Fiber Enables Drug Delivery, Jan. 2007.
-  Nature Photonics - Plasmonics: Sensors tune in, Oct. 2006.
-  Optics.org - Environmentally friendly fiber takes on medical role, July 2006.
-  Les possibilités infinies de la fibre microstructurée, Oct. 2006.
 The infinite potential of microstructured fibres, Oct. 2006.

Conférences invitées importantes / Notable invited talks:

THz photonics:

[Plastic fibers for terahertz wave guiding \(ECOC invited talk, November 2011\), 38Mb with audio](#)

Plasmonics:

[Design and fabrication of photonic crystal and plasmonic waveguides for bio and chemical sensing, applications from the visible to THz spectral range \(FiO invited talk, October 2011\), 26Mb with audio](#)

Optical Sensors:

[All-polymer Photonic Bandgap Bragg fibers for Bio-chemical Sensors and Fiber Spectrometers \(MOC invited talk, November 2011\), 21Mb with audio](#)

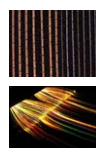
Textiles Intelligents (FR):

[Textiles intelligents autonomes \(ACFAS, kiosque invité, Mai 2012\), 1Mb](#)

Smart Textiles (ENG):

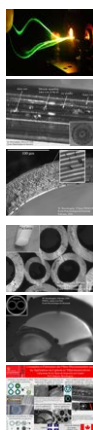
[Photonic textiles, Sensor textiles, and Energy storage textiles: towards developing a leaving, breathing T-shirt \(CAP invited talk, June 2011\), 6Mb](#)

Exemples de fibres fabriquées dans notre groupe / Examples of fibers fabricated in our group:



Highly reflective photonic textiles based on Photonic Band Gap fibers, Futurotextiel 08 exhibition, Kortrijk, Belgium

Color-tunable photonic textiles using Photonic Crystal Fibers



"Colorful" solid core plastic Bragg fibers in the visible

Biodegradable and Biocompatible Microstructured Fiber for In-Vivo Sensing

Hollow Bragg Fiber for Low Loss Radiation Transmission from the Visible to THz

Multicore Porous Fiber for Imaging and Sensing

Multimode Microstructured Fiber for Sensing Applications

Group Poster

Logiciels / Software from our group:

[PolyMOF - modesolvers for the Microstructured and Photonic Crystal Fibers, updated Aug. 2007](#)

[PolyFIT - statistical imperfection analysis software and high resolution 2D tal images, updated Nov. 2005](#)

Aperçus de certaines technologies / Reviews of selected technologies:

[Overview of the Smart Textile research conducted in our group, updated Dec. 2011, 6Mb](#)

[Bringing nanotechnology into fiber optics, updated Oct. 2009, 9Mb](#)

[Overview of the photonic textiles, updated March 2009, 21Mb](#)

[Overview of THz waveguides and applications, updated Apr. 2007, 2.1Mb](#)

[Overview of Microstructured Fibers for sensor applications, updated Feb. 2006, 1.6Mb](#)

Diapositives de mon cours / Slides from my graduate course "Introduction to Photonic Crystals"

- 1) [1D Photonic Crystals \(Multilayer stacks\), updated Jan. 2005, 1Mb](#)
- 2) [Hollow planar waveguides and multilayer stacks, updated Oct. 2005, 1Mb](#)
- 3) [Quasi-1D Photonic Crystals \(Bragg fibers\), updated Feb. 2005, 4Mb](#)
- 4) [Battling Imperfection in Photonic Crystals, updated Oct. 2005, 6Mb](#)
- 5) [Some applications of PC's, 5Mb](#)



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Advanced Research

Maksim Skorobogatiy Toying with light

"I was born in Russia," says Maksim Skorobogatiy, "but Canada is my second home." The 29-year-old researcher arrived at Polytechnique in 2003 after completing his doctorate degree at MIT and a two-year period working for a company active in the area of photonic crystals. "I plan to stay here now," he says with conviction. And that is great news because the holder of a Canada Research Chair in photonic band gap materials and devices is involved in a highly advanced area that will strengthen Québec's position in the area of photonics.



Maksim Skorobogatiy, professor in the Department of Engineering Physics and holder of a Canada Research Chair in Photonic Band Gap Materials and Devices.

Like computer chips, which are very compact devices used to control electrical current, photonic crystals enable ultra-compact optical components to control light waves. Moreover, photonic crystal being carefully assembled of sub-wave-length dielectric elements is really an artificial material whose properties can be engineered to exhibit very different light transmission characteristics from that of its constituent materials.

Traditionally, fibre-optic information transmission is carried out using 1,550-nanometre light waves. This is the optimal frequency for fibre optics, where optical loss of the light conducting silica material is minimal.

However, "the 3- and 10-micrometre wave is extremely interesting for medical applications," points out the new Canadian. "Unfortunately, at such wavelengths it is extremely hard to find optically transparent materials to make a high quality fibre for guiding a laser beam it through the cavities and curves of the human body." The only option would be to transmit a light through the hollow low loss fibre core and use photonic crystals to confine the light. To inject the photonic crystals into the fibre one would place minute holes or

deposit very thin multilayers into a fibre structure. This will make it possible for the fibre to transmit at the new required wavelength.

The researcher has two areas of interest. He would like to develop new applications for photonic crystals, especially biocompatible fibre optics and, most importantly, he would like to make industrial manufacturing processes more accessible.

He plans to achieve his objectives in an unusual manner. "Usually," he explains, "we focus directly on improving processes. However, the tolerance requirements for photonic crystals are such that this approach would be very costly." Mr. Skorobogatiy feels it would be better to focus on the designing of the products themselves to ensure that they can handle less precise crystals and are considerably less expensive to manufacture. ■



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Chef de groupe / Group leader

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2016-
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Canada Research Chair Tier I in Ubiquitous Terahertz Photonics

Prof. Maksim Skorobogatiy
PhD, MIT Physics 2001
MSc, MIT EECS 2000
MSc, McGill Physics 1997
BSc, RIT Physics 1995
Undgr, MFTI FOPF 1991-1994
[CV](#)

2014-2016
Chaire de Recherche d'École Polytechnique en Photonique terahertz
École Polytechnique Research Chair in Terahertz Photonics

2004-2014
Chaire de Recherche du Canada Tier II en micro et nanophotonique
Canada Research Chair Tier II in Micro and Nanophotonics

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Étudiants en formation / Current students

2017 - Cao Yang - PhD in THz wireless communications, China Scholarship Council fellow

2017 - Deepak Divakaran - PhD in optical sensors

2016 - Qu Hang - Research Associate in advanced optical and non-optical fiber fabrication

2016 - Jayesh Sadasivan - PhD in THz wireless communications

2015 - Hichem Guerboukha - PhD in THz imaging
2016 - NSERC graduate studies (PhD) fellowship

2014 - Katirvel Nallapan - PhD in THz communications

2014 - Xin Lu - PhD in electroactive fiber fabrication, China Scholarship Council fellow

Anciens étudiants / Former students

2014-2017 - Jingwen Li - PhD in optical fiber sensors

2013-2017 - Tian Ma - PhD in THz fibers for communications and imaging

2013-2015 - Hichem Guerboukha - MSc in THz fibers and THz instrumentation

2015 - Prix des meilleurs mémoires et thèses MSc (Best MSc thesis award), pour « Advanced Instrumentation for Practical Applications of Terahertz Spectroscopy and Imaging. »

2015 - [Lauréat de juin 2015 du concours Étudiants-chercheurs étoiles par le Fonds Nature et Technologies du Québec](#) pour son travail en conception et applications des guides ondes THz en soie biodégradable (H. Guerboukha, G. Yan, O. Skorobogata, M. Skorobogatiy, "[Silk Foam Terahertz Waveguides.](#)" Advanced Optical Materials, DOI: 10.1002/adom.201400228 (2014))

2013-2015 - Qu Hang - Post. Doc. in microstructured fiber fabrication

2009-2013 - PhD in the optical fiber sensors

2013 - Nomination for the best PhD thesis of 2013

2014-2015 - Jingshan Hou - Post. Doc. in electroactive fiber fabrication

2010-2015 - Andrey Markov - PhD in THz fibers and THz instrumentation

2015 - Post. Doc. at INRS with R. Morandotti

2014-2015 - Maria Zhuldybina - Internship in optical fiber sensors

2015 - Graduate student at ETS

2012-2014 - Martin Girard - MSc in coupled fiber / metamaterial systems

2014 - Nomination for the best MSc thesis of 2014

2014 - NSERC international graduate studies (PhD) fellowship (Northwestern University)

2013 - NSERC graduate studies (MSc) fellowship

2012-2013 - Yan Guofeng - PhD in THz waveguides, China Scholarship Council exchange fellow from the Zhejiang University

2009-2012 - Anna Mazhorova - PhD in fabrication of microstructured fibers

2012 - Post. Doc. at INRS with R. Morandotti

2012 - [Lauréate du concours Étudiants-chercheurs étoiles par le Fonds Nature et Technologies du Québec pour son travail en biodétection des bactéries par les ondes THz \("Label-free bacteria detection using evanescent mode of a suspended core terahertz fiber," Optics Express, vol. 20, no 5, 2012, p. 5344-5355\)](#)

2008-2012 - Bora Ung - PhD in theory of photonic crystal fibers

2014 - Assistant professor at the electrical engineering department at the Ecole de Technologie Supérieure (ETS), Montréal, Canada

2012 - FQRNT Postdoc fellowship at U. Laval with R. Valée and Y. Messaddeq

2012 - Nomination for the best PhD thesis of 2012

2011 - [Holder of the Incubic/Milton Chang Travel Grant, 2011](#)

2011 - [Holder of the SPIE Scholarship](#)

2009 - FQRNT graduate studies (PhD) fellowship

2009-2012 - Stepan Gorgutsa - MSc in smart textiles

2012 - PhD at U. Laval, COPL

2010-2011 - Mathieu Rosé - Post. Doc. in glass processing

2011 - Researcher at the Université de Rennes, France

2010-2010 - Niyaz Ahmad Madhar - Post. Doc. in chalcogenide glass processing

2012 - Assistant professor at the King Saud University, Riyadh, Kingdom of Saudi Arabia

2009-2011 - Jian Fang Gu - Post. Doc. in polymer processing and smart textiles
2011 - Lead Scientist at the GE Global Research, China
Global Research Center, SABIC Innovative Plastic Program.

2009-2011 - Yang Liu - Post. Doc. in electrochemistry and smart textiles
2011 - Research associate at the University of Waterloo

2006-2010 - Alexandre Dupuis - PhD in fabrication of THz fibers
2010 - R&D Engineer and Laser Scientist at Genia Photonics
2010 - Nomination for the best PhD thesis of 2010
2010 - NSERC industrial postdoc fellowship
2008 - NSERC graduate studies (PhD) fellowship

2009-2010 - Imran Syed - PhD in smart textiles

2008-2009 - Frederic Desevedavy - Post. Doc. in soft glass processing
2009 - Research Engineer at the University of Bourgogne, Dijon, France

2007-2009 - Ning Guo - Research Associate in fabrication of photonic band gap fibers
2004-2007 - Ning Guo - MSc in fabrication of photonic band gap fibers

2004-2009 - Alireza Hassani - PhD in modeling of photonic crystal fiber sensors
2011-2012 - London School of Economics and Political Science, U. of London
2009-2011 - NSERC Strategic Postdoctoral Fellow at National Institute of Scientific Research INRS-EMT
2008 - [Holder of the Incubic/Milton Chang Travel Grant.](#)
2008 - [Holder of the LEOS Graduate Student Fellowship.](#)

2007-2009 - Elio Pone - Research Associate in development of electromagnetic solvers for photonic crystal fibers
2005-2007 - Elio Pone - Post. Doc. in modeling of fluid dynamics of microstructured fiber drawing
2011 - R&D Researcher, Lasers & Fused Components Division at ITF Laboratories

2007-2009 - Lina Shi - Post. Doc. in photonic crystal and plasmonic sensors
2009 - Associate Professor at Institute of Microelectronics of Chinese Academy of Sciences, Beijing, China

2007-2009 - Bertrand Gauvreau - MSc in photonic crystal fiber-based sensors
2013 - Customer Solutions Representative at Avera, Montréal, Canada 2009 - R&D Engineer and Group Leader, Lasers & Fused Components Division at ITF Laboratories
2009 - Prix des meilleurs mémoires et thèses (Best thesis award), MSc pour « Dispositifs à bande photonique interdite pour des applications de textiles photoniques et capteurs plasmoniques »
2008 - NSERC graduate studies (MSc) fellowship

2007-2008 - Dhia Hadri - PhD (Tunis) in microstructured fiber assisted sensing

2005-2006 - Yan Gao - Research Associate in fabrication of all-polymer multilayers and fibers

2004-2005 - Mahmoud Rajabian - Post. Doc. in fabrication of polymer multilayers

2005 - Researcher, Ecole Polytechnique de Montréal

2004-2005 - Laurent Chouinard - MSc in modeling of photonic band gap fibers

Stagiaires d'été / Summer students

2013 - Patrick Laurin - NSERC summer fellowship in THz waveguides

2013 - Hichem Guerboukha - NSERC summer fellowship in measurements of THz metamaterials

2012 - Martin Girard - NSERC summer fellowship in theory of THz metamaterials

2011 - Evelyne Brown Dussault - NSERC summer fellowship in THz characterization of complex materials

2008 - Alexandre Horth - NSERC summer fellowship in fabrication of photonic crystal fibers for plasmonic sensors

2006 - Bertrand Gauvreau - plasmonic photonic crystals

2006 - Majid Fassi Fehri - plasmonic photonic crystals

2004 - Galina Nemova - heat transfer in high power optical systems

2004 - Guillaume Begin - NSERC summer fellowship in study of imperfections in photonic crystals



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