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Apratim Majumder

CURRENT DESIGNATION

Research Assistant Professor, University of Utah (November 2020 – Present)
Department of Electrical and Computer Engineering,
50 S Central Campus Drive, Rm 1444, Salt Lake City, Utah-84112

Responsibilities: Responsible for the design, simulation, characterization and experimental verification of diffractive optical elements (DOEs) for use in ultra-flat lenses, hyperspectral imaging cameras, holograms, etc. Responsible for the design, fabrication and analyses of compact snapshot hyperspectral cameras and novel silicon nanophotonic devices enabled by computational metamaterials.
Additionally, responsible for advising graduate students, leading research projects and acquiring research funding.

Past responsibilities include the development of tunable focus liquid-filled lenses for applications in autofocus consumer eyewear , the development, analyses and characterization of a maskless nano-lithographic technique named Absorbance Modulation Optical Lithography, with potential applications in achieving patterning beyond the far-field diffraction limit.

RESEARCH INTERESTS

Diffractive Optics: Research focused on the development of novel diffractive optical elements to design and fabricate flat lenses, holograms, phase plates, etc. leading to the realization of ultra-thin imaging systems with applications in hyperspectral imaging, microscopy, photography, anti-counterfeit security, etc.
Novel Silicon photonics: Research focused on developing new silicon nanophotonic circuit elements for future applications in photonic circuits.
Super-resolution nano-lithography: Research focused on developing optical systems and materials that can enable super-resolution nano-lithography and nanoscopy and future technology trends to support the CMOS fabrication industry and high density data recording.

EDUCATION

Ph.D. in Electrical and Computer Engineering, (2011 – 2018)
University of Utah, Salt Lake City, Utah, USA
Advisor: Dr. Rajesh Menon
Thesis title: *Super-Resolution Optical Nanopatterning Beyond the Far-Field Diffraction Limit Using Photochromic Molecules and Absorbance Modulation Optical Lithography*

M.S. in Electrical and Computer Engineering, (2011 – 2014)
University of Utah, Salt Lake City, Utah, USA
Advisor: Dr. Rajesh Menon

B.Tech in Electronics and Communication Engineering, (2007 – 2011)
West Bengal University of Technology, Kolkata, India

PROFESSIONAL EXPERIENCE

Postdoctoral Research Associate (2017 – 2020)
Department of Electrical and Computer Engineering, University of Utah
Diffractive Optics: Flat Lenses for full-color video and still imaging and Multi-color Holograms
Inverse design is implemented to optimize the design of diffractive optical elements enabling ultra-broadband flat lenses and holograms.

- Performing electromagnetic simulations and experimental characterization to design and study the behavior of ultra-flat lenses (more than 10 times thinner than human hair) based on diffractive optics. Demonstrated achromatic imaging performance of ultra-flat lenses across a huge bandwidth (visible to long wave infrared) and extreme depth-of-focus (from 5 to 1200 mm), previously believed to be impossible. This work has applications in the reduction of weight of optics for military and drones.
- Developed full-color holograms capable of 3D image projection with the ability to work with incoherent inexpensive light sources, such as flash light of mobile phone cameras. This work has applications in security technology, such as anti-counterfeiting measures for currency notes.

- Constructing optical setups and performing imaging experiments, analysing aberration characteristics of flat lenses.
- Analyzing effects of fabrication errors on performance degradation.
- Awarded $36000 (2021-2023) research seed grant from University of Utah College of Engineering for developing tunable focus flat lenses.
- Awarded $471,000 (Role: co-PI, main PI: Rajesh Menon) (2021-2023) from Office of Naval Research for developing large area MWIR flat lenses with extended depth of focus.

Hyperspectral Imaging (HSI) using Diffractive Filter Array

- Performing experiments to demonstrate broadband high-resolution mutli-spectral imaging with diffractive filter array and monochromatic sensor across the visible and IR bands. This work has applications in developing inexpensive HSI cameras for use in agriculture, quality control, etc, a demand that is currently unmet.
- Chief point-of-contact at the University of Utah for this project which is a collaboration between University of Utah, Lumos Imaging and Sony Corporation.
- Responsible for design of experiments, simulations and characterization of this novel HSI technique.
- Responsible for advancing this technique to the design, construction and analyses of an endoscope with the ability to produce real-time HSI to aid in the detection of cancer cells in the human body. This work is being undertaken in collaboration with researchers from the Huntsman Cancer Institute and the Department of Medicine at the University of Utah School of Medicine.

Silicon Nanophotonic Devices based on Computational Metamaterials

Computational techniques are applied to design and simulate the working of novel integrated silicon nanophotonic devices using digital metamaterials. These include passive devices such as on-chip polarization rotators, power-splitters, beam-splitters, etc. as well as extension to active nanophotonic switches like optical modulators.

- Designing, fabricating and characterizing novel integrated silicon nanophotonic devices.
- Developing silicon photonics design method based on inverse design, EM solutions (FDTD) and machine learning.
- Successfully demonstrated ultra-compact polarization rotator (6 μm^2 – one of the smallest ever made) and power-splitter (2.4 μm^2) ~ 50% reduction in footprint compared to conventional designs.
- Awarded $5000 (2017) and $10000 (2018) research grants for Amazon Web Services (AWS) usage and LBNL Molecular Foundry project grant.
- Proposed design of ultra-compact optical router and tunable wavelength filter, currently being developed for research grants.
- Implemented machine learning algorithm for improving device design.
- Developing design of ultra-compact gas sensor based on digital nanophotonic metamaterials and graphene.

Chief Engineer, SharpEyes LLC, Utah (Aug 2018 – March 2019)

Tunable Focus Lenses for Adaptive Eyeglasses

Liquid-filled tunable lenses are developed for applications in consumer eyewear, AR/VR headsets, imaging systems, cameras, etc.

- Designing and constructing optical and fluidic systems for characterization of tunable lenses.
- Performing system calibration, maintenance and experiments to demonstrate tunable lenses.

Graduate Research Assistant (Aug 2011 – Dec 2016)

Department of Electrical and Computer Engineering, University of Utah

Super-resolution Optical Nanopatterning beyond the Far-field Diffraction Limit Using Photochromic Molecules and Absorbance Modulation Optical Lithography (AMOL)

AMOL aims to break the far-field diffraction limit that governs the size of the smallest spot that can be fabricated using photolithography by employing a thin layer of spectrally selective reversible photochromic molecules in conjunction with a dual wavelength exposure system thereby creating a nano-scale optical probe that can pattern a recording medium like photoresist placed under it with features much smaller than the diffraction limit.

- Built a dual-wavelength (325/650 nm illumination) photolithography system with sub-100 nm (~ 50 nm) patterning ability.
- Developed processes integrating photoresists, photochromic materials, photo-active compounds, photopolymers.
- Developed model to successfully predict effect of process parameters on resolution of AMOL.
- Built interferometry systems, characterized and analyzed results.
- Organized collaborations with researchers at MIT, UMass Amherst, KemLab, IBM to work as a team.
- Gained 5+ years' hands-on fabrication and characterization experience at the University of Utah Nanofab class 100 cleanroom environment.

Research video: https://nanoptics.wordpress.com/research/

PUBLICATIONS

(In reverse chronological order)

Peer-reviewed journals

1. P. Srivastava, **A. Majumder**, R. Menon and G. Swartzlander, "High Forward Thrust Metasurface Beam-Riding Sail," Opt. Exp. 32(2) 1756-1763 (2024).
2. D. Lin, T. M. Hayward, W. Jia, **A. Majumder**, B. Sensale-Rodriguez, and R. Menon, "Inverse-designed multi-level diffractive doublet for wide field-of-view imaging," ACS Photonics 10, 8, 2661–2669 (2023).
3. A. Banerjee, C. Ghosh, M. U. Karkhanis, A. Deshpande, E. Pourshaban, **A. Majumder**, H. Kim, and C. H Mastrangelo, "Refractive-type varifocal liquid-crystal Fresnel lenses for smart contacts," Optics Express, 31(10), 17027-17049 (2023).
4. **A. Majumder,** M. Meem, N. Brimhall and R. Menon, "Circumventing size-bandwidth limits in imaging with flat lenses," arXiv:2112.15157 [physics.optics] (2022).
5. **A. Majumder,** M. Meem, R. Stewart and R. Menon, "Broadband point-spread function engineering via a free-form diffractive microlens array," Optics Express 30(2), 1967-1975 (2022).
6. M. Meem, **A. Majumder**, S. Banerji, J. C. Garcia, O. B. Kigner, P. W. C. Hon, B. Sensale-Rodriguez, & R. Menon, "Imaging from the visible to the longwave infrared wavelengths via an inverse-designed flat lens," Optics Express 29(13), 20715-20723 (2021).
7. M. Meem, **A. Majumder,** & R. Menon, "Free-form broadband flat lenses for visible imaging," OSA Continuum 4(2), 491-497 (2021).
8. S. Banerji, **A. Majumder**, A. Hamrick, R. Menon, & B. Sensale-Rodriguez, "Ultra-compact integrated photonic devices enabled by machine learning and digital metamaterials," OSA Continuum 4(2), 602-607 (2021).
9. W. Jia, **A. Majumder**, S. Banerji, R. Menon, & B. Sensale-Rodriguez, "Ammonia optical gas sensing based on graphene-covered silicon microring resonators: A design space exploration," Microelectronics Journal 111, 105041 (2021).
10. **A. Majumder**, M. Meem, S. Banerji, B. Sensale-Rodriguez, & R. Menon, "Versatile diffractive flat optics," Optics and Photonics News Dec. 2020 issue - **Optics in 2020** (2020).
11. S. Banerji, M. Meem, **A. Majumder**, B. Sensale-Rodriguez, & R. Menon, "Super-resolution imaging with an achromatic multi-level diffractive microlens array," Optics Letters 45(22), 6158-6161 (2020) **[Editor's pick]**.
12. S. Banerji, **A. Majumder**, A. Hamrick, R. Menon, & B. Sensale-Rodriguez, "Machine learning enables design of on-chip integrated silicon T-junctions with footprint of 1.2 μm × 1.2 μm," Nano Communications Networks 25, 100312 (2020).
13. M. Meem, S. Banerji, **A. Majumder**, C. Pies, T. Oberbiermann, B. Sensale-Rodriguez, & R. Menon, "Inverse-designed achromatic flat lens enabling imaging across the visible and near-infrared with diameter > 3 mm and NA = 0.3," Appl. Phys. Lett. 117, 041101 (2020).
14. R. Likhite, A. Banerjee, **A. Majumder**, M. Karkhanis, H. Kim, & C. H. Mastrangelo, "VOC sensing using batch-fabricated temperature compensated self-leveling microstructures," Sensors and Actuators B: Chemical, 311, 127817 (2020).
15. M. Meem, S. Banerji, C. Pies, T. Oberbiermann, **A. Majumder**, B. Sensale-Rodriguez, & R. Menon, "Large-area, high-numerical-aperture multi-level diffractive lens via inverse design," Optica 7(3), 252-253 (2020).
16. S. Banerji, M. Meem, **A. Majumder**, B. Sensale-Rodriguez, & R. Menon, "Extreme-depth-of-focus imaging with a flat lens," Optica, 7(3), 214-2017 (2020).
17. M. Meem, **A. Majumder**, & R. Menon, "Multi-plane, multi-band image projection via broadband diffractive optics," Applied Optics, 59, 38-44 (2020) **[Editor's pick]**.

18. S. Banerji, M. Meem, **A. Majumder**, F. Guevara-Vasquez, B. Sensale-Rodriguez, & R. Menon, "Ultra-thin near infrared camera enabled by a flat multi-level diffractive lens," Optics Letters 44(22), 5450-5452 (2019).
19. M. Meem, S. Banerji, **A. Majumder**, F. Guevara-Vasquez, B. Sensale-Rodriguez, & R. Menon, "Broadband lightweight flat lenses for long-wave infrared imaging," Proceedings of the National Academy of Sciences, 116 (43), 21375-21378 (2019).
20. S. Banerji, M. Meem, A. Majumder, C. Dvonch, B. Sensale-Rodriguez, & R. Menon, "Single flat lens enabling imaging in the short-wave infra-red (SWIR) band," OSA Continuum 2, 2968-2974 (2019).
21. R. Likhite, A. Banerjee, **A. Majumder**, M. Karkhanis, H. Kim, & C. H. Mastrangelo, "Parametrically amplified low-power MEMS capacitive humidity sensor," MDPI Sensors, 19(18), 3954 (2019).
22. **A. Majumder**, C. Ghosh, M. U. Karkhanis, A. Banerjee, R. Likhite, & C. H. Mastrangelo, "Creep deformation in elastomeric membranes of liquid-filled tunable-focus lenses," Applied Optics, 58(23), 6446-6454 (2019).
23. S. Banerji, M. Meem, **A. Majumder**, F. Guevara-Vasquez, B. Sensale-Rodriguez, & R. Menon, "Imaging with flat optics: metalenses or diffractive lenses?," Optica, 6(6), 805-810 (2019).
24. **A. Majumder,** L. Bourke, T. L. Andrew, & R. Menon, "Superresolution optical nanopatterning at low light intensities using a quantum yield-matched photochrome," OSA Continuum, 2(5), 1754-1761 (2019).
25. M. Meem, **A. Majumder,** & R. Menon, "Full-color video and still imaging using two flat lenses," Optics Express, 26(21), 26866-26871 (2018).
26. **A. Majumder,** B. Shen, R. Polson, & R. Menon, **"**Ultra-compact polarization rotation in integrated silicon photonics using digital metamaterials," Optics Express 25, 19721-19731 (2017).
27. **A. Majumder,** X. Wan, F. Masid, B. J. Pollock, T. L. Andrew, O. Soppera, & R. Menon, "Reverse-absorbance-modulation-optical lithography for optical nanopatterning at low light levels," AIP Advances, 6, 065312 (2016).
28. **A. Majumder,** P.L. Helms, T. L. Andrew, & R. Menon, "A comprehensive simulation model of the performance of photochromic films in absorbance-modulation-optical-lithography," AIP Advances, 6, 035210 (2016).
29. **A. Majumder,** F. Masid, B. J. Pollock, T. L. Andrew, and R. Menon, "Barrier-free absorbance modulation for super-resolution optical lithography", Optics Express, 23(9), 12244-12250 (2015).

Peer-reviewed conference proceedings and presentations

30. **[Invited talk] A. Majumder**, "Versatile diffractive flat optics", ECE departmental seminar, Oct 21, 2023.
31. T. M. Hayward, **A. Majumder**, and R. Menon, "Multi-level diffractive lenses (MDL) with extended depth-of-focus (EDOF) over 50mm fabricated by grayscale lithography for laser cutting applications," EIPBN San Francisco, CA May 31-June 3, 2023.
32. D. Lin, W. Jia, **A. Majumder**, and R. Menon, "Machine-learning-assisted inverse design for large FOV dual-layer multi-level diffractive lens," CLEO San Jose May 7-12, 2023.
33. **[Invited talk] A. Majumder**, "Ultra-compact nanophotonic devices and diffractive structures for imaging", MIT MEEPCon, July 28, 2022.
34. **[Invited talk] A. Majumder**, "Versatile diffractive flat optics", ECE departmental seminar, March 04, 2022.
35. W. Jia, S. Banerji, **A. Majumder**, A. Hamrick, R. Menon, and B. Sensale-Rodriguez, "Ultra-compact Integrated Photonic Devices Enabled by Digital Metamaterials," Frontiers in Optics + Laser Science 2021.
36. M. Meem, **A. Majumder**, S. Banerji, B. Sensale-Rodriguez, & R. Menon, "Achromatic broadband visible imaging with a 10cm flat lens," CLEO, San Jose CA, May 2021.
37. M. Meem, **A. Majumder**, S. Banerji, B. Sensale-Rodriguez, & R. Menon, "Xenos peckii's Compound Eye Structure Inspired Flat Microlens Array for Super-resolution Imaging," CLEO, San Jose CA, May 2021.
38. M. Meem, **A. Majumder**, S. Banerji, B. Sensale-Rodriguez, & R. Menon, "Free-form Broadband Flat Lens for F-Number and Numerical Aperture Decoupling," CLEO, San Jose CA, May 2021 (poster).

39. **A. Majumder**, M. Meem, F. G. del Cueto, C. B. Reddy, F. Guevara Vasquez, & R. Menon, "Full-frame snapshot hyperspectral imaging for biomedical applications enabled by diffractive optics and computational reconstruction," OSA Biophotonics Congress: Optics in the Life Sciences, April 14, 2021.
40. S. Banerji, A. Hamrick, **A. Majumder**, B. Sensale-Rodriguez, & R. Menon, "Designing ultra-compact silicon T-junctions using machine learning," CLEO, San Jose CA, May 14, 2020 (poster).
41. S. Banerji, M. Meem, **A. Majumder**, C. Dvonch, B. Sensale-Rodriguez, & R. Menon, "Large-area ultra-broadband achromatic flat lens for imaging in the SWIR," CLEO, San Jose CA, May 11, 2020.
42. S. Banerji, M. Meem, **A. Majumder**, B. Sensale-Rodriguez, & R. Menon, "Single flat lens enables extreme depth of focus imaging," CLEO, San Jose CA, May 11, 2020.
43. S. Banerji, M. Meem, **A. Majumder**, B. Sensale-Rodriguez, & R. Menon, "Imaging across an unlimited bandwidth: Is it possible?" CLEO, San Jose CA, May 11, 2020.
44. S. Banerji, M. Meem, **A. Majumder**, F. Guevara-Vasquez, B. Sensale-Rodriguez, & R. Menon, "Ultra-thin near-infrared camera via single flat lens for wide-angle imaging," CLEO, San Jose CA, May 9, 2020.
45. M. Meem, **A. Majumder**, & R. Menon, "High-security optical features enabled by ultra-flat micro- and nano-optics," Proceedings of the Optical Document Security conference 2020, 227-234, 2020.
46. R. Likhite, A. Banerjee, C. Ghosh, **A. Majumder**, M. Karkhanis, H. Kim, & C. H. Mastrangelo, "MEMS Stiction Suppression Using Low-Stress Camphor Sublimation," 2020 IEEE 33rd International Conference on Micro Electro Mechanical Systems (MEMS), 291-294, 2020.
47. S. Banerji, M. Meem, **A. Majumder**, B. Sensale-Rodriguez, & R. Menon, "Imaging with ultra-lightweight flat lenses: visible near-IR to long-wave IR," SPIE Optics & Photonics, San Diego CA, August 14, 2019.
48. S. Banerji, M. Meem, **A. Majumder**, B. Sensale-Rodriguez, & R. Menon, "Achromatic broadband diffractive lenses for focusing and imaging in LWIR," OSA Imaging Systems and Applications, Munich Germany, June 25, 2019 (poster).
49. M. Meem, S. Banerji, **A. Majumder**, B. Sensale-Rodriguez, & R. Menon, "Flat Lenses for ultra-lightweight longwave-infrared broadband imaging," CLEO, San Jose, May 8, 2019.
50. M. Meem, **A. Majumder**, & R. Menon, "Full-color, multi-plane image projection with mobile-phone flashlight and a multi-level diffractive hologram," CLEO, San Jose, May 10, 2019.
51. **A. Majumder**, S. Banerji, K. Miyagawa, M. Meem, M. Mondol, B. Sensale-Rodriguez, & R. Menon, "Programmable metamaterials & metasurfaces for ultra- compact multi-functional photonics," CLEO, San Jose, May 6, 2019.
52. S. Banerji, M. Meem, **A. Majumder**, F. Guevara-Vasquez, R. Menon, & B. Sensale-Rodriguez, "Multi-level diffractive lenses for real-time long-wave IR imaging," 2019 44th International Conference on Infrared, Millimeter, and Terahertz Waves (IRMMW-THz), Paris, France, 2019.
53. C. Ghosh, A. Mastrangelo, A. Banerjee, R. Likhite, M. Karkhanis, **A. Majumder**, H. Kim, & C. H. Mastrangelo, " Low-power distance ranging for smart contact lenses using quad scleral coil mutual inductance," Annual BMES Meeting Conference 2019.
54. **A. Majumder**, B. Shen, R. C. Polson, & R. Menon, "Ultra-compact nanophotonic devices designed by computational metamaterials," OSA Imaging Systems and Applications, San Francisco CA, June 28, 2017.
55. **A. Majumder**, B. Shen, R. C. Polson, & R. Menon, "Passive and active light control using computational metamaterials," CLEO 2017, San Jose, CA, May 19, 2017.
56. **A. Majumder**, X. Wan, B. J. Pollock, T. L. Andrew, & R. Menon, "Modelling the performance of photochromic thin films to achieve super-resolution nanopatterning by absorbance modulation at low light intensity," OSA Imaging Systems and Applications, Heidelberg, Germany, July 25, 2016.
57. **A. Majumder**, F. Masid, B. Pollock, T. L. Andrew, & R. Menon, "Super-resolution optical lithography via barrier-free absorbance modulation & separable-substrate technique," OSA Imaging Systems & Applied Optics, Arlington, VA, June 10, 2015.
58. **A. Majumder**, F. Masid, B. Pollock, T. L. Andrew, & R. Menon, "Super-resolution optical lithography using two approaches of Absorbance Modulation," EIPBN, San Diego, CA, May 27, 2015.
59. **A. Majumder**, F. Masid, B. Pollock, T. L. Andrew, & R. Menon, "Super-resolution optical nanolithography: Beyond the far-field diffraction limit," CLEO, San Jose, CA, May 14, 2015.
60. **A. Majumder**, P. Cantu, F. Masid, T. L. Andrew, &R. Menon, "Exploiting photochromism for optical nanopatterning", OSA Imaging and Applied Optics, 2014.

61. **A. Majumder**, T. L. Andrew, & R. Menon, "Maskless subwavelength nanopatterning using vortex phase plates and absorbance modulation," EIPBN, Nashville, TN, May 28-31, 2013 (poster).
62. **A. Majumder**, P. Cantu, F. Masid, R. Castagna, C. Bertarelli, & R Menon, "Maskless nanopatterning using a spatial light modulator and absorbance modulation," OSA Frontiers in Optics, Rochester, NY, 14–18 October, 2012.

ACADEMIC SERVICE

- Currently serving as a committee member on 2 graduate student's PhD committee.
- Reviewer for highly reputed research journals (75+ articles reviewed across 20 journals including Scientific Reports, Nature Communications, Optics Express, Optics Letters, Nanoscale, Optica, etc.). Received the **Outstanding Reviewer Recognition** from the Optical Society of America (2017).
- Project mentor to 8 undergraduate students.
- Guest lecturer on Geometrical Optics for ECE 5962 Optics for Energy, Fall 2016-2023, and Computational Photography, Spring 2022-2024.
- Technical mentor to project team for ECE 5962 Optics for Energy, Fall 2016.

FUNDING

1. Awarded the University of Utah College of Engineering Seed Grant ($36,000 for 1 year) to conduct preliminary investigation in the development of tunable flat optics for applications in consumer eyewear and to gather preliminary data for writing proposals in the future.
2. Awarded (as co-PI, primary PI: Rajesh Menon) research grant from the Office of Naval Research ($471,000 for 2 years) to develop large area ultra-lightweight MWIR flat lenses with extended depth of focus.
3. Awarded sub-award from Lumos Inc ($30,000 for 2 years) to develop diffractive optics based snapshot hyperspectral camera.

HONORS AND AWARDS

1. **Outstanding Reviewer Recognition:** Optical Society of America (OSA), 2017, Featured among top 200 reviewers, 2018.
2. **OSA Optics and Photonics News year-end feature - Optics in 2020. (Highlights best optics research in the year): A. Majumder,** et. al., "Versatile diffractive flat optics".
3. **Editor's Pick** in Applied Optics: Appl. Opt. 59, 38-44 (2020).
4. **Editor's Pick** in Optics Letters: Opt. Lett. 45, 6158-6161 (2020).
5. **Top 15 most cited paper** in Optica in 2020 - Optica7(3) 252-253 (2020).
6. **Most downloaded papers** for February 2021 in OSA Continuum - OSA Continuum 4(2) 602-607 (2021) and OSA Continuum 4(2) 491-497 (2021).
7. **Most downloaded papers** for April and May 2020 in Optica - Optica, 7(3), 214-2017 (2020).
8. **Most downloaded papers** for March 2020 in Optica - Optica, 7(3), 252-253 (2020) and Optica, 7(3), 214-2017 (2020).
9. **Most downloaded paper** for March 2020 and October 2019 in OSA Continuum - OSA Continuum, 2(10), 2968-2974 (2019).
10. **Most downloaded paper** for June-July 2019 in Optica - Optica 6, 805-810 (2019).
11. **Most downloaded Nanophotonics paper for entire year** 2017 in Optics Express - Optics Express, 25 (17), 19721-19731, 2017.
12. **1st Place Poster Award:** nanoUtah 2013, Category: Nanotechnology – Materials and Characterization.
13. **Best Paper Award:** IEEE Workshop on Microelectronics and Electron Devices, 2013.
14. **Extensive media coverage for the publications:** Optica, 7(3), 214-2017 (2020) and PNAS, 116 (43), 21375-21378 (2019).

RESEARCH COLLABORATIONS

- Prof. Atanas Gotchev, Tampere University, Finland.
- Prof. Berardi Sensale-Rodriguez, Dept. of ECE, University of Utah, USA.
- Prof. Carlos H. Mastrangelo, Dept. of ECE, University of Utah, USA.
- Prof. Henry I. Smith, Massachusetts Institute of Technology, USA.
- Prof. Trisha L. Andrew, University of Massachusetts Amherst, USA.
- Laurent Node-Langlois, Managing Director – Licensing, GE Corporate, USA.
- Prof. Fernando Guevara-Vasquez, Dept. of Mathematics, University of Utah, USA.

- Fernando Gonzalez del Cueto, Lumos Inc., USA.
- Hirotaka Murakami, Sony Corporation, USA and Japan.
- Dr. Chakravarthy B. Reddy, Huntsman Cancer Institute and Dept. of Medicine, University of Utah School of Medicine, USA.
- Prof. Atanas Gotchev, Tampere University, Finland.
- Gregory M. Wallraff, IBM Almaden Research Center, USA.
- Dr. Mark Mondol, Massachusetts Institute of Technology, USA.

SKILLS

Extensive experience in the design and construction of various types of maskless lithography systems based on interferometry using principles of Mach-Zehnder and Lloyd's Mirror Interferometers and dual-wavelength maskless 2D optical exposure systems, controlled using LabView.
Modelling and simulations of novel nano-lithography system AMOL using Matlab and COMSOL.
Design, fabrication and experimental characterization of diffractive optical elements.
Simulation, design, fabrication and performance analyses of silicon nanophotonic devices.

Optical Engineering: Diffractive optics, hyperspectral imaging, holograms, tunable lenses, Silicon nanophotonics, laser based optical exposure systems for interferometric lithography, optical filtering, arbitrary 2D optical maskless lithography systems, optical vortices and spiral phase plates, spatial light modulators, free-space to waveguide light coupling, optical set-up construction, imaging system engineering.

Photolithography: Experience in working with non-amplified and chemically-amplified photoresists, Photo-initiators, Photo-active compounds, Photo-acid generators, 3D-polymers, Grayscale lithography, Photochromic molecules and polymers, Direct Laser Writing (DLW).

Micro- and Nano-fabrication: Mask design and patterning, Mask based and maskless photolithography, Thin film deposition using Sputtering, E-beam Evaporation, LPCVD, PECVD, Wet/dry Etching.

Device Characterization and Metrology: Optical microscopy, SEM, AFM, Optical and Mechanical Profilometry, Ellipsometry.

Programming Languages and Simulation Software: Matlab, COMSOL Multiphysics, LabView, MEEP, Python, Cloud computing using Amazon Web Services, inverse problems, numerical optimization, FDTD, FEM, AutoCad, Adobe suite, L-Edit, LightTools, ImageJ, Octave, Scheme.

RELATED COURSEWORK

Integrated Circuit Microfabrication, Micromachining, Solid State Memory Devices, Thin Film Techniques, Nanostructured Materials, Lasers and Applications, Nanophotonics, Fourier Optics, Optics in Energy, Advanced E-M Fields, Optics in Biology, Spintronic Materials.

MEMBERSHIP IN SCIENTIFIC SOCITIES

- Member, The Optical Society of America (OSA).

CITATION REPORTS

Citation report (according to Google scholar)
https://scholar.google.com/citations?user=tuLpumcAAAAJ&hl=en

Total Citation: 1131 (until 02/01/2024)
h-index: 16
i10-index: 20