



## LUDDY

SCHOOL OF INFORMATICS,  
COMPUTING, AND ENGINEERING

### Alexander Gumennik, Ph.D.

Assistant Professor of Intelligent Systems Engineering

Director of Fibers & Additive Manufacturing Enabled Systems Laboratory (FAMES Lab)

**E-mail:** gumennik@iu.edu

**Address:** 114A, Multidisciplinary Engineering & Sciences Hall (MESH),  
2425 N Milo B Sampson Ln, Bloomington, IN 47408

**Phone:** (812) 856-7277

**Website:** <https://fames.indiana.edu/>

#### Research interests

---

Fibers for biomedical applications. Fibers for long-haul quantum interconnects. Integrated microelectronics and photonics in fibers. Fibers with data processing capabilities. Pervasive sensing with fibers for Internet of Things, environmental monitoring, and surveillance. Bioprinting and additive manufacturing. Fabrics with active functionalities.

#### Positions

---

<b>Assistant Professor</b>	Indiana University, Bloomington	<b>08/2016 – Present</b>
<b>Lead Engineer</b>	Formlabs Inc., Somerville, MA	<b>02/2015 – 07/2016</b>
<b>Research Affiliate</b>	Massachusetts Institute of Technology	<b>02/2015 – 08/2016</b>
<b>Postdoctoral Associate</b>	Massachusetts Institute of Technology	<b>02/2011 – 02/2015</b>
<b>Graduate Researcher</b>	Hebrew University of Jerusalem, Israel	<b>10/2002 – 12/2010</b>
<b>Assistant Lecturer</b>	Hebrew University of Jerusalem, Israel	<b>10/2004 – 04/2010</b>
<b>Fulbright Visiting Scholar</b>	University of California, San Diego	<b>01/2007 – 04/2007</b>
<b>Engineering Intern</b>	Intel, FAB8, Jerusalem, Israel	<b>08/2003 – 11/2004</b>

#### Education

---

- **Ph.D., Applied Physics, Hebrew University of Jerusalem.** **June 2011**  
Thesis: "Refractive Index Engineering of Photonic Devices in Electrooptic Substrates by Implantation of Light Energetic Ions."  
Advisor: Prof. Aharon J. Agranat (HUJI). Co-advisors: Profs. Mordechai Segev (Technion) and Michael Hass (Weizmann Institute).



- **M.Sc., Applied Physics, Hebrew University of Jerusalem.** **May 2005**  
Thesis: "Construction of Waveguiding Structures within Electrooptic Crystals by Implantation of Light Ions."  
Advisor: Prof. Aharon J. Agranat (HUJI).
- **B.Sc., Physics and Mathematics, Hebrew University of Jerusalem.** **May 1999**  
Fulfilled the degree requirements at the age of 19.

## Awards, Honors, and Fellowships

---

- National Science Foundation CAREER Award **2022-2027**
- Rothschild post-doctoral fellowship of Yad Hanadiv **2011**
- Eshkol scholarship of the Israel Ministry of Science **2007-2010**
- Intel award for outstanding Ph.D. students **2007-2008**
- Wolf foundation doctoral excellence scholarship **2006-2007**
- Fulbright doctoral dissertation fellowship **2006-2007**

## Journal Publications

---

- [1] L. A. van der Elst, C. Faccini de Lima, M. Gokce Kurtoglu, V. N. Koraganji, M. Zheng, **A. Gumennik**, "3D Printing in Fiber-Device Technology", **Adv. Fiber Mater.** **3**, 59 (2021).
- [2] L. A. van der Elst, M. Gokce Kurtoglu, T. Leffel, M. Zheng, **A. Gumennik**, "Rapid Fabrication of Sterile Medical Nasopharyngeal Swabs by Stereolithography for Widespread Testing in a Pandemic," **Adv. Eng. Mater.** **22**, 2000759 (2020).
- [3] C. Faccini de Lima, L. A. van der Elst, V. N. Koraganji, M. Zheng, M. Gokce Kurtoglu, **A. Gumennik**, "Towards digital manufacturing of smart multimaterial fibers," **Nanoscale Res. Lett.** **14**:209 (2019).
- [4] T. Khudiyev, J. Clayton, E. Levy, N. Chocat, **A. Gumennik**, A. M. Stolyarov, J. Joannopoulos, and Y. Fink, "Electrostrictive all-fiber microelectromechanical systems," **Nat. Commun.** **8**, 1435 (2017).
- [5] **A. Gumennik** \*, E. C. Levy \*, B. Grena \*, C. Hou, M. Rein, A. Abouraddy, J. D. Joannopoulos, Y. Fink, "Confined in-fiber solidification and structural control of silicon and silicon-germanium microparticles," **PNAS** **114**, 7240 (2017).
- [6] L. Wei, C. Hou, E. Levy, G. Lestoquoy, **A. Gumennik**, A. F. Abouraddy, J. D. Joannopoulos, and Y. Fink, "Optoelectronic fibers via selective amplification of in-fiber capillary instabilities," **Adv. Mater.** **29**, 1603033 (2017).



- [7] M. Rein, E. Levy, **A. Gumennik**, A. F. Abouraddy, J. Joannopoulos, and Y. Fink, "Self-assembled fibre optoelectronics with discrete translational symmetry," **Nat. Commun.** **7**, 12807 (2016).
- [8] S. Frishman, **A. Gumennik**, H. Ilan, Aharon J. Agranat, "A Bragg grating embedded in a slab waveguide fabricated by the implantation of high-energy light ions in KLTN substrate," **Appl. Phys. B** **115**, 143 (2014).
- [9] **A. Gumennik** \*, L. Wei \*, G. Lestoquoy \*, A. M. Stolyarov, X. Jia, P. H. Rekemeyer, M. J. Smith, X. Liang, B. J.-B. Grena, S. G. Johnson, S. Gradečak, A. F. Abouraddy, J. D. Joannopoulos, Y. Fink, "Silicon-in-Silica spheres via axial thermal gradient in-fibre capillary instabilities," **Nat. Commun.** **4**, 2216 (2013).
- [10] **A. Gumennik** \*, A. M. Stolyarov \*, B. R. Schell \*, C. Hou, G. Lestoquoy, F. Sorin, W. McDaniel, A. Rose, J. D. Joannopoulos, and Y. Fink, "All-in-fiber chemical sensing," **Adv. Mater.** **24**, 6005 (2012).
- [11] A. M. Stolyarov \*, **A. Gumennik** \*, W. McDaniel, O. Shapira, B. Schell, F. Sorin, K. Kuriki, G. Benoit, A. Rose, J. D. Joannopoulos, and Y. Fink, "Enhanced chemiluminescent detection scheme for trace vapor sensing in pneumatically-tuned hollow core photonic bandgap fibers," **Opt. Express** **20**, 12407 (2012).
- [12] **A. Gumennik**, Y. Kurzweil-Segev, A. J. Agranat, "Electrooptical effects in glass forming liquids of dipolar nano-clusters embedded in a paraelectric environment," **Opt. Mater. Express** **1**, 332 (2011).
- [13] H. Siman Tov, **A. Gumennik**, H. Ilan, and A. J. Agranat, "Construction of conducting and photoconducting 3D structures with submicron resolution in electrooptical substrates," **Appl. Phys. A** **102**, 45 (2011).
- [14] **A. Gumennik**, G. Perepelitsa, A. Israel, and A. J. Agranat, "A tunable channel waveguide array fabricated by the implantations of He<sup>+</sup> ions in an electrooptical KLTN substrate," **Optics Express** **17**, 6166 (2009).
- [15] H. Ilan, **A. Gumennik**, G. Perepelitsa, A. Israel, and A. J. Agranat, "Construction of an optical wire imprinted in potassium lithium tantalate niobate by He<sup>+</sup> implantation," **Appl. Phys. Lett.** **92**, 191101 (2008).
- [16] **A. Gumennik**, H. Ilan, R. Fathei, A. Israel, A. J. Agranat, I. Shachar, and M. Hass, "Design methodology of refractive index engineering by implantation of high-energy particles in electrooptic materials," **Appl. Opt.** **46**, 4132 (2007).



- [17] H. Ilan, **A. Gumennik**, R. Fathei, A. J. Agranat, I. Shachar, and M. Hass, "Submerged waveguide constructed by the implantation of  $^{12}\text{C}$  ions in electrooptic crystals," **Appl. Phys. Lett.** **89**, 241130 (2006).
- [18] **A. Gumennik**, A. J. Agranat, I. Shachar, and M. Hass, "Thermal stability of a slab waveguide implemented by  $\alpha$  particles implantation in potassium lithium tantalate niobate," **Appl. Phys. Lett.** **87**, 251917 (2005).

*Asterisk (\*) denotes equally contributing authors.*

### Student Researchers Mentored at IU

	Degree	Name	Since	Until
1.	PhD Students	Veda Narayana Koraganji	August 2016	October 2020
2.		Yafei Wang	2017	2018
3.		Louis van der Elst	August 2017	
4.		Camila Faccini de Lima	January 2018	
5.		Mengxin Zheng	August 2018	
6.		Merve Gokce Kurtoglu	January 2019	
7.	MSc students	Troy Leffel	August 2019	December 2020
8.		Tyson Miller	August 2020	December 2020
9.		Jeffery Coulter	August 2020	
10.	Undergraduates	Neil Patel	2016	2018
11.		Andrew Gotts	2018	2019
12.		Natalie Burke	2019	2020
13.		Garrett Fairbanks	April 2020	
14.		Oreva Omodior	September 2021	
15.		Max Jancich	September 2021	

### Patents

- [1] Y. Fink, A. F. Abouraddy, B. Grena, **A. Gumennik**, J. D. Joannopoulos, G. R. Lestoquoy, L. Wei, "Dynamic In-Fiber Particle Production With Precise Dimensional Control." Patent granted to MIT and UCF **US10406723 (2019)**.
- [2] **A. Gumennik**, A. M. Stolyarov, B. R. Schell, C. Hou, G. R. Lestoquoy, F. Sorin, W. R. McDaniel, Y. Fink, A. Rose, J. D. Joannopoulos, "Fiber Sensor." Patent granted to MIT **US10338000B2 (2019)**.
- [3] **A. Gumennik** and A. Eltony, "Techniques of Additive Fabrication Using an Aspheric Lens and Related Systems and Methods." Patent granted to Formlabs Inc. **US10131095B2 (2018)**.
- [4] **A. Gumennik**, Y. Fink, B. J.-B. Grena, J. D. Joannopoulos, "High-Pressure In-Fiber Particle Production with Precise Dimensional Control." Patent granted to MIT **US10112321B2 (2018)**.



## Patent Applications

---

- [1] **A. Gumennik**, L. A. van der Elst, M. Gokce Kurtoglu, "Trophowell." Patent Application by Indiana University **US20210301244A1 (2021)**.
- [2] **A. Gumennik**, L. A. van der Elst, M. Gokce Kurtoglu, "Methods for Creating Three-Dimensional Biosynthetic Tissue." Patent Application by Indiana University **US20210330864A1 (2021)**.
- [3] **A. Gumennik**, M. Zheng, C. Faccini de Lima, V. N. Koraganji, "Very Large-Scale Integration for Fibers (VLSI-Fi)." Patent Application by Indiana University **US20210333131A1 (2021)**.
- [4] J. T. Lennon, L. A. van der Elst, E. A. Mueller, **A. Gumennik**, "Gut Bioreactor and Methods for Making the Same." Patent Application by Indiana University **US20210332314A1 (2021)**.
- [5] C. K. Sen, **A. Gumennik**, L. A. van der Elst, M. Gokce Kurtoglu, "Technologies for Fiber Nanotechnology." Patent Application by Indiana University **WO2021087438A1 (2021)**.

## Grants

---

- [1] L. A. Baker (PI), **A. Gumennik (Co-PI)**, S. C. Jacobson (Co-PI), S. Setayeshgar (Co-PI), A. Zlotnick (Co-PI), "MRI: Acquisition of a Nanoimprint Lithography Instrument for Research and Education," **National Science Foundation**, Submitted (**January 2017**), Granted (**September 2017**) - \$ 458,600.
- [2] G. Ortiz (PI), D. Baxter (Co-PI), **A. Gumennik (Co-PI)**, R. Pynn (Co-PI), Ph. Richerme (Co-PI), A. Sabry (Co-PI), M. Snow (Co-PI), Sh. Zhang (Co-PI), "Center for Quantum Information Science and Engineering," **Indiana University** - Emerging Areas of Research Funding Program, Submitted (**October 2017**), Granted (**February 2018**) - \$ 2,999,998.
- [3] J. T. Lennon (PI), **A. Gumennik (Co-PI)**, N. Moldovan (Co-PI), D. Rusch (Co-PI), K. Locey (Co-PI), "Complexity of the gut microbiome: an experimental approach," **Indiana University** - Collaborative Research Grants Program (IUCRG), Submitted (**January 2018**), Granted (**May 2018**) - \$ 74,990.
- [4] **A. Gumennik (PI)**, "CAREER: Liquid-phase processing of microelectronic materials: a route to high-performance devices and systems in fiber and fabric form factor," **Indiana University** - Faculty Research Support Program – External Resubmission (FRSP-ER), Submitted (**March 2019**), Granted (**April 2019**) - \$ 74,571.
- [5] One of the five faculty (K. Connelly, J. Bardzell, D. Crandall, P. Macklin, **A. Gumennik**), presenting "SICE Faculty Research Highlights" to **Fred Luddy**, which resulted in donation of \$60M for establishment of the Luddy Center for Artificial Intelligence. Presented (**April 2019**), Granted (**October 2019**) - \$ 60,000,000.



- [6] **A. Gumennik (PI)**, "Smart Fibers for Medical Devices," **Cook Medical**, Submitted (**July 2021**), Granted (**August 2021**) - \$ **347,428**.
- [7] **A. Gumennik (PI)**, " CAREER: Liquid-Phase Processing of Fiber-Based Electronic and Photonic Materials and Devices", **National Science Foundation**, Submitted (**July 2021**), Recommended for Award (**January 2022**) - \$ **646,338**.

## Plenary Talks

---

- [1] **A. Gumennik**, "Materials Processing for Smart Fibers," SPb-POEM2020, Saint Petersburg, Russia, International (**April 30, 2020**).

## Keynote Talks

---

- [1] **A. Gumennik**, "Towards Digital Manufacturing of Smart Multimaterial Fibers," POEM2019, London, UK, International (**April 10, 2019**).
- [2] **A. Gumennik**, "Material Processing for Smart Fibers," SNAIA2019, Paris, France, International (**December 13, 2019**).
- [3] **A. Gumennik**, "Photonic and Optoelectronic Systems in Fibers," SNAIA2020, Paris, France, International (**December 11, 2020**).

## Invited Tutorials

---

- [1] **A. Gumennik**, "Multimaterial, functional, "smart" fibers," Special Course, The Peter Brojde Center for Innovative Engineering and Computer Science, Hebrew University of Jerusalem, Israel, National (**December 17, 2018**).

## Invited Talks

---

- [1] **A. Gumennik**, "From Macro to Nano ...and Back: Functional fiber devices and systems for bio-synthetic interfacing and Internet of Things," 3D Bioprinting Core Users Group Meeting, IU School of Medicine, IUPUI, IN, United States, Academic, Local (**December 12, 2016**).
- [2] **A. Gumennik**, "From Macro to Nano ...and Back: Functional fiber devices and systems for Internet of Things," Mech E Seminar Series, Department of Mechanical Engineering, IUPUI, IN, United States, Local (**January 17, 2017**).
- [3] **A. Gumennik**, "High Performance Fiber Devices for Pervasive Sensing," Applied Physics Colloquium, Department of Applied Physics, Hebrew University of Jerusalem, Israel, Local (**August 2, 2017**).



- [4] **A. Gumennik**, "High Performance Fiber Devices for Pervasive Sensing," the Joseph and Sophia Konopinski Colloquium Series, Department of Physics, IUB, Local (**December 6, 2017**).
- [5] **A. Gumennik**, "VLSI for Fibers: a liquid-phase processing of microelectronic materials as a route to high-performance devices and systems in fiber and fabric form factor," SNAIA2018, Paris, France, International (**December 13, 2018**).
- [6] **A. Gumennik**, "VLSI for Smart Fibers," Symposium NN – Fiber-Based Technologies and Applications, ICMAT2019, Singapore, International (**June 25, 2019**).
- [7] **A. Gumennik**, "VLSI for Smart Fibers," Advanced Fiber Based Technologies Workshop, NTU EEE, IEEE Photonic Society Singapore Chapter, The Optical Society (OSA) Singapore Section, Singapore, Regional (**June 26, 2019**).
- [8] **A. Gumennik**, "VLSI for Smart Fibers," Symposium 2 - Advanced Functional Fibers and Smart Fabrics (F3), POEM 2019, Wuhan, China, International (**November 11, 2019**).
- [9] **A. Gumennik**, "Material Processing for Smart Fibers," Applied Physics Colloquium, Department of Applied Physics, Hebrew University of Jerusalem, Israel, Local (**December 17, 2019**).
- [10] **A. Gumennik**, "Molten-phase processing of multimaterial monofilaments: a route to functional fiber-embedded systems," SNAIA2021, Paris, France, International (**December 09, 2021**).

## Conference Abstracts and Proceeding Papers

---

- [1] V. N. Koraganji, C. F. de Lima, M. Zheng, M. Gokce Kurtoglu, **A. Gumennik**, "Effects of 3D Printed Preform Annealing on Structural and Optical Properties of Fibers," in CLEO Pacific Rim Conference 2020, OSA Technical Digest (Optical Society of America, **2020**), paper C6H.6.
- [2] M. Zheng, C. F. de Lima, V. N. Koraganji, and **A. Gumennik**, "3D printed glass preforms for optical fibers with nonequilibrium cross-sections," in Conference on Lasers and Electrooptics, OSA Technical Digest (Optical Society of America, **2020**), paper JTh2C.9.
- [3] C. Faccini de Lima, M. Zheng, V. N. Koraganji, L. A. van der Elst, **A. Gumennik**, "Substantiation of 3D architectural control in crystalline-semiconductor fiber-embedded microelectronic systems," oral presentation ICG-SIV-177-2019 at 25th International Congress on Glass (The American Ceramic Society, **2019**).
- [4] **A. Gumennik**, E. Levy, B. Grena, C. Hou, M. Rein, A. Abouraddy, J. Joannopoulos, Y. Fink, "Si-Ge Micro-Spheres of Prescribed Morphology from In-Fiber Capillary Breakup and Controlled Crystallization," oral presentation SM2.4.02 at 2017 MRS Spring Meeting & Exhibit (Material Research Society, **2017**).





- [5] **A. Gumennik**, L. Wei, G. Lestoquoy, A. M. Stolyarov, X. Jia, B. Grena, S. G. Johnson, A. F. Abouraddy, J. D. Joannopoulos, Y. Fink, "In-fiber capillary breakup as a generic method for silicon processing and device fabrication," oral presentation A10.02 at 2015 MRS Spring Meeting & Exhibit (Material Research Society, **2015**).
- [6] **A. Gumennik**, **B. Grena**, E. Levy, L. Wei, C. Hou, T. Sarathi, A. Abouraddy, J. D. Joannopoulos, Y. Fink, "Extraordinary stress in silicon spheres via anomalous in-fiber expansion," oral presentation A10.05 at 2015 MRS Spring Meeting & Exhibit (Material Research Society, **2015**).
- [7] **M. Rein**, **A. Gumennik**, E. Levy, C. Hou, Y. Fink, "Self-Assembled Fiber Optoelectronic Devices through Selective In-Fiber Fluid Instabilities," oral presentation V6.07 at 2015 MRS Spring Meeting & Exhibit (Material Research Society, **2015**).
- [8] L. Wei, A. M. Stolyarov, **A. Gumennik**, C. Hou, G. Lestoquoy, X. Jia, B. Grena, **A. F. Abouraddy**, J. D. Joannopoulos, and Y. Fink, "Recent progress in multimaterial fibers: From nanofabrication to novel device architectures," (PIERS 2014, Guangzhou, China, 25-28 Aug., **2014**), Session 3P9a.
- [9] **Y. Fink**, **A. F. Abouraddy**, B. Grena, **A. Gumennik**, C. Hou, X. Jia, J. Joannopoulos, J. J. Kaufman, G. Lestoquoy, and L. Wei, "Opportunities in Multimaterial Fibers," in Workshop on Specialty Optical Fibers and their Applications, (Optical Society of America, **2013**), paper F1.1.
- [10] **A. M. Stolyarov**, L. Wei, **A. Gumennik**, O. Shapira, G. Lestoquoy, F. Sorin, B. R. Schell, C. Hou, W. McDaniel, A. Rose, J. Joannopoulos, and Y. Fink, "Multimaterial functional fibers," in Optical Fiber Communication Conference/National Fiber Optic Engineers Conference 2013, OSA Technical Digest (online) (Optical Society of America, **2013**), paper OTh1J.6.
- [11] **A. J. Agranat**, **A. Gumennik** and H. Ilan, "Refractive index engineering by fast ion implantations: a generic method for constructing multi-components electro-optical circuits," in Proc. SPIE 7604, (**2010**), 76040Y DOI:10.1117/12.841287.
- [12] **A. Gumennik**, G. Perepelitsa, A. Israel and A. J. Agranat, "Refractive Index Engineering of a Tunable Channel Waveguide Array by the He<sup>+</sup> implantation in an Electrooptic KLTN Substrate," in The Conference on Lasers and Electro-Optics (CLEO)/The International Quantum Electronics Conference (IQEC) (Optical Society of America, Washington, DC, **2009**), CTuEE4.
- [13] H. Ilan, **A. Gumennik**, G. Perepelitsa, A. Israel and A. J. Agranat, "Channel Waveguide Formed by "One Shot" Implantation of He<sup>+</sup> Ions," in Conference on Lasers and Electro-Optics/Quantum Electronics and Laser Science Conference and Photonic Applications Systems Technologies 2008 Technical Digest (Optical Society of America, Washington, DC, **2008**), CTuS3.





**Alexander Gumennik**  
gumennik@iu.edu  
(812) 856-7277

- [14] H. Ilan, **A. Gumennik**, R. Fathei, A. J. Agranat, "Submerged waveguide constructed by the implantation of 12C ions in electrooptic crystals," in Conference on Lasers and Electro Optics/Quantum Electronics and Laser Science Conference and Photonic Applications Systems Technologies 2007 Technical Digest (Optical Society of America, Washington, DC, **2007**), CMGG3.

*Speakers are underlined.*



## Highlights

---

- Designer, Project Manager (during the construction phase), and Director of Fibers and Additive Manufacturing Enabled Systems Laboratory at the Department of Intelligent System Engineering (ISE FAMES Lab).
- Co-developer of the new Intelligent Systems Engineering curriculum at Indiana University, beginning its launch in 2016.
- Founding member of IU Quantum Science and Engineering Center, Engineering Health, and Health@Luddy.
- Extensive experience in 3D printing, bioprinting, electrooptic materials, semiconductor device physics, integrated photonic circuits, and functional fibers, leading to eighteen peer-reviewed journal articles, four patents granted, five patent applications, and twenty seven international conference talks, including invited, keynote, plenary, and tutorials.
- Invented and tested novel fabrication techniques, including generic methodologies for fabrication of photonic and electronic integrated circuitry in electrooptic substrates, fiber-embedded arrays of integrated devices, biosynthetic 3D printed tissue integrating fiber devices into bioink constructs for biosensing and metabolic stimulation with microscale precision.
- Designed and assembled measurement and processing setups such as: 3D printing setups, multi-axial prism couplers for characterization of waveguide-embedded photonic structures, birefringence-measurement setups for characterization of magneto- and electrooptical properties of ferroelectrics, and high-throughput high-temperature tapering and breakup setups for silica-based fiber processing.
- Developed and investigated novel prototype devices such as electrooptically-tunable photonic structures, photo detecting fibers, and fiber-based chemical sensors.

## Research Experience

---

***Director of Fibers & Additive Manufacturing Enabled Systems Laboratory at the Department of Intelligent System Engineering (ISE FAMES Lab)*** **08/2016 – Present**

- The vision of the ISE FAMES Lab is to provide an efficient interface, linking the cyberspace with the physical world. This is done by an engineering of fibers and fabrics, embedding ensembles of nano-transducers and sensors, that would listen, watch, smell, and palp their surroundings and communicate there sensations to a computer. Applications range from smart fibers for neuromorphic computation and quantum data processing to biosynthetic engineered tissue, where fibers mimic a natural vasculature, musculature, and innervation.

***Lead Photonics Process Engineer, Formlabs Inc., Somerville, MA***

**02/2015 – 07/2016**

***Consulting Scientist, Formlabs Inc., Somerville, MA***

**11/2014 – 02/2015**

- Designing, constructing and characterizing the laser-optics portion of 3D printing setups.
- Improved the laser for Form 2 (***Patent Granted***).



Alexander Gumennik  
gumennik@iu.edu  
(812) 856-7277

- Developed from concept to manufacturability the optical portion of Fuse 1 (**launched commercially in June 2017**).

**Research Affiliate, Massachusetts Institute of Technology**

**02/2015 – 08/2016**

**Postdoctoral Associate, Massachusetts Institute of Technology**

**02/2011 – 02/2015**

**Research Laboratory of Electronics, Fibers @ MIT group**

- Invented and implemented a fiber-based remote and distributed chemical detector, including project planning and effort coordination **with FLIR Systems, Inc. (Optics Express 2012, Advanced Material 2012 (cover story) + Patent Granted)**
- Invented, designed and implemented an in-fiber process for Si nano-spheres fabrication for photonic, electronic and pharmaceutical applications. (**Nature Communications 2013 + Patent Application**)
- Designed and assembled 2 tapering setups for semiconductor/metal-core silica fibers scaling and break-up.
- Discovered and developed a method for ultra-high pressure generation and fabrication of hetero-structured Si-Ge particles in Janus and core-shell configuration by a capillary breakup of semiconductor-core silica fibers with subsequent gradual solidification of fiber-confined semiconducting droplets. (**PNAS 2017 + Granted**)
- Developed a fabrication of doped silicon microspheres with ultra-smooth surfaces for phonon-polaron near-field thermal transfer for photovoltaic and nano-scale thermal management applications. (**Manuscript in Preparation**)
- Developed and investigated self-assembly approach for fiber optoelectronics by means of selective amplification of capillary instabilities in chalcogenide core polymeric fibers. (**Nature Communications 2016**)
- Co-invented a method for self-assembly of in-fiber optoelectronics by means of selective amplification of capillary instabilities in germanium-core silica fibers. (**Advanced Materials 2017**)

**Graduate Researcher, Hebrew University of Jerusalem**

**10/2002 – 12/2010**

**Department of Applied Physics, Optoelectronic Computing Group**

- Developed and implemented a generic methodology for design and fabrication of building blocks for integrated photonic circuitry in electrooptic substrates by light energetic ions implantation. This project was conducted in collaboration with **Department of Particle Physics, Weizmann Institute, Rehovot, Israel**, and included multiple steps:
  - Design, fabrication and characterization of optical properties and thermal stability of He-implanted surface slab waveguide in potassium lithium tantalate niobate (KLTN). (**Applied Physics Letters 2005**)



- Design, fabrication and characterization of C-implanted buried slab waveguide in KLTN. (*Applied Physics Letters* 2006)
- Development of semi-empirical calculation strategy allowing obtaining the implantation-induced refractive index change in KLTN knowing the ion species and the implantation dose. (*Applied Optics* 2007)
- Design, fabrication and characterization of He-implanted optical wire in KLTN. (*Applied Physics Letters* 2008)
- Design, fabrication and characterization of He-implanted electrooptically tunable coupled waveguide array in KLTN. (*Optics Express* 2009)
- Development of high-aspect ratio implantation-assisted etching technique in closely-packed perovskites. (*Proceedings of SPIE* 2010)
- Design, fabrication and characterization of He- and H-implanted photonic filtering/multiplexing grating in KLTN. (*Applied Physics B* 2014)
- Discovered and characterized electrically induced optical depolarization in glass forming liquids of ferroelectric nano-clusters in paraelectric Cu, Mo, Li – doped and pristine potassium tantalate niobate in the vicinity of phase transition. (*Optical Materials Express* 2012)
- Led technological and scientific investigation of conducting and photoconducting properties of submicron proton-implanted structures in KLTN. (*Applied Physics A* 2011)
- Assembled a measurement setup and investigated magneto-optic properties of KLTN with Mn-Ti, Mo, W doping.
- Inspired and planned a research strategy for investigation of applicability of KLTN to THz operation.
- Inspired and planned a strategy for fabrication of wide-beam large-angle stacked electrooptical beam deflector in KLTN.
- Co-wrote multiple research proposals.

***Fulbright Visiting Scholar, University of California, San Diego***

**01/2007 – 04/2007**

**Jacobs School of Engineering, Ultrafast & Nanoscale Optics Group**

- Initiated and led a joint project for characterization of photonic gratings in electrooptic crystals fabricated at Hebrew University by means of Time-Resolving Heterodyne Near-Field Scanning Optical Microscopy (NSOM) invented in UCSD.

***Process Engineering Intern, Intel, FAB8, Jerusalem, Israel***

**08/2003 – 11/2004**

**Diffusion-CVD Group**

- Improved statistical performance characterization and contamination control over chemical vapor deposition (CVD) processes.
- Participated in implementation of 2DPM (2 defects-per-million) standards.



**Research Assistant. Hebrew University of Jerusalem**

**06/2002 – 08/2003**

**Department of Applied Physics, Optoelectronic Computing Group**

- Optimized the growth of ferroelectric crystals by Czochralski method. Maintained and troubleshot the high-temperature crystal growth towers.

**Education Activities**

---

**Member of Engineering Program Curriculum Committee, IUB, ISE**

**09/2016-Present**

- Leading the development of MSc curriculum for Molecular and Nanoscale Engineering track
- Developing BSc curriculum for Molecular and Nanoscale Engineering track

**Lecturer, IUB, SICE**

**01/2017-Present**

- Developing and/or lecturing
  - ENGR-E 500 Introduction to Intelligent Systems Engineering **(beginning Fall 2016)**
  - ENGR-E 687 Graduate Independent Study **(beginning Fall 2016)**
  - ENGR-E 537/399 Rapid Prototyping **(beginning Spring 2017)**
  - PHYS-P 408/508 Current Research in Physics **(beginning Spring 2017)**
  - ENGR-E 505/399 Introduction to Nanoengineering **(beginning Spring 2018)**

**Research Mentor, IUB, ISE FAMES Lab**

**08/2016-Present**

- Mentoring multiple graduate and undergraduate students

**Research Mentor, MIT, Research Laboratory of Electronics**

**02/2011-08/2016**

- Co-Mentored two M.Sc. students, one Ph.D. candidates and two post-docs. This resulted in co-design and co-assembly experimental setups and a research articles' co-authorships by the students.
- Provided ongoing training and guidance to new students and post-docs.

**Assistant Lecturer, HUJI, The School of Computer Science and Engineering**

**10/2004-04/2010**

- Co-composed and co-lectured courses "Physics of Guided Waves" and "Introduction to Optonics" (B.Sc./M.Sc. level).

**Research Mentor HUJI, The School of Computer Science and Engineering**

**10/2004-04/2010**

- Mentored seven M.Sc. students and two Ph.D. candidates. This led to four first-name authorships and six co-authorships by students on peer-reviewed papers, one conference presentation by student and four students' co-authorships on conference abstracts. Five of the students continued to Ph.D. studies.



- Composed tutorials, assembled setups and mentored students in engineering-students' physics lab (B.Sc. level).
- Supervised graduation projects by engineering students (B.Sc. level).

## Professional Activities

---

### ***Symposium Organizer and Chair at SNAIA2021, Paris, France*** **12/2021**

- Smart, Functional Fibers and Textiles Symposium

### ***Session Chair at SNAIA2021, Paris, France*** **12/2021**

- Smart Nanomaterials Symposium

### ***Session Chair at SNAIA2019, Paris, France*** **12/2019**

- Energy Harvesting and Photovoltaics Special Symposium

### ***Session Chair at POEM2019, London, UK*** **04/2019**

- Metamaterials and Plasmonic Devices Symposium

### ***Session Chair at SNAIA2018, Paris, France*** **12/2018**

- Smart Nanomaterials II

### ***Session Chair at MRS Spring Meeting, Phoenix AZ*** **04/2017**

- SM2.2: Energy Storage and Harvesting in Fibers and Textiles
- SM2.9: Nanofibers and Nanoscale Phenomena in Fibers and Textiles
- SM2.10: Advances in Fibers and Textiles III

### ***Ad-Hoc Reviewer*** **05/2007 – Present**

- Reviewed multiple articles for Scientific Reports, Materials Chemistry and Physics, Chemical Physics Letters, Advanced Optical Materials, Journal of Lightwave Technology, Applied Optics, Optical Materials Express, Optics Express, Applied Physics B, Concurrency and Computation: Practice and Experience as primary reviewer. Co-reviewed multiple articles with concurrent PIs for Nature Communications, Optics Letters, Applied Optics, and Applied Physics B: Lasers and Optics.
- Reviewed research proposals for Israel Science Foundation (ISF).

### ***Member of Optical Society of America*** **11/2006 – Present**

### ***Member of Materials Research Society*** **04/2015 – Present**





Alexander Gumennik  
gumennik@iu.edu  
(812) 856-7277

**Representative of IUB at Advanced Functional Fabrics of America (AFFOA) 09/2016 – Present**

**Project Leader, MIT & FLIR Systems, Inc. 02/2010 – 06/2014**

- Directed and advised projects in collaboration with FLIR Systems to model, fabricate, and test fiber-based remote chemical vapor sensors for detection of TNT and peroxide-based explosives.

**Graduate Researcher, HUJI & Weizmann Institute, Rehovot, Israel 12/2004 – 12/2010**

- Developed and executed the Van-de-Graaff and Tandem accelerators adjustment for implantation of light ions into ferroelectric electrooptic crystals. Coordinated and led research efforts in collaboration with Prof. Michael Hass at the Department of Particle Physics at Weizmann Institute.

## **Computational, Analytical and Processing Skills**

---

- Skilled in designing and launching new fabrication and R&D facilities, including lab design, construction, and management, workflow design for fabrication processes, equipment evaluation for procurement, equipment installation and maintenance, process development, troubleshooting, and failure analysis.
- Experienced in cleanroom operation and equipment, including electroplating, CVD, thermal diffusion and deposition systems, photo- and e-beam- lithography, sputtering.
- Proficient with characterization and processing techniques such as: AFM-NSOM, SEM, TEM, FIB, FTIR, Prism Coupling. Experienced with Raman, XRD, Ellipsometry, and Reflectometry.
- Experienced with mechanical design, CAD-CAM, machine/fabrication shop, circuit design and laboratory test equipment.
- Proficient with Zemax, Matlab and Solidworks parametric modeling. Proficient with RSoft, Mathcad and Origin modeling and data analysis. Experienced with COSMOL and LabVIEW.

## **Languages**

---

- Russian, Hebrew, English.