

Chih-Hao Chang

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A. Professional Preparation

Massachusetts Institute of Technology	Mechanical Engineering	Ph.D.	2008
Massachusetts Institute of Technology	Mechanical Engineering	M.S.	2004
Georgia Institute of Technology	Mechanical Engineering	B.S.	2002

B. Appointments

2017-present	Associate Professor (with tenure), Mechanical & Aerospace Engineering, North Carolina State University, Raleigh, NC
2016-present	University Faculty Scholar, North Carolina State University, Raleigh, NC
2011-2017	Assistant Professor, Mechanical & Aerospace Engineering, North Carolina State University, Raleigh, NC
2009-2011	Postdoctoral Associate, Massachusetts Institute of Technology, Cambridge, MA
2008-2009	Postdoctoral Associate, Singapore-MIT Alliance for Research and Technology (SMART) Centre, Singapore
2002-2008	Graduate Research Assistant, Massachusetts Institute of Technology

C. Honors and Awards

- University Faculty Scholar, North Carolina State University, 2016.
- Faculty Early Career Development (CAREER) Award, National Science Foundation (NSF), 2016.
- Outstanding Teacher Award, North Carolina State University and NC State Alumni Association, 2015.
- Ralph E. Powe Junior Faculty Enhancement Award, Oak Ridge Associated Universities (ORAU), 2013.
- Space Technology Research Early Career Faculty (ECF) Award, National Aeronautics and Space Administration (NASA), 2012.
- Best student paper, *52nd International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, Portland, Oregon, May 27-30, 2008.

D. Research and Scholarly Activities

D.1. Journal Publications (19 since 2002, 15 as corresponding author)

1. A. Poteet, X. Zhang, H. Nagai, and **C.-H. Chang**, "Twin photonic nanojets," *accepted for publication, Nanotechnology*, Dec 2017.
2. W.-Y. Chang, X. A. Zhang, W. Huang, J. Kim, A. Bagal, **C.-H. Chang**, T. Fang, and X. Jiang, "Low-energy high-efficiency photoacoustic transducers using candle soot nanoparticle/PDMS composites," *Acta Materialia*, **143**, 166-173, 2018.
3. X. A. Zhang, Y.-A. Chen, A. Bagal, and **C.-H. Chang**, "Enhanced Total Internal Reflection Using Low-Index Nanolattice Materials," *Optics Letters*, **42**(20), 4123-4126, 2017.
4. A. Bagal, X. A. Zhang, R. Shahrin, E. C. Dandley, J. Zhao, F. R. Pobleto, C. J. Oldham, Y. Zhu, G. N. Parsons, C. Bobko, and **C.-H. Chang**, "Large-Area Nanolattice Film with Enhanced Modulus, Hardness, and Energy Dissipation," *Scientific Reports*, **7**, 9145, 2017.
5. J. Tippens, A. Bagal, X. A. Zhang, and **C.-H. Chang**, "Nanostructured antireflective in-plane solar harvester," *Optics Express*, **26**(16), A840-A850, 2017.
6. H. Nagai, A. Poteet, X. A. Zhang, and **C.-H. Chang**, "Three-Dimensional Colloidal Interference Lithography," *Nanotechnology*, **28**, 125302, 2017.
7. Z. Wang, J. Zhao, A. Bagal, E. C. Dandley, C. J. Oldham, T. Fang, G. N. Parsons, and **C.-H. Chang**, "Wicking Enhancement in Three-Dimensional Hierarchical Nanostructures," *Langmuir*, **32**, 8029-9033, 2016.
8. D. Alden, W. Guo, R. Kirste, F. Kaess, I. Bryan, T. Troha, A. Bagal, P. Reddy, Luis H. Hernandez-Balderrama, A. Franke, S. Mita, **C.-H. Chang**, A. Hoffmann, M. Zgonik, R. Collazo and Z. Sitar, "Fabrication and structural properties of AlN submicron periodic lateral polar structures and waveguides for UV-C applications," *Applied Physics Letters*, **108**, 261106, 2016.
9. J.- H. Min, A. Bagal, J. Z. Mundy, C. J. Oldham, B.- I. Wu, G. N. Parsons, and **C.- H. Chang**, "Fabrication and design of metal nano-accordion structures using atomic layer deposition and interference lithography," *Nanoscale*, **8**, 4984-4990, 2016.
10. J.-H. Min, X. A. Zhang, and **C.-H. Chang**, "Designing unit cell in three-dimensional periodic nanostructures using colloidal lithography," *Optics Express*, **24**(2), 247983, 2016
11. X. A. Zhang, A. Bagal, E. Dandley, J. Zhao, C. Oldham, B. Wu, G. Parsons, and **C.-H. Chang**, "Ordered Three-Dimensional Thin-Shell Nanolattice Materials with Near-Unity Refractive Indices," *Advanced Functional Materials*, **25**, 6644-6649, 2015.
12. A. Bagal, E. Dandley, J. Zhao, X. A. Zhang, C. Oldham, G. Parsons, and **C.-H. Chang**, "Multifunctional Nano-Accordion Structures for Stretchable Transparent Conductors," *Materials Horizons*, **2**, 486-494, 2015. *Features as inside front cover article for August 2015.*

13. J. E. Elek, X. A. Zhang, B. Dai, Z. Xu and **C.-H. Chang**, "Fabrication of three-dimensional hierarchical nanostructures using template-directed colloidal assembly," *Nanoscale*, **7**, 4406-4410, 2015.
14. X. A. Zhang, B. Dai, Z. Xu, and **C.-H. Chang**, "Sculpting Asymmetric Hollow-Core Three-Dimensional Nanostructures Using Colloidal Particles," *Small*, **11**, 1285-1292, 2015. *Featured as Inside Front Cover Article for March 2015.*
15. W-Y Chang, W. Huang, A. Bagal, **C.-H. Chang**, J. Tian, P. Han, and Xiaoning Jiang, "Study on dielectric and piezoelectric properties of 0.7 Pb(Mg_{1/3}Nb_{2/3})O₃-0.3 PbTiO₃ single crystal with nano-patterned composite electrode," *J. Appl. Phys.*, **114**, 114103, 2013.
16. A. Bagal and **C.-H. Chang**, "Fabrication of Subwavelength Periodic Nanostructures using Liquid Immersion Lloyd's Mirror Interference Lithography," *Optics Letters*, **38**(14), 2531-2534 (2013).
17. X. A. Zhang, J. Elek, and **C.-H. Chang**, "Three-Dimensional Nanolithography Using Light Scattering from Colloidal Particles," *ACS Nano*, **7**(7), 6212-6218 (2013). *Featured as Front Cover Article for July 2013.*
18. Q. Yang, X. A. Zhang, A. Bagal, W. Guo, and **C.-H. Chang**, "Antireflection Effects at Nanostructured Material Interfaces and the Suppression of Thin-Film Interference," *Nanotechnology*, **24**, 235202 (2013).
19. K.-C. Park, H. J. Choi, **C.-H. Chang**, R. E. Cohen, G. H. McKinley, and G. Barbastathis, "Nanotextured Silica Surfaces with Robust Superhydrophobicity and Omnidirectional Broadband Supertransmissivity," *ACS Nano*, **6**, no. 5, 3789-3799 (2012). *Top 10 most read article of 2012.*
20. **C.-H. Chang**, L. Tian, W. Hesse, H. Gao, H. J. Choi, M. Siddiqui, and G. Barbastathis, "From 2-dimensional self-assembly to 3-dimensional nanolithography," *Nano Lett.*, **11**(6), 2533-2537 (2011).
21. **C.-H. Chang**, J. A. Dominguez-Caballero, H. J. Choi, and G. Barbastathis, "Nanostructured gradient-index antireflection diffractive optics," *Opt. Lett.*, **36**, 2354-2356 (2011).
22. R. K. Heilmann, M. Ahn, A. Brucoleri, **C.-H. Chang**, E. M. Gullikson, P. Mukherjee, and M. L. Schattenburg, "Diffraction efficiency of 200 nm-period critical-angle transmission gratings in the soft x-ray and extreme ultraviolet wavelength bands," *Applied Optics*, **50**, 1364-1373 (2011).
23. **C.-H. Chang**, H. J. In, S. Takahashi, M. Deterre, H. J. Choi, K. W. Gotrik, and G. Barbastathis, "Assembling Nanoparticle Catalysts with Nanospheres for Periodic Carbon Nanotube Structure Growth," *Nanotechnology*, **22**, 035301 (2011).
24. **C.-H. Chang**, L. Waller, and G. Barbastathis, "Design and optimization of broadband wide-angle antireflection structures for binary diffractive optics," *Opt. Lett.*, **35**, 907-909 (2010).
25. D. L. Voronov, M. Ahn, E. H. Anderson, R. Cambie, **C.-H. Chang**, E. M. Gullikson, R. K. Heilmann, F. Salmassi, M. L. Schattenburg, T. Warwick, V. V. Yashchuk, L. Zipp,

- and H. A. Padmore, "High-efficiency 5000 lines/mm multilayer-coated blazed grating for EUV wavelengths," *Optics Letters*, **35**, 2615-2617 (2010).
26. **C.-H. Chang**, C.-W. Tan, J. Miao, and G. Barbastathis, "Self-assembled ferrofluid lithography: patterning micro and nanostructures by controlling magnetic nanoparticles," *Nanotechnology*, **20** 495301 (2009).
 27. **C.-H. Chang**, Y. Zhao, R. K. Heilmann, and M. L. Schattenburg, "Fabrication of 50 nm period gratings with multilevel interference lithography," *Opt. Lett.*, **33**, 1572-1574 (2008).
 28. **C.-H. Chang**, Y. Zhao, R. K. Heilmann, and M. L. Schattenburg, "Spatial-frequency multiplication with multilevel interference lithography," *J. Vac. Sci. Technol. B*, **26** (6) 2135-2138 (2008).
 29. **C.-H. Chang**, R. K. Heilmann, M. L. Schattenburg, and P. Glenn, "Spectral leakage analysis of a shear mode double-pass acousto-optical modulator," *Rev. Sci. Instrum.*, **79**, 033104 (2008).
 30. Y. Zhao, **C.-H. Chang**, R.K. Heilmann and M.L. Schattenburg, "Phase control in multiexposure spatial frequency multiplication," *J. Vac. Sci. Technol. B*, **25** (6), 2439-2443 (2007).
 31. **C.-H. Chang**, M. Akilian, and M. L. Schattenburg, "Describing isotropic and anisotropic out-of-plane deformations in thin cubic materials by use of Zernike polynomials," *Applied Optics*, **45** (3), 432-437 (2006).
 32. J. F. Seely, L. I. Goray, B. Kjornrattanawanich, J. M. Laming, G. E. Holland, K. A. Flanagan, R. K. Heilmann, **C.-H. Chang**, M. L. Schattenburg, and A. P. Rasmussen, "Efficiency of a grazing-incidence off-plane grating in the soft-x-ray region," *Appl. Opt.*, **45** (8), 1680-1687 (2006).
 33. M. P. Kowalski, R. K. Heilmann, M. L. Schattenburg, **C.-H. Chang**, F. B. Berendse, and W. R. Hunter, "Near-normal-incidence extreme-ultraviolet efficiency of a flat crystalline anisotropically etched blazed grating," *Appl. Opt.*, **45** (8), 1676-1679 (2006).
 34. J. C. Montoya, **C.-H. Chang**, R. K. Heilmann, and M. L. Schattenburg, "Doppler writing and linewidth control for scanning beam interference lithography," *J. Vac. Sci. Technol. B*, **23** (6), 2640-2645 (2005).
 35. **C.-H. Chang**, J. C. Montoya, M. Akilian, A. Lapsa, R. K. Heilmann, and M. L. Schattenburg, M. Li, K. A. Flanagan, A. P. Rasmussen, J. F. Seely, J. M. Laming, B. Kjornrattanawanich, and L. I. Goray, "High fidelity blazed grating replication using nanoimprint lithography," *J. Vac. Sci. Technol. B*, **22** (6), 3260-3264 (2004).
 36. P. T. Konkola, C. G. Chen, R. K. Heilmann, C. Joo, J. C. Montoya, **C.-H. Chang**, and M. L. Schattenburg, "Nanometer-level repeatable metrology using the Nanoruler," *J. Vac. Sci. Technol. B*, **21** (6), 3097-3101 (2003).
 37. **C.-H. Chang**, R. K. Heilmann, R. C. Fleming, J. Carter, E. Murphy, M. L. Schattenburg, T. C. Bailey, J. G. Ekerdt, R. D. Frankel, and R. Voisin, "Fabrication of sawtooth diffraction gratings using nanoimprint lithography," *J. Vac. Sci. Technol. B*, **21** (6), 2755-2759 (2003).

D.2. Invited Talks and Seminars

1. C.-H. Chang, "Engineering Three-Dimensional Nanostructures with Multiple Functionalities," Department of Mechanical Engineering, Temple University, Philadelphia, PA, April 13, 2015.
2. C.-H. Chang, "Engineering Multifunctional Three-Dimensional Nanostructures: Going Beyond Biomimetics," NASA Glenn Research Center, Cleveland, OH, June 6, 2014.
3. C.-H. Chang, "Bio-Improved Antireflection Structures: Going Beyond the Moth Eye," Optical Society of America (OSA) topic meeting on *Optics for Solar Energy (SOLAR)*, Tucson, AZ, November 4-6, 2013.
4. C.-H. Chang, "Multifunctional Two/Three-Dimensional Nanostructured Materials," NASA Langley Research Center, Langley, VA, August 20, 2013.
5. C.-H. Chang, "Design and Fabrication of Multifunctional Two/Three-Dimensional Nanostructured Materials," Emerging Information and Technology Association Young Investigator Conference (EITA-YIC), Cambridge, MA, August 2, 2013.
6. C.-H. Chang, "Multifunctional Two/Three-Dimensional Nanostructured Materials," Oak Ridge National Laboratory, Oak Ridge, TN, June 2013.
7. C.-H. Chang, "Multifunctional Nanostructured Materials: Blurring the Lines between Optical Interfaces," 57th *International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, Nashville, TN, May 28-31, 2013.
8. C.-H. Chang, "Multifunctional Nanostructured Materials," Joint School of Nanoscience and Nanoengineering (JSNN), NC A&T State University and UNC-Greensboro, Greensboro, NC, September 21, 2012.
9. C.-H. Chang, "Bio-inspired Multifunctional Nanostructured Materials," Department of Mechanical and Aerospace Engineering, North Carolina State University, Raleigh, NC, April 25, 2011.
10. C.-H. Chang, "Manufacturing Nanomaterials and the Roles of Lithography, Metrology, and Self-Assembly," Department of Mechanical Engineering, University of Michigan, Ann Arbor, MI, March 17, 2010.
11. C.-H. Chang, "From Macrolenses to Adaptive Nanostructured Optical Elements," Department of Mechanical Engineering, University of Texas, Austin, TX, April 1, 2009.
12. C.-H. Chang, "Tunable Nanostructured Optical Material," Department of Mechanical Engineering, Temple University, Philadelphia, PA, February 20, 2009.
13. C.-H. Chang, Y. Zhao, R. K. Heilmann, and M. L. Schattenburg, "Spatial-frequency multiplication with multilevel interference lithography," 34th *Intl. Conf. on Micro and Nano Engineering*, Athens, Greece, September 15-19, 2008.

D.3. Conference Presentations/Proceedings

1. X. A. Zhang, A. Bagal, and C.-H. Chang, "Scalable Fabrication of Multifunctional Thin-Shell Nanolattice Film with Novel Mechanical and Optical Properties," *International Mechanical Engineering Congress & Exposition (IMECE)*, Tampa, FL, November 5-8, 2017.

2. I-T. Chen, X. A. Zhang, J.-H. Min, and **C.-H. Chang**, “Roll-to-Roll Fabrication of Three-Dimensional Periodic Nanostructures,” *International Mechanical Engineering Congress & Exposition (IMECE)*, Tampa, FL, November 5-8, 2017.
3. X. Zhang, I.-T. Chen, and **C.-H. Chang**, “Recycling Particles for Sustainable Colloidal Optical Lithography,” *International Mechanical Engineering Congress & Exposition (IMECE)*, Tampa, FL, November 5-8, 2017.
4. J.-H. Min, A. Bagal, P. Lemaire, J. Z. Mundy, C. J. Oldham, G. N. Parsons, and **C.-H. Chang**, “Fabrication and Characterization of Transparent, Flexible Metallic Nano-Accordions,” *61st International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, Orlando, FL, May 30-June 2, 2017.
5. I.-T. Chen, X. Zhang, X. A. Zhang, J.-H. Min, and **C.-H. Chang**, “Continuous Patterning of Three-Dimensional Periodic Nanostructures using Roll-to-Roll System,” *61st International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, Orlando, FL, May 30-June 2, 2017.
6. J.-H. Min, D. T. Lee, T. Sun, B. O’Connor, G. N. Parsons, and **C.-H. Chang**, “Conformal Coating of Gold on Nanostructured Surfaces using Thermal Evaporation,” *61st International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, Orlando, FL, May 30-June 2, 2017.
7. Z. Luo, X. A. Zhang, A. Poteet, and **C.-H. Chang**, “High-aspect-ratio magnetic tunable nanopillar array,” *61st International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, Orlando, FL, May 30-June 2, 2017 (**invited poster**).
8. Y.-A. Chen, S. V. Naidu, Z. Luo, and **C.-H. Chang**, “Design of interfacial antireflection nanostructures in multilayers,” *61st International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, Orlando, FL, May 30-June 2, 2017.
9. X. A. Zhang, A. Bagal, E. C. Dandley, J. Zhao, C. J. Oldham, G. N. Parsons, and **C.-H. Chang**, “Optical Properties of “Air-Like” Ordered 3D Thin-Shell Nanolattice Materials,” *60th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, Pittsburg, PA, May 31-June 3, 2016.
10. X. A. Zhang, Z. Luo, A. Poteet, and **C.-H. Chang**, “Fabrication of Magnetically Tunable Periodic Nanostructures,” *60th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, Pittsburg, PA, May 31-June 3, 2016.
11. A. Bagal, X. A. Zhang, R. Shahrin, E. C. Dandley, J. Zhao, C. J. Oldham, G. N. Parsons, C. Bobko, and **C.-H. Chang**, “Lightweight Ultrastrong Thin-Shell Nanolattice Material for Enhanced Energy Dissipation,” *60th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, Pittsburg, PA, May 31-June 3, 2016.
12. J.-H. Min, A. Bagal, J. Z. Mundy, C. J. Oldham, G. N. Parsons, and **C.-H. Chang**, “Fabrication of Metallic Microstructured Nano-Accordions for Transparent Electrodes,” *60th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, Pittsburg, PA, May 31-June 3, 2016.
13. J. Tippens, A. Bagal, and **C.-H. Chang**, “Design and Fabrication of an In-Plane Nanostructured Solar Concentrator,” *60th International Conference on Electron, Ion and*

Photon Beam Technology and Nanofabrication, Pittsburg, PA, May 31-June 3, 2016 (invited poster).

14. H. Nagai, X. A. Zhang, and **C.-H. Chang**, “Three-Dimensional Colloidal Interference Lithography,” *60th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, Pittsburg, PA, May 31-June 3, 2016.
15. A. Bagal, E. Dandley, J. Zhao, X. A. Zhang, C. Oldham, G. Parsons, and **C.-H. Chang**, “Fabrication of Stretchable Transparent Conductors using Nano-Accordion Structures,” *59th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, San Diego, CA, May 26-29, 2015.
16. A. Bagal, X. A. Zhang, R. Shahrin, E. C. Dandley, J. Zhao, C. J. Oldham, G. N. Parsons, C. Bobko, and **C.-H. Chang**, “Fabrication and Mechanical Properties of Porous 3D Nanostructures,” *59th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, San Diego, CA, May 26-29, 2015.
17. J.-H. Min, A. Bagal, J. Z. Mundy, C. J. Oldham, G. N. Parsons, and **C.-H. Chang**, “Fabrication of Thin Metallic Nanostructures using Atomic Layer Deposition,” *59th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, San Diego, CA, May 26-29, 2015.
18. X. A. Zhang, E. C. Dandley, A. Bagal, J. Zhao, C. J. Oldham, G. N. Parsons, and **C.-H. Chang**, “Low-Index Materials with Controllable Ordered Geometry by Three-Dimensional Nanolithography and Atomic Layer Deposition,” *8th International Conference on Nanophotonics*, Changchun, China, May 25-28, 2015.
19. X. A. Zhang, Z. Xu, B. Dai, and **C.-H. Chang**, “Three-Dimensional Nanolithography Using Colloidal Nanospheres with Oblique and Multiple Exposures,” *58th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, Washington, DC, May 27-30, 2014 (invited talk).
20. A. Bagal, E. Dandley, J. Zhao, C. Oldham, G. Parsons, and **C.-H. Chang**, “Fabrication of ZnO Nano-Spring for Transparent Stretchable Conductor,” *58th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, Washington, DC, May 27-30, 2014.
21. J. E. Elek, X. A. Zhang, Z. Xu, and **C.-H. Chang**, “Design of Hierarchical Three-Dimensional Porous Nanostructures using Template-Directed Colloidal Assembly,” *58th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, Washington, DC, May 27-30, 2014.
22. J.-H. Min, X. A. Zhang, and **C.-H. Chang**, “Fabrication of Three-Dimensional Periodic Nanostructures in Negative Photoresist Using a Colloidal Phase Mask,” *58th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, Washington, DC, May 27-30, 2014 (invited poster).
23. Z. Wang, A. Bagal, J. Zhao, E. Dandley, C. Oldham, T. Fang, G. Parsons, and **C.-H. Chang**, “Fabrication of ZnO Three-Dimensional Hierarchical Nanostructures for Wicking Applications,” *58th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication*, Washington, DC, May 27-30, 2014.

24. **C.-H. Chang**, “Bio-Improved Antiflection Nanostructures: Going Beyond the Moth Eye,” in *Renewable Energy and the Environment*, OSA Technical Digest, paper RM2D.1, 2013.
25. T. Rivord, A. Bagal, and **C.-H. Chang**, “Nanostructured In-Plane Solar Concentrator,” in *Renewable Energy and the Environment*, OSA Technical Digest, paper RT3D.4, 2013.
26. A. Bagal and **C.-H. Chang**, “Liquid-Immersion Lloyd’s Mirror Interference Lithography,” *57th Intl. Conf. on Electron, Ion, Photon Beam Technology and Nanofabrication*, Nashville, TN, May 28-31, 2013.
27. J. E. Elek, X. A. Zhang, and **C.-H. Chang**, “Fabrication of Hierarchical Three-Dimensional Nanostructures Using Template-Directed Assembly of Colloidal Particles,” *57th Intl. Conf. on Electron, Ion, Photon Beam Technology and Nanofabrication*, Nashville, TN, May 28-31, 2013.
28. X. A. Zhang and **C.-H. Chang**, “Fabrication of Periodic Hollow-Shell Nano-Volcano Arrays for Particle Trapping,” *57th Intl. Conf. on Electron, Ion, Photon Beam Technology and Nanofabrication*, Nashville, TN, May 28-31, 2013.
29. X. A. Zhang, J. Elek, and **C.-H. Chang**, “Fabrication of hollow-shell nano-volcanoes from Mie scattering by colloidal nanospheres,” *56th Intl. Conf. on Electron, Ion, Photon Beam Technology and Nanofabrication*, Waikoloa, HI, June 2012.
30. **C.-H. Chang**, L. Tian, W. R. Hesse, H. Gao, H. J. Choi, J.-G. Kim, M. Siddiqui, and G. Barbastathis, “3D Nanolithography Using Self-Assembled Nanospheres,” *55th Intl. Conf. on Electron, Ion, Photon Beam Technology and Nanofabrication*, Las Vegas, NV, June 1-3, 2011.
31. **C.-H. Chang**, J. A. Dominguez-Caballero, H. J. Choi, and G. Barbastathis, "Gradient-Index adiabatic impedance matching antireflective diffractive optics," *Conference on Lasers and Electro-Optics (CLEO)*, Baltimore, MD, May 1-6, 2011.
32. **C.-H. Chang** and G. Barbastathis, “Fabrication of Antireflection Structures for Binary Diffraction Gratings,” *54th Intl. Conf. on Electron, Ion, Photon Beam Technology and Nanofabrication*, Alaska, June 1-4, 2010.
33. **C.-H. Chang**, H. J. In, M. Deterre, H. J. Choi, and G. Barbastathis, “Assembling Nanoparticle Catalysts with Nanospheres for Growth of Periodic Carbon Nanotube Arrays,” *54th Intl. Conf. on Electron, Ion, Photon Beam Technology and Nanofabrication*, Alaska, June 1-4, 2010.
34. S. Takahashi, **C.-H. Chang**, S. Y. Yang, and G. Barbastathis, “Design and fabrication of dielectric nanostructured Luneburg lens in optical frequencies,” *Int. Conf. on Optical MEMS & Nanophotonics*, Sapporo, Japan (2010).
35. D. L. Voronov, M. Ahn, E. H. Anderson, R. Cambie, **C.-H. Chang**, L. I. Goray, E. M. Gullikson, R. K. Heilmann, F. Salmassi, M. L. Schattenburg, T. Warwick, V. V. Yashchuk, and H. A. Padmore, “High Efficiency Multilayer Blazed Gratings for EUV and Soft X-Rays: Recent Developments,” *Proc. SPIE 7802, Advances in X-Ray/EUV Optics and Components V*, 780207 (2010).

36. **C.-H. Chang**, C.-W. Tan, Z. Wang, J. Miao, and G. Barbastathis, “Self-Assembled Ferrofluid Lithography,” 53rd Intl. Conf. on Electron, Ion and Photon Beam Technology and Nanofabrication, Marco Island, Florida, May 26-29, 2009.
37. D. L. Voronov, E. H. Anderson, R. Cambie, F. Salmassi, E. M. Gullikson, V. V. Yashchuck, H. A. Padmore, M. Ahn, **C.-H. Chang**, R. K. Heilmann, and M. L. Schattenburg, “5000 Groove/mm Multilayer-Coated Blazed Grating with 33% Efficiency in the 3rd Order in the EUV Wavelength Range,” *Proc. SPIE 7448, Advances in X-Ray/EUV Optics and Components IV*, 74480J (2009).
38. **C.-H. Chang**, R.K Heilmann and M.L. Schattenburg, “Advanced heterodyne fringe-locking system using multiple frequency shifts,” *Proceeding of the 20th Annual Meeting of the American Society of Precision Engineering*, Norfolk, Virginia, Oct. 9-14, 2005.
39. Y. Zhao, **C.-H. Chang**, J. Montoya, R. Heilmann and M.L. Schattenburg, “Measurement of milli-degree temperature gradients in environmental enclosures,” *Proceeding of the 20th Annual Meeting of the American Society of Precision Engineering*, Norfolk, Virginia, Oct. 9-14, 2005.
40. R.K. Heilmann, M. Akilian, **C.-H. Chang**, R. Hallock, E. Cleaveland and M.L. Schattenburg, “Shaping of thin grazing-incidence reflection grating substrates via magnetorheological finishing,” *Proc. SPIE 5900, Optics for EUV, X-ray, and Gamma-ray Astronomy II*, 59000B (2005).
41. J.F. Seely, L.I. Goray, B. Kjornrattanawanich, J.M. Laming, G.E. Holland, K.A. Flanagan, R.K. Heilmann, **C.-H. Chang**, M.L. Schattenburg and A.P. Rasmussen, “Off-plane grazing-incidence Constellation-X grating calibrations using polarized synchrotron radiation and PCGRATE code calculations,” *Proc. SPIE 5900, Optics for EUV, X-ray, and Gamma-ray Astronomy II*, 59-65 (2005).
42. R.K. Heilmann, M. Akilian, **C.-H. Chang**, C.R. Forest, C. Joo, A. Lapsa, J.C. Montoya and M.L. Schattenburg, “Thin foil reflection gratings for Constellation-X,” *Proc. SPIE 5488, UV-Gamma Ray Space Telescope Systems*, 283-290 (2004).
43. R.K. Heilmann, M. Akilian, **C.-H. Chang**, C.G. Chen, C. Forest, C. Joo, P. Konkola, J.C. Montoya, Y. Sun, J. You and M.L. Schattenburg, “Advances in reflection grating technology for Constellation-X,” *Proc. SPIE 5168, Optics for EUV, X-ray, and Gamma-ray Astronomy*, 271-282 (2004).
44. A.P. Rasmussen, A. Aquila, J. Bookbinder, **C.-H. Chang**, E. Gullikson, R.K. Heilmann, S.M. Kahn, F. Paerels and M.L. Schattenburg, “Grating arrays for high-throughput soft x-ray spectrometers,” *Proc. SPIE 5168, Optics for EUV, X-ray, and Gamma-ray Astronomy*, 248-259 (2004).

D.4. Citation Indices

- Google Scholar: h-index = 18, total citations = 1027.
<https://scholar.google.com/citations?user=aYGjRXAAAAAJ&hl=en>
- Web of Science: h-index = 14, total citations = 616.
<http://www.researcherid.com/rid/E-9642-2011>

D.5. Patents and Invention Disclosures

1. “Nanostructured Multilayer Armor with Enhanced Optical Transmission,” NCSU Invention Disclosure #17210, 2017.
2. “System for Continuous Printing of Three-Dimensional Nanostructures,” NCSU Invention Disclosure #16297, 2016.
3. “Robust film with air-like optical properties,” NCSU Invention Disclosure #16098, 2015.
4. “Nanolithography Using Light Scattering from Particles and its Applications in Controlled Material Release,” US provisional patent 61/888,775 (US patent pending, 14/509,672), 2015.
5. “Process for Manufacturing Glass with Micro/Nanostructured Surface Texture,” US Patent #9120669, 2015.
6. “Method for Antireflection in Binary and Multi-Level Diffractive Elements,” US provisional patent 61/379,804, 2012.
7. “Tunable Optical Element,” PCT Patent Application No. : PCT/SG2010/000290, 2010.
8. “Tunable Lithography Mask,” US provisional patent 61/143,224, 2009.

D.6. News and Press Releases

1. “[University Faculty Scholars Named](#),” NC State News Office, 2016.
2. “[Chang receives NSF CAREER award](#)” and “[Honoring Outstanding Faculty](#),” NC State News Office, 2016.
3. “[Dielectric Film Has Refractive Index Close to Air for Photonics Applications](#),” NC State News Office. Also reported in [Triangle Business Journal](#), [Le Scienze \(Italy\)](#), [Materials Today](#), [Optics & Photonics News \(OSA\)](#), [Photonics.com](#), [Phys Org](#), [R&D Magazine](#), [Science Daily](#), [Nanotechnology Now](#), [AZO Materials](#), [Nanowerk](#), [Chem Europe](#), etc.
4. “[Researchers Create Transparent, Stretchable Conductors Using Nano-Accordion Structure](#),” NC State News Office, 2015. Also reported in [CBS News](#), [Chemistry World](#), [Materials Today](#), [Phys.org](#), [the Engineer \(UK\)](#), [Digital Trends](#), [New Electronics](#), [R&D Magazine](#), [EurekaAlert](#), [Nanowerk](#), [ECN Magazine](#), [Product Design & Development](#), [Gizmag](#), [AZoNano](#), etc.
5. “[Annual Alumni Association Faculty Awards](#),” NC State Alumni Association, 2015. “[Teaching Awards Presented](#),” NC State News Office, 2015.
6. “[Nanoparticle Allows Low-Cost Creation of 3-D Nanostructures](#),” NC State News Office, December 8, 2014. Also reported in [NSF.gov](#), [PhysOrg](#), [ScienceDaily](#), [R&D Magazine](#), [Kurzweilai](#), [The Engineer \(UK\)](#), [Nanowerk](#), [3DPrint](#), [AZonano](#), [Engineering.com](#), [e-Science News](#), [Photonics.com](#), [Biomedical Picture of the Day](#), etc.
7. “[Light-Carved ‘Nano-Volcanoes’ Hold Promise for Drug Delivery](#),” NC State News Office, June 13, 2013. Also reported in [NSF.gov](#), [WRAL TechWire](#), [Triangle Business Journal](#), [the Engineer \(UK\)](#), [Materials Views](#), [ScienceDaily](#), [PhysOrg](#), [R&D Magazine](#), [RedOrbit](#), [Photonics.com](#), [e-Science News](#), [Nanowerk](#), [Azonano](#), etc.

8. [“ORAU awards 30 research grants for 2013-2014 academic year to junior faculty at its consortium member universities,”](#) ORAU, May 28, 2013.
9. [“Moth-Inspired Nanostructures Take the Color Out of Thin Films,”](#) NC State News Office, May 16, 2013. Also reported in [NSF.gov](#), [Science 360 \(NSF\)](#), [Materials360 \(MRS\)](#), [R&D Magazine](#), [PhysOrg](#), [the Engineer \(UK\)](#), [ScienceDaily](#), [Laser Focus World](#), [TreeHugger](#), [Gizmag](#), [Azonano](#), etc.
10. [“Universities Go to Space: NASA Announces Early Career Faculty Space Tech Research Grants,”](#) NASA, August 14, 2012.
11. [“Through a Glass, Clearly,”](#) MIT News Office, April 26, 2012.
12. [“A New Way to Build Nanostructures,”](#) MIT News Office, July 6, 2011.
13. [“Magnetic Field Assembles Lithography Mask,”](#) Nanotechweb.org, Institute of Physics Publishing, London, UK, Jan 19, 2010.
14. [“MIT Reports Finer Lines for Microchips,”](#) MIT News Office, July 8, 2008.

E. Funded Research (Total \$1.957 M; Chang share \$1.692 M)

E.1. Active Funding

- “Plasma Processing of Sapphire Nanostructures for Low-Loss Multilayer Composites,” Investigator(s): Chih-Hao Chang, Army Research Office (ARO), September 1, 2017-May 31, 2018, Amount: \$60,000.
- “CAREER: Three-Dimensional Nanolithography with Inexpensive Hardware,” Investigator(s): Chih-Hao Chang, National Science Foundation (NSF), June 1, 2015 – May 31, 2020. Amount: \$500,000.
- “Surface and Domain Nano-Engineering of Relaxor Single Crystal for Acoustic Sensors,” Investigator(s): Xiaoning Jiang (PI), Chih-Hao Chang (co-PI), Office of Naval Research (ONR), June 1, 2015 – May 31, 2018. Amount: \$362,105 (Chang share \$120,702).
- “Tunable Nanostructures with Dynamic Optical Properties,” Investigator(s): Chih-Hao Chang, Defense Advanced Research Projects Agency (DARPA), April 07, 2015 – January 06, 2018, \$200,000.

E.2. Past Funding

- “Hexagonal boron nitride nanosheets for advanced nanoscale electronics and radiation shielding,” Investigator(s): Zhenguo Huang (PI), Ravi Silva (co-PI), Chih-Hao Chang (co-PI), University Global Partnership Network (UGPN), August 01, 2016 – July 31, 2017, Amount: \$30,000 (Chang share \$10,000).
- “Enhancing Optical Transmission of Multilayer Composites with Interfacial Nanostructures,” Investigator(s): Chih-Hao Chang, Army Research Office (ARO), August 15, 2016 – May 14, 2017, Amount: \$50,000.

- “Electromagnetic (EM) Properties of Ultra-Low Density 3D Shell-Like Materials,” Investigator(s): Chih-Hao Chang, Defense Engineering Corporation (Prime: Air Force Research Laboratory), June 01, 2014 – May 31, 2015. Amount: \$20,000.
- “Probing the Nanomechanics of Engineered Three-Dimensional Nanostructures,” Investigator(s): Chih-Hao Chang (PI), Christopher Bobko (co-PI), NCSU Faculty Research & Professional Development Fund (internal), July 01, 2014 – June 30, 2015. Amount: \$7,000 (Chang share \$3,500).
- “Integrating Three-Dimensional Nanoporous Medium in Microfluidic Devices for Synthetic Biological Systems,” Investigator(s): Chih-Hao Chang, Oak Ridge Associated Universities (ORAU), June 1, 2013 – May 31, 2014. Amount: \$5,000.
- “Hierarchical Nanostructured Heat Pipe for Enhanced Two-Phase Heat Transfer,” Investigator(s): Chih-Hao Chang, NCSU Advanced Self Powered Systems of Sensors and Technologies (ASSIST) Center, August 15, 2012 – August 31, 2014, Amount: \$106,393.
- “Ultralight Nanolattices with Co-Optimized Mechanical, Thermal, and Optical Properties,” Investigator(s): Chih-Hao Chang, National Aeronautics & Space Administration (NASA), September 15, 2012 – September 14, 2016, Amount: \$567,000.

E.3. Other Funding

- “University Faculty Scholar Program,” Investigator: Chih-Hao Chang, North Carolina State University, August 01, 2016 – July 31, 2021, Amount: \$50,000.

F. Teaching Activities

F.1. Courses Taught and Student Evaluation (Department Average = 3.9/5)

- MAE 316 – Strength of Mechanical Components, Spring 2017, evaluation = 4.7/5
- MAE 589 – Optical Engineering, Fall 2016, evaluation = 4.8/5
- MAE 435 – Principles of Controls, Fall 2016, evaluation = 4.7/5
- MAE 316 – Strength of Mechanical Components, Spring 2016, evaluation = 4.5/5
- MAE 589 – Optical Engineering, Fall 2015, evaluation = 5/5
- MAE 435 – Principles of Controls, Fall 2015, evaluation = 4.5/5
- MAE 589 – Optical Engineering, Spring 2015, evaluation = 4.7/5
- MAE 314 – Solid Mechanics, Spring 2015, evaluation = 4.7/5
- MAE 435 – Principles of Controls, Fall 2014, evaluation = 4.6/5
- MAE 589 – Optical Engineering, Spring 2014, evaluation = 4.7/5
- MAE 314 – Solid Mechanics, Spring 2014, evaluation = 4.6/5
- MAE 435 – Principles of Controls, Fall 2013, evaluation = 4.7/5
- MAE 314 – Solid Mechanics, Spring 2013, evaluation = 4.8/5

- MAE 435 – Principles of Controls, Fall 2012, evaluation = 4.6/5
- MAE 435 – Principles of Controls, Spring 2012, evaluation = 4.7/5
- MAE 435 – Principles of Controls, Fall 2011, evaluation = 4.7/5

F.2. New Courses Introduced

- **Optical Engineering (MAE589):** Graduate-level introductory course to optics with a focus on engineering applications. The course covers topics in geometrical optics: ray-tracing, reflection, refraction, lens design, imaging optical systems, as well as topics in wave optics: basic electrodynamics, scalar wave theory, interference, Fresnel and Fraunhofer diffraction, image formation, Fourier optics, and 4F systems. The course also examines commonly observed optical systems, such as the human eye, microscopes/telescopes, and solar concentrators. The role of optics in advanced nano/microscale manufacturing will be highlighted, as well as applications in more efficient solar energy systems, engineered materials, and nanotechnology.
- **Engineering Bio-Inspired Nanostructures (In Progress):** Graduate-level introductory course on the fundamental principles of bio-inspired nanostructures and their applications in engineering materials, structures, and systems. The course will examine novel mechanical, fluidic, optical, electrical, and magnetic properties at the nanoscale, as well as topics in nanofabrication/manufacturing techniques including “top-down” lithographic and “bottom-up” self-assembly approaches. A central theme of the course will be engineering methods and tools to improve bio-inspired principles.

G. Collaborators and Advisorship

G.1. Collaborators

- Dr John Connell and Dr Christopher Wohl, NASA Langley Research Center.
- Dr. Brendan O’Connor, Dr. Tiegang Fang, Dr. Xiaoning Jiang, Dr. Yong Zhu, Mechanical and Aerospace Engineering, North Carolina State University
- Dr. Michael Dickey, Dr. Jan Genzer, Dr. Gregory Parson, Dr. Orlin Velev, Chemical and Biomolecular Engineering, North Carolina State University
- Dr. Linyou Cao, Dr Joseph Tracy, Dr. Zlatko Sitar, Material Science and Engineering, North Carolina State University.
- Dr. Jingyan Dong, Industrial and Systems Engineering, North Carolina State University.
- Dr. Shuang Fan Lim, Physics, North Carolina State University.
- Dr. Grant Wilson, University of Texas, Austin.
- Dr. Bae-Ian Wu, Air Force Research Laboratory.
- Dr. Zhenguo Huang, University of Wollongong.
- Dr. Ravi Silva, University of Surrey.

G.2. Graduate and Post-Graduate Advisors

- Dr. George Barbastathis, MIT, Post-Doctoral advisor

- Dr. Mark Schattenburg, MIT, Doctoral advisor

Thesis Advisorships

G.3. Current Graduate Students (4 PhD):

- Wei-Yi Chang (PhD in ME, expected May 2018, co-chair)
- I-Te Chen (PhD in ME, expected May 2020)
- Yi-An Chen (PhD in ME, expected May 2020)
- Zhiren Luo (PhD in ME, expected May 2019)

G.4. Previous Graduate Students (4 PhD, 4 MS):

- Joong Hee Min (PhD in ME, May 2017, now at Applied Materials, Santa Clara, CA)
- Sharan Naidu (MS in ME, May 2017, now at GlobalFoundries, Malta, NY)
- Xu Zhang (MS in ME, Dec 2015; PhD in ME, May 2016, now Postdoc Researcher at University of Pennsylvania.)
- Abhijeet Bagal (MS in ME, May 2012; PhD in ME, May 2016, now at Applied Materials, Santa Clara, CA)
- Erinn Dandley (PhD in CBE, May 2016, co-chair, now at Intel Corporation, Hillsboro, OR)
- Zhiting Wang (MS in ME, Aug 2015)
- Jonathan Elek (MS in ME, May 2014, now at MEMSCAP, Durham, NC)
- Qiaoyin Yang (MS in ME, May 2012, now at Schweitzer Engineering Laboratories, Pullman, WA)

G.5. Current and Previous Undergraduate Students (7):

- Elizabeth Schappell (BS in ME, current.)
- Jared Tippen (BS in ME, May 2017, now PhD student at Georgia Tech.)
- Austen Poteet (BS in ME, May 2017, now PhD student at Stanford University.)
- Hiro Nagai (BS in ME, May 2017.)
- Jonathan Chu (BS in ME, May 2014, now PhD student at Georgia Tech.)
- Travis Rivord (BS in ME, May 2014.)
- Kyle Rogers (BS in ME, May 2012.)

G.6. Visiting REU Students (9):

- Mohammed Al-Dhafer, North Carolina State University, Summer 2017.
- Hadi Homaidi, North Carolina State University, Summer 2017.
- Marram Andijani, North Carolina State University, Summer 2017.
- Abdullah Alabdulaaly, Purdue University, Summer 2016.

- Zainab Alnajar, Stony Brook University, Summer 2016.
- Bin Dai, Jiangsu University, China, Fall 2013-Summer 2014.
- Kathryn Daly, University of Maine, Summer 2013.
- Zhiyuan Xu, Jiangsu University, China, Spring 2013-Fall 2013.
- Polite Steward, Jr, Southern University, Summer 2012.

G.7. Awards by Students:

- I-Te Chen, Honorable Mention for scanning electron micrograph contest at the *61st International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication* in Orlando, FL, June, 2017.
- Xu Zhang, Chinese Government Award for Outstanding Students Abroad, China Scholarship Council, China, March 2017.
- Hiro Nagai, Departmental Research Experience for Undergraduates (REU), Mechanical and Aerospace Engineering, NCSU, 2017.
- Jared Tippen, Best Invited Poster Award at the *60th International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication* in Pittsburg, PA, June, 2016.
- Austen Poteet, Departmental Research Experience for Undergraduates (REU), Mechanical and Aerospace Engineering, NCSU, 2016.
- Jared Tippen, Departmental Research Experience for Undergraduates (REU), Mechanical and Aerospace Engineering, NCSU, 2015.
- Jonathan Chu, Undergraduate Research Fellowship, NSF Nanosystems Engineering Research Center for Advanced Self-Powered Systems of integrated Sensors and Technologies (ASSIST) at NCSU, 2013.
- Polite Steward, Jr, 2nd Place for Best Poster Presentation in Technology and Engineering, Louisiana State University Undergraduate Research Conference, 2012.
- Jonathan Chu, Awarded Undergraduate Research Grants, research competition sponsored by Duke/Progress Energy, 2012.

H. Synergistic Activities and Services

H.1. Leadership and Services in Professional Societies

- Member of Steering Committee, Nanoengineering for Energy and Sustainability (NEES), American Society of Mechanical Engineers (ASME), 2017-present.
- Topic Co-Organizer for Nanomanufacturing, *International Mechanical Engineering Congress & Exposition (IMECE)*, 2017-present.
- Session Chair, *International Mechanical Engineering Congress & Exposition (IMECE)*, Tampa, FL, Nov 2017.

- Member of Program Committee, *International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication (EIPBN)*, 2012-present.
- Member of Program Committee, Optical Society of America (OSA) topic meeting on *Optics for Solar Energy (SOLAR)*, 2012-2014.
- Session Chair, 60th *International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication (EIPBN)*, Pittsburgh, PA, June 2016.
- Session Chair, 58th *International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication (EIPBN)*, Washington DC, June 2014.
- Session Chair, Optical Society of America *Renewable Energy and the Environment Congress*, Tucson, AZ, November 2013.

H.2. University Committees and Services

- 2016-present: Advisory Committee of SEM Steering Committee of the Analytical Instrument Facilities (AIF), a University-wide user facility for metrology instruments.
- 2016-present: Seminar Committee, Mechanical and Aerospace Engineering Department, North Carolina State University.
- 2015-present: Advisory Committee of NCSU Nanofabrication Facilities (NNF), a University-wide cleanroom user facility.
- 2016: Panelist for University workshop on NSF CAREER Program.
- 2016: Faculty mentor, Goodnight Scholars Program's Faculty Dinner Series.
- 2011-2016: Undergraduate Curriculum Committee, Mechanical and Aerospace Engineering Department, North Carolina State University. Took part in ABET review of undergraduate program.
- 2013 and 2014: New faculty search committee in thermal/fluid science.

H.3. Grant and Journal Reviewers

- Grant proposal reviewer for *NASA Space Technology Directorate*, Feb, 2013.
- Grant proposal panel reviewer for *NSF Division of Civil, Mechanical and Manufacturing Innovation (CMMI), Nanomanufacturing (NM) program*, Feb, 2013, May 2015.
- Grant proposal ad hoc reviewer for *NSF, Division of Chemistry, Macromolecular, Supramolecular and Nanochemistry (MSN) program*, Dec 2016.
- Grant proposal ad hoc reviewer for Israel Science Foundation (ISF), Feb 2014.
- User grant proposal reviewer for Oak Ridge National Laboratory (ORNL) *Center for Nanophase Materials Sciences* (2013-present).
- External Doctoral thesis reviewer, Institute of Superconducting and Electronic Materials (ISEM), University of Wollongong, Australia, June 2016.

- Journal reviewer for *ACS Nano*, *Advanced Functional Materials*, *Nano Energy*, *Scientific Reports*, *Small*, *Nanoscale*, *Langmuir*, *Nanotechnology*, *ACS Applied Materials and Interfaces*, *Light: Science & Applications*, *Advanced Optical Materials*, *Optics Letters*, *Optics Express*, *Applied Optics*, *Journal of Optical Society America A*, *Journal of Materials Chemistry C*, etc.

H.4. Educational and Community Outreach

- Leads an educational outreach program with the **Wake County Public School System (WCPSS) to provide hands-on experiences to Nanotechnology through a “Nano-in-a-Box” program**. This program introduces state-of-the-art research in nanotechnology and highlights the parallels to current curriculum for elementary, middle, and high school students. The goal is to extend this program to all 28 schools with Science, Technology, Engineering, and Math (STEM) designation within the WCPSS system.
- Leads a collaboration to install an interactive display featuring the theme of **“Natural vs Engineering Nanostructures” at the Museum of Life and Science in Durham, NC**. The goal is to introduce Nanotechnology to the general public, and how they can be found in everyday life.
- Participated in **NanoDays** annually on NC State's Centennial Campus, 2012-present. Over 2,500 science Olympiad participants, teachers, and parents from throughout the state took part in the day's activities. Educators from UNC-Chapel Hill, Marbles Childrens Museum, the NC Museum of Life and Sciences, and the School of Nanoscience and Nanoengineering at UNC-Greensboro highlighted new developments in science and technology.

H.5. Scientific and Professional Society

- Member, Optical Society of America (OSA)
- Member, American Association for Mechanical Engineers (ASME)