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Department of Applied Physics & Applied Mathematics
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ACADEMIC TRAINING

B.S. in Electrical Engineering, Jun. 2004

Peking University, Department of Electronics, Beijing, P. R. China

Ph.D. in Engineering Sciences, Jun. 2009

Harvard University, School of Engineering and Applied Sciences, Cambridge, MA, USA

Advisor: Federico Capasso

Dissertation title: Near-field and Far-field Engineering of Semiconductor Lasers; Sponsor: AFOSR

Postdoctoral research on nanophotonics and optoelectronics, Jun. 2009 – Dec. 2012

Harvard University, School of Engineering and Applied Sciences, Cambridge, MA, USA

Advisor: Federico Capasso

APPOINTMENTS

Associate Professor of Applied Physics

Apr. 2018 – present

Columbia University

Assistant Professor of Applied Physics

Jan. 2013 – Apr. 2018

Columbia University

Research Associate

Jul. 2010 – Dec. 2012

Harvard University

Postdoctoral Researcher

Jun. 2009 – Jun. 2010

Harvard University

RESEARCH INTERESTS

My research focuses on “flat optics”, which investigates strong interaction between light and two-dimensional (2D) nanostructured interfaces (“metasurfaces”) to control light at will.

AWARDS

2017 Defense Advanced Research Projects Agency (DARPA) Director’s Fellowship

2016 Office of Naval Research Young Investigator Program (ONR YIP) Award

2015 Defense Advanced Research Projects Agency Young Faculty Award (DARPA YFA)

PUBLICATIONS

Manuscripts submitted and in preparation

- Overvig, S. Shrestha, C. Zheng, and **N. Yu**, “High-efficiency amplitude-phase modulation holograms based on dielectric metasurfaces,” in preparation.
- Wu, Z. Li, D. Schwanz, Z. Zhang, S. Ramanathan, and **N. Yu**, “Variable emissivity coatings based on plasmonic metasurfaces integrated with phase-transition materials,” in preparation.
- Z. Li, Y. Zhu, J. C. Hone, Q. Lin, and **N. Yu**, “Active metasurface sensors for high sensitivity detection of the concentration and mid-infrared spectral fingerprints of biomolecules,” submitted.

- C.-C. Tsai, N. N. Shi, J. Pelaez, N. Pierce, and **N. Yu**, “Physical and behavioral adaptations to beat the heat in the living wings of butterflies,” submitted.

2018

1. S. Shrestha, A. C. Overvig, M. Lu, A. Stein, and **N. Yu**, “Broadband achromatic dielectric metalenses,” *Light: Science & Applications* vol. 7, 85 (2018).
2. J. Mandal, Y. Fu, A. Overvig, M. Jia, K. Sun, N. Shi, H. Zhou, X. Xiao, **N. Yu***, Y. and Yang*, Hierarchically porous polymer coatings for highly efficient passive daytime radiative cooling *Science* vol. 362, 315–319 (2018) (*co-corresponding authors).
3. Y. Zhu, Z. Li, Z. Hao, C. DiMarco, P. Maturavongsadit, Y. Hao, M. Lu, A. Stein, Q. Wang, J. Hone, **N. Yu*** and Q. Lin*, Optical conductivity-based ultrasensitive mid-infrared biosensing on a hybrid metasurface, *Light: Science & Applications* vol.7, 67 (2018) (*co-corresponding authors).
4. N. N. Shi, C.-C. Tsai, M. J. Carter, J. Mandal, A. C. Overvig, M. Y. Sfeir, M. Lu, C. L. Craig, G. D. Bernard, Y. Yang, and **N. Yu**, “Nanostructured fibers as a versatile photonic platform: Radiative cooling and waveguiding through transverse Anderson localization,” *Light: Science & Applications* vol. 7, 37 (2018).
5. J. Mandal, S. Du, M. Dontigny, K. Zaghbi, **N. Yu***, and Y. Yang*, “Li₄Ti₅O₁₂: A visible-to-infrared broadband electrochromic material for optical and thermal management,” *Advanced Functional Materials* vol. 28, 1802180 (2018) (*co-corresponding authors).
6. A. C. Overvig, S. Shrestha, and **N. Yu**, “Dimerized high contrast gratings,” *Nanophotonics* vol. 7, 1157–1168 (2018).
7. Z. Zhang, D. Schwanz, B. Narayanan, M. Kotiuga, J. A. Dura, M. Cherukara, H. Zhou, J. W. Freeland, J. Li, R. Sutarto, F. He, C. Wu, J. Zhu, Y. Sun, K. Ramadoss, S. S. Nonnenmann, **N. Yu**, R. Comin, K. M. Rabe, S. K. R. S. Sankaranarayanan, and S. Ramanathan, “Perovskite nickelates as electric-field sensors in salt water,” *Nature* vol. 553, 68–72 (2018).

2017

8. Z. Li, M.-H. Kim, C. Wang, Z. Han, S. Shrestha, Adam C. Overvig, M. Lu, A. Stein, A. M. Agarwal, M. Lončar, and **N. Yu**, “Controlling propagation and coupling of waveguide modes using phase-gradient metasurfaces,” *Nature Nanotechnology* vol. 12, 675–683 (2017).
9. C. Wang, Z. Li, M.-H. Kim, X. Xiong, X.-F. Ren, G.-C. Guo, **N. Yu***, and M. Loncar*, Metasurface-assisted phase-matching-free second harmonic generation in lithium niobate waveguides, *Nature Communications* vol. 8, 2098 (2017) (*co-corresponding authors).
10. J. Mandal, D. Wang, A. C. Overvig, N. N. Shi, D. Paley, A. Zangiabadi, Q. Cheng, K. Barmak, **N. Yu***, and Yuan Yang*, “Scalable, ‘dip-and-dry’ fabrication of a wide-angle plasmonic selective absorber for high-efficiency solar–thermal energy conversion,” *Advanced Materials* vol. 29, 1702156 (2017) (*co-corresponding authors).
11. Y. Wang, A. C. Overvig, S. Shrestha, R. Zhang, R. Wang, **N. Yu**, and L. Dal Negro, “Tunability of indium tin oxide materials for mid-infrared plasmonics applications,” *Optical Materials Express* vol. 7, 2727–2739 (2017).

2016

12. Z. Li, Y. Zhou, H. Qi, Q. Pan, Z. Zhang, N. N. Shi, M. Lu, A. Stein, C. Y. Li, S. Ramanathan, and **N. Yu**, “Correlated perovskites as a new platform for super broadband tunable photonics,” *Advanced Materials* vol. 28, 9117–9125 (2016).
13. S. Zhang, M. H. Kim, F. Aieta, A. She, T. Mansuripur, I. Gabay, M. Khorasaninejad, D. Rousso, X. Wang, M. Troccoli, **N. Yu**, and F. Capasso, “High efficiency near diffraction-limited mid-infrared flat lenses based on metasurface reflectarrays,” *Optics Express* vol. 24, 18024 (2016).

14. H.-T. Chen, A. J. Taylor, and **N. Yu**, “A review of metasurfaces: physics and applications,” *Reports on Progress in Physics* vol. 79, 076401 (2016).

2015

15. N. N. Shi, C.-C. Tsai, F. Camino, G. D. Bernard, **N. Yu***, R. Wehner*, “Keeping cool: Enhanced optical reflection and radiative heat dissipation in Saharan silver ants,” *Science* vol. 349, 298–301 (2015) (*co-corresponding authors).
16. **N. Yu** and F. Capasso, “Optical metasurfaces and prospect of their applications including fiber optics,” *IEEE Journal of Lightwave Technology* vol. 33, 2344 (2015).

2014

17. **N. Yu** and F. Capasso, “Flat optics with designer metasurfaces,” *Nature Materials* vol. 13, 139–150 (2014).

2013

18. Z. Li and **N. Yu**, “Modulation of mid-infrared light using graphene-metal plasmonic antennas,” *Applied Physics Letters* vol. 102, 131108 (2013).
19. **N. Yu**, P. Genevet, F. Aieta, M. A. Kats, R. Blanchard, G. Aoust, J.-P. Tetienne, Z. Gaburro, and F. Capasso, “Flat optics: Controlling wavefronts with optical antenna metasurfaces,” *IEEE Journal of Selected Topics in Quantum Electronics* vol. 19, 4700423 (2013).
20. R. Blanchard, T. S. Mansuripur, B. Gokden, **N. Yu**, M. Kats, P. Genevet, K. Fujita, T. Edamura, M. Yamanishi, and F. Capasso, “High-power low-divergence tapered quantum cascade lasers with plasmonic collimators,” *Applied Physics Letters* vol. 102, 191114 (2013).
21. Y. Yao, M. A. Kats, P. Genevet, **N. Yu**, Y. Song, J. Kong, and F. Capasso, “Broad electrical tuning of graphene-loaded plasmonic antennas,” *Nano Letters* vol. 13, pp. 1257–1264 (2013).

2012

22. **N. Yu**, F. Aieta, P. Genevet, M. A. Kats, Z. Gaburro, and F. Capasso, “A Broadband, background-free quarter-wave plate based on plasmonic metasurfaces,” *Nano Letters* vol. 12, pp. 6328–6333 (2012).
23. F. Aieta, A. Kabiri, P. Genevet, **N. Yu**, M. A. Kats, Z. Gaburro, and F. Capasso, “Reflection and refraction of light from metasurfaces with phase discontinuities,” *Journal of Nanophotonics* vol. 6, 063532 (2012).
24. F. Aieta, P. Genevet, M. A. Kats, **N. Yu**, R. Blanchard, Z. Gaburro, and F. Capasso, “Aberration-free ultrathin flat lenses and axicons at telecom wavelengths based on plasmonic metasurfaces,” *Nano Letters* vol. 12, pp. 4932–4936 (2012).
25. M. A. Kats, P. Genevet, G. Aoust, **N. Yu**, R. Blanchard, F. Aieta, Z. Gaburro, and F. Capasso, “Giant birefringence in optical antenna arrays with widely tailorable optical anisotropy,” *Proceedings of the National Academy of Sciences of the United States of America* vol. 109, pp. 12364–12368 (2012).
26. R. Blanchard, G. Aoust, P. Genevet, **N. Yu**, M. A. Kats, Z. Gaburro, and F. Capasso, “Modeling nanoscale V-shaped antennas for the design of optical phased arrays,” *Physical Review B* vol. 85, 155457 (2012).
27. P. Genevet, **N. Yu**, F. Aieta, J. Lin, M. A. Kats, R. Blanchard, M. O. Scully, Z. Gaburro, and F. Capasso, “Ultra-thin plasmonic optical vortex plate based on phase discontinuities,” *Applied Physics Letters* vol. 100, 13101 (2012).
- Featured as the cover of the Jan. 2, 2012 issue of *Applied Physics Letters*

28. F. Aieta, P. Genevet, **N. Yu**, M. A. Kats, Z. Gaburro, and F. Capasso, “Out-of-plane reflection and refraction of light by anisotropic optical antenna metasurfaces with phase discontinuities,” *Nano Letters* vol. 12, pp. 1702-1706 (2012).
29. **N. Yu**, Q. J. Wang, and F. Capasso, “Beam engineering of quantum cascade lasers,” *Laser & Photonics Reviews* vol. 6, pp. 24-46 (2012).
- Featured as the cover of the Jan. 2012 issue of *Laser & Photonics Reviews*

2011

30. **N. Yu**, P. Genevet, M. A. Kats, J.-P. Tetienne, F. Aieta, F. Capasso, and Z. Gaburro, “Light propagation with phase discontinuities: Generalized laws of reflection and refraction,” *Science* vol. 334, pp. 333-337 (2011).
- Featured as the cover of the Oct. 21, 2011 issue of *Science*;
 - “Antenna-guided light,” *Science Perspectives* vol. 334, pp. 317-318 (2011);
 - “Phase-shifting surfaces bend the rules of ray optics,” *Physics Today* Nov. 2011 issue
31. M. A. Kats, **N. Yu**, P. Genevet, Z. Gaburro, and F. Capasso, “Effect of radiation damping on the spectral response of plasmonic components,” *Optics Express* vol. 19, pp. 21748-21753 (2011).
32. R. Blanchard, S. V. Boriskina, P. Genevet, M. A. Kats, J.-P. Tetienne, **N. Yu**, M. O. Scully, L. Dal Negro, and F. Capasso, “Multi-wavelength mid-infrared plasmonic antennas with single nanoscale focal point,” *Optics Express* vol. 19, pp. 22113-22124 (2011).
33. M. A. Kats, D. Woolf, R. Blanchard, **N. Yu**, F. Capasso, “Spoof plasmon analogue of metal-insulator-metal waveguides,” *Optics Express* vol. 19, pp. 14860-14870 (2011).
34. A. K. Wójcik, **N. Yu**, F. Capasso, and A. Belyanin, “Nonlinear optical interactions of laser modes in quantum cascade lasers,” *Journal of Modern Optics* vol. 58, pp. 727-742 (2011).
35. A. K. Wójcik, **N. Yu**, L. Diehl, F. Capasso, and A. Belyanin, “Self-synchronization of laser modes and multistability in quantum cascade lasers,” *Physical Review Letters* vol. 106, 133902 (2011).
36. J. P. Tetienne, R. Blanchard, **N. Yu**, P. Genevet, M. A. Kats, J. A. Fan, T. Edamura, S. Furuta, M. Yamanishi, H. Kan, and F. Capasso, “Dipolar modeling and experimental demonstration of multi-beam plasmonic collimators,” *New Journal of Physics* vol. 13, 53057 (2011).

2010

37. **N. Yu**, Q. J. Wang, M. A. Kats, J. A. Fan, S. P. Khanna, L. Li, A. G. Davies, E. H. Linfield, and F. Capasso, “Designer spoof-surface-plasmon structures collimate terahertz laser beams,” *Nature Materials* vol. 9, pp. 730-735 (2010).
38. **N. Yu**, and F. Capasso, “Wavefront engineering for mid-infrared and terahertz quantum cascade lasers,” *Journal of the Optical Society of America B* vol. 27, pp. B18-B35 (2010) (invited paper).
39. **N. Yu**, Q. J. Wang, M. A. Kats, J. A. Fan, S. P. Khanna, L. Li, A. G. Davies, E. H. Linfield, and F. Capasso, “Terahertz plasmonics,” *Electronics Letters* vol. 46, pp. S52-S57 (2010).
40. Q. J. Wang, C. Yan, **N. Yu**, J. Unterhinninghofen, J. Wiersig, C. Pflügl, L. Diehl, T. Edamura, M. Yamanishi, H. Kan, and F. Capasso, “Whispering gallery mode resonators for highly unidirectional laser action,” *Proceedings of the National Academy of Sciences of the United States of America* vol. 107, pp. 22407-22412 (2010).
41. A. K. Wójcika, **N. Yu**, L. Diehl, F. Capasso, and A. Belyanin, “Nonlinear dynamics of coupled transverse modes in quantum cascade lasers,” *Journal of Modern Optics* vol. 57, pp. 1892-1899 (2010).
42. **N. Yu**, R. Blanchard, J. Fan, Q. J. Wang, C. Pflügl, L. Diehl, T. Edamura, M. Yamanishi, H. Kan, and F. Capasso, “Plasmonics for laser beam shaping,” *IEEE Transactions on Nanotechnology* vol. 9, pp. 11-29 (2010) (invited paper).
- Featured as the cover of the Jan. 2010 issue of *IEEE Transactions on Nanotechnology*

43. M. Geiser, C. Pflügl, A. Belyanin, Q. J. Wang, **N. Yu**, T. Edamura, M. Yamanishi, H. Kan, M. Fischer, A. Wittmann, J. Faist, and F. Capasso, “Gain competition in dual wavelength quantum cascade lasers,” *Optics Express* vol. 18, pp. 9900-9908 (2010).
44. M. Geiser, C. Pflügl, A. Belyanin, Q. J. Wang, **N. Yu**, M. A. Belkin, T. Edamura, H. Kan, M. Fischer, A. Wittmann, J. Faist, and F. Capasso, “Surface-emitting THz sources based on difference-frequency generation in mid-infrared quantum cascade lasers,” *Proceedings of SPIE* vol. 7616, 76160R (2010).

2009

45. **N. Yu**, L. Diehl, E. Cubukcu, D. Bour, S. Corzine, G. Höfler, A. K. Wojcik, K. B. Crozier, A. Belyanin, and F. Capasso, “Coherent coupling of multiple transverse modes in a quantum cascade laser,” *Physical Review Letters* vol. 102, 013901 (2009).
46. **N. Yu**, M. A. Kats, C. Pflügl, M. Geiser, Q. J. Wang, M. A. Belkin, F. Capasso, M. Fischer, A. Wittmann, J. Faist, T. Edamura, S. Furuta, M. Yamanishi, and H. Kan, “Multi-beam multi-wavelength semiconductor lasers,” *Applied Physics Letters* vol. 95, 161108 (2009).
- Featured as the cover of the Dec. 7, 2009 issue of *Applied Physics Letters*
47. C. Yan, Q. J. Wang, L. Diehl, M. Hentschel, J. Wiersig, **N. Yu**, C. Pflügl, F. Capasso, M. Belkin, T. Edamura, M. Yamanishi, and H. Kan, “Directional emission and universal far-field behavior from semiconductor lasers with Limaçon-shaped microcavity,” *Applied Physics Letters* vol. 94, 251101(2009).
- Featured as the cover of the Jun. 22, 2009 issue of *Applied Physics Letters*
48. F. Capasso, **N. Yu**, E. Cubukcu, and E. Smythe, “Using plasmonics to shape light beams,” *Optics and Photonics News* May issue, pp. 22 (2009) (invited article).
- Featured as the cover of the May 2009 issue of *Optics and Photonics News*
49. **N. Yu**, A. Belyanin, J. Bao, and F. Capasso, “Controlled modification of Erbium lifetime by near-field coupling to metallic films,” *New Journal of Physics* vol. 11, 015003 (2009) (invited paper).
50. **N. Yu**, Q. J. Wang, C. Pflügl, L. Diehl, T. Edamura, M. Yamanishi, H. Kan, and F. Capasso, “Semiconductor lasers with integrated plasmonic polarizers,” *Applied Physics Letters* vol. 94, 151101 (2009).
- Featured as the cover of the Apr. 13, 2009 issue of *Applied Physics Letters*

2008

51. **N. Yu**, J. Fan, Q. J. Wang, C. Pflügl, L. Diehl, T. Edamura, M. Yamanishi, H. Kan, and F. Capasso, “Small-divergence semiconductor lasers by plasmonic collimation,” *Nature Photonics* vol. 2, pp. 564-570 (2008).
- Featured as the cover of the Sept. 2008 issue of *Nature Photonics*;
 - “Plasmonics: A sharper approach,” *Nature Photonics News & Views* vol. 2, pp. 524-525 (2008)
52. **N. Yu**, R. Blanchard, J. Fan, T. Edamura, M. Yamanishi, H. Kan, and F. Capasso, “Small divergence semiconductor lasers with two-dimensional plasmonic collimators,” *Applied Physics Letters* vol. 93, 181101 (2008).
- Featured as the cover of the Nov. 3, 2008 issue of *Applied Physics Letters*
53. **N. Yu**, R. Blanchard, J. Fan, Q. J. Wang, C. Pflügl, L. Diehl, T. Edamura, M. Yamanishi, H. Kan, and F. Capasso, “Quantum cascade lasers with integrated plasmonic antenna-array collimators,” *Optics Express* vol. 16, pp. 19447-19461 (2008).
54. E. Cubukcu, **N. Yu**, E. J. Smythe, L. Diehl, K. B. Crozier, and Federico Capasso, “Plasmonic laser antennas and related devices,” *IEEE Journal of Selected Topics in Quantum Electronics* vol. 14, pp. 1448-1461 (2008).

55. M. Troccoli, L. Diehl, D. P. Bour, S. W. Corzine, **N. Yu**, C. Y. Wang, M. A. Belkin, G. Höfler, R. Lewicki, G. Wysocki, F. K. Tittel, and F. Capasso, “High performance quantum cascade lasers grown by metal-organic vapor phase epitaxy and their applications to trace gas sensing,” *IEEE Journal of Lightwave Technology* vol. 26, pp. 3534-3555 (2008) (invited paper).

2007

56. **N. Yu**, E. Cubukcu, L. Diehl, M. A. Belkin, K. B. Crozier, D. Bour, S. Corzine, and G. Höfler, and F. Capasso, “Plasmonic quantum cascade laser antenna,” *Applied Physics Letters* vol. 91, 173113 (2007).
- Featured as the cover of the Oct. 22, 2007 issue of *Applied Physics Letters*
57. **N. Yu**, E. Cubukcu, L. Diehl, D. Bour, S. Corzine, J. Zhu, G. Höfler, K. B. Crozier, and F. Capasso, “Bowtie plasmonic quantum cascade laser antenna,” *Optics Express* vol. 15, pp. 13272-13281 (2007).
58. **N. Yu**, L. Diehl, E. Cubukcu, C. Pflügl, D. Bour, S. Corzine, J. Zhu, G. Höfler, K. B. Crozier, and F. Capasso, “Near-field imaging of quantum cascade laser transverse modes,” *Optics Express* vol. 15, pp. 13227-13235 (2007).
59. J. Bao, **N. Yu**, F. Capasso, T. Mates, M. Troccoli, and A. Belyanin, “Controlled modification of erbium lifetime in silicon dioxide with metallic overlayers,” *Applied Physics Letters* vol. 91, 131103 (2007).
60. B. Tian, X. Zheng, T. J. Kempa, Y. Fang, **N. Yu**, G. Yu, J. Huang, and C. M. Lieber, “Coaxial silicon nanowires as solar cells and nanoelectronic power sources,” *Nature* vol. 449, pp. 885-889 (2007).

BOOK CHAPTERS

- **N. Yu**, P. Genevet, M. A. Kats, J.-P. Tetienne, F. Aieta, Z. Gaburro, and F. Capasso, “Controlling Light Propagation Using Phase Discontinuities,” in *Active Plasmonics and Tuneable Metamaterials*, edited by A. Zayats and S. Maier, **Wiley**.
- **N. Yu** and F. Capasso, “Wavefront Engineering of Quantum Cascade Lasers Using Plasmonics,” in *Plasmonics and Plasmonic Metamaterials*, edited by I. Tsukerman and G. Shvets, **World Scientific**.

CONFERENCE PRESENTATIONS

1. **N. Yu**, “Beating the heat: Tales of the Saharan silver ants and butterfly wings,” invited talk in Escuela Politecnica Nacional, Quito, Ecuador, Aug. 23, 2018.
2. **N. Yu**, “Flat Optics,” invited talk in the 17th International Conference on Organized Molecular Films (ICOMF17), New York University, New York, July 24, 2018.
3. **N. Yu**, “Flat Optics,” invited talk in the Workshop on Analysis, Modeling, and Computation for Nanoscale Systems, The Fields Institute, Toronto, Canada, May 29, 2018.
4. **N. Yu**, “Flat Optics,” invited talk in the National Synchrotron Light Source II (NSLS-II) and Center for Functional Nanomaterials (CFN) Users’ Meeting, Brookhaven National Laboratory, New York, May 22, 2018.
5. A. Overvig, S. Shrestha, M. Lu, A. Stein, C. Xiao, C. Zheng, and **N. Yu**, “Two-color and three-dimensional phase-amplitude modulation metasurface holograms,” and S. Shrestha, A. Overvig, M. Lu, A. Stein, and **N. Yu**, “Aberration corrected metalenses for imaging,” oral presentations in the Conference on Lasers and Electro-Optics (CLEO), San Jose, California, May 14–18, 2018.
6. **N. Yu**, “Metasurface-based nanophotonic devices,” invited talk in the Asia Communications and Photonics Conference, Guangzhou, China, Nov. 10–13, 2017.

7. **N. Yu**, “Metasurface-based nanophotonic devices,” invited talk in the Pearl River Symposium of Nano-Optics, Jinan University, Guangzhou, China, Nov. 14, 2017.
8. **N. Yu**, “Metasurface-based nanophotonic devices,” invited talk in CLEO-Pacific Rim, OECC and PGC 2017, Singapore, July 31–August 4, 2017.
9. S. Shrestha, A. Overvig, and **N. Yu**, “Broadband achromatic metasurface lenses,” A. Overvig, S. Shrestha, C. Zheng, and **N. Yu**, “High-efficiency amplitude-phase modulation holograms based on dielectric metasurfaces,” and C. Wu, Z. Li, D. Schwanz, Z. Zhang, S. Ramanathan, and **N. Yu**, “Variable emissivity coatings based on plasmonic metasurfaces integrated with phase-transition materials,” oral presentations in the Conference on Lasers and Electro-Optics (CLEO), San Jose, California, May 14–19, 2017.
10. Z. Li, Y. Zhu, J. Hone, Q. Lin, and **N. Yu**, “Active metasurface sensors for high sensitivity detection of the concentration and mid-infrared spectral fingerprints of biomolecules,” oral presentation.
11. N. N. Shi, C.-C. Tsai, C. Craig, and **N. Yu**, “Nano-structured wild moth cocoon fibers as radiative cooling and waveguiding optical materials,” oral presentation.
12. **N. Yu**, “Optical and optoelectronic devices based on metasurfaces,” invited talk in the 37th Progress in Electromagnetics Research Symposium, Shanghai, China, August 8–11, 2016.
13. **N. Yu**, “Active photonic devices based on metasurfaces integrated with phase-transition correlated perovskites” and “Natural and biomimetic radiative cooling nano-photonics structures,” invited talks in META’16, and the 7th International Conference on Metamaterials, Photonic Crystals and Plasmonics, Malaga, Spain, July 25–28, 2016.
14. M.-H. Kim, Z. Li, and **N. Yu**, “Experimental demonstration of waveguide mode converters based on phase-gradient metasurfaces,” Z. Li, Y. Zhou, H. Qi, C. Li, S. Ramanathan, and **N. Yu**, “Correlated Perovskites as a New Platform for Super Broadband Tunable Photonics,” and N. N. Shi, C.-C. Tsai, F. Camino, G. D. Bernard, R. Wehner, N. Pierce, and **N. Yu**, “Radiative cooling nano-photonics structures discovered in Saharan silver ants and related biomimetic metasurfaces,” oral presentations in the Conference on Lasers and Electro-Optics (CLEO), San Jose, California, June 5–10, 2016.
15. **N. Yu**, “Correlated perovskites for super broadband tunable photonics,” invited talk in the 18th Photonics North Conference 2016, Quebec City, Canada, May 24–26, 2016.
16. **N. Yu**, “Molding optical space using metasurfaces,” plenary talk on March 4, and “Optical and optoelectronic devices based on metasurfaces,” plenary talk on March 5 in the 6th Symposium on Metamaterials organized by the University-Industry Cooperative Research Committee on Metamaterials, University of Tokyo, March 4–5, 2016.
17. **N. Yu**, “Controlling light propagation in integrated photonic circuits using optical metasurfaces,” invited talk in META’15, and the 6th International Conference on Metamaterials, Photonic Crystals and Plasmonics, City College of New York, New York, August 4–7, 2015.
18. Z. Li, M.-H. Kim, and **N. Yu**, “Controlling guided waves in telecom waveguides using one-dimensional phased antenna array,” oral presentation in the Conference on Lasers and Electro-Optics (CLEO), San Jose, California, May 10–15, 2015.
19. **N. Yu**, “Controlling light propagation in integrated photonic circuits using optical metasurfaces,” invited talk in Laboratory for Surface Modification seminar series, Rutgers University, New Jersey, February 12, 2015.
20. **N. Yu**, “Controlling light propagation in optical waveguides using one dimensional phased antenna arrays,” invited talk in the 2014 IEEE Photonics Conference, San Diego, Oct. 12–16, 2014.
21. **N. Yu**, “Controlling light propagation in optical waveguides using one dimensional phased antenna arrays,” invited talk in the 6th International Workshop on Electromagnetic Metamaterials (IWEM-VI), Santa Fe, New Mexico, Sept. 22–23, 2014.

22. **N. Yu** “Controlling light propagation in optical waveguides using one dimensional phased antenna arrays,” invited talk in the 8th International Congress on Advanced Electromagnetic Materials in Microwaves and Optics – Metamaterials 2014, Copenhagen, Denmark, August 25–30, 2014.
23. M.-H. Kim, Z. Li, and **N. Yu**, “Controlling Light Propagation and Mode Coupling in Optical Waveguides Using One Dimensional Phased Antenna Arrays,” oral presentation in the 2014 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting, Memphis, Tennessee, July 6–11, 2014.
24. **N. Yu**, “Controlling light propagation in optical waveguides using one dimensional phased antenna arrays,” invited talk in the Conference on Lasers and Electro-Optics (CLEO), San Jose, California, June 8–13, 2014.
25. **N. Yu**, C.-C. Tsai, T. Dai, N. N. Shi, Z. Li, M.-H. Kim, and N. Pierce, “Perfect blackbodies on butterfly wings,” and N. N. Shi, C.-C. Tsai, Z. Li, M.-H. Kim, G. D. Bernard, R. Wehner, and **N. Yu**, “Thermal and optical properties of Saharan silver ants,” invited talks in the Workshop on Structural Color organized by The Aizenberg and Manoharan labs, Harvard University, May 21, 2014.
26. **N. Yu**, “Controlling light propagation in waveguides using phased antenna arrays,” invited talk in the 2014 Materials Research Society Spring Meeting, San Francisco, California, April 21–25, 2014.
27. **N. Yu**, “Controlling light propagation in free space and in waveguides with metasurfaces,” plenary talk in PQE 2014: the 44th Winter Colloquium on the Physics of Quantum Electronics, Snowbird, Utah, January 5–9, 2014.
28. **N. Yu**, “Controlling optical wavefronts with active plasmonic meta-surfaces,” invited talk in the 2013 IEEE International Symposium on Antennas and Propagation, Orlando, Florida, July 7–13, 2013.
29. **N. Yu**, “Large modulation of mid-infrared light using graphene-metal plasmonic antennas,” oral presentation in the Conference on Lasers and Electro-Optics (CLEO), San Jose, California, June 9–14, 2013.
30. **N. Yu**, “Flat optics: Controlling wavefronts with optical antenna metasurfaces,” invited talk in PQE 2013: the 43rd Winter Colloquium on the Physics of Quantum Electronics, Snowbird, Utah, Jan. 6–10, 2013.
31. **N. Yu**, “Broadband polarizing meta-interface: Combining beaming with polarization control in an ultra-thin interface,” invited talk in the Sixth International Conference on Nanophotonics, Peking University, Beijing, China, May 27–30, 2012.
32. **N. Yu**, “Broadband polarizing meta-interface,” oral presentation in the Conference on Lasers and Electro-Optics (CLEO), San Jose, California, May 6–11, 2012.
33. **N. Yu**, “Controlling light propagation using metainterfaces,” invited talk in the Harvard Applied Physics Colloquium, Harvard University, Mar. 23, 2012.
34. **N. Yu**, “Broadband birefringent metainterfaces,” invited talk in PQE 2012: the 42nd Winter Colloquium on the Physics of Quantum Electronics, Snowbird, Utah, Jan. 2–6, 2012.
35. **N. Yu**, “Molding optical wavefronts using phase discontinuities,” invited talk in FiO/LS: Frontiers in Optics 2011/ Laser Science XXVII, San Jose, California, Oct. 2011.
36. **N. Yu**, “Molding optical wavefront using phase discontinuities (or How to let a flat mirror have the effect of a fun-house mirror),” invited talk in the Harvard Center for Nanoscale Systems Seminar, Harvard University, Oct. 12, 2011.
37. **N. Yu**, “Designer plasmonic structures collimate terahertz laser beams,” invited talk in SPIE Photonics West, San Francisco, California, Jan. 2011.
38. **N. Yu**, “Terahertz quantum cascade lasers with integrated plasmonic collimators,” poster presentation in the Gordon Research Conference on Plasmonics, Colby College, Waterville, Maine, Jun. 2010.

39. **N. Yu**, “Terahertz quantum cascade lasers with integrated plasmonic collimators,” oral presentation in the Conference on Lasers and Electro-Optics, and Quantum Electronics and Laser Science conference (CLEO/QELS), San Jose, California, May 2010.
40. **N. Yu**, “Wavefront engineering of semiconductor lasers using plasmonics,” invited talk in the IEEE International NanoElectronics Conference (INEC), Hong Kong, China, Jan. 2010.
41. **N. Yu**, “Wavefront engineering using plasmonics” and “Directional emission from limaçon-shaped microcavity lasers,” invited talks in the 10th International Conference on Intersubband Transitions in Quantum Wells (ITQW), Montreal, Canada, Sept. 2009.
42. **N. Yu**, “Beam shaping of semiconductor lasers using plasmonics,” invited talk in SPIE Optics and Photonics Conference, San Diego, CA, Aug. 2009.
43. **N. Yu**, “Semiconductor lasers with integrated plasmonic polarizers,” oral presentation in the Conference on Lasers and Electro-Optics, and International Quantum Electronics Conference (CLEO/IQEC), Baltimore, Maryland, June 2009.
44. **N. Yu**, “Beam shaping of semiconductor lasers using plasmonics,” invited talk in SPIE Photonics West, San Jose, CA, Feb. 2009.
45. **N. Yu**, “Small divergence semiconductors by plasmonic collimation,” poster presentation in the Gordon Research Conference on Plasmonics: Optics at the Nanoscale, Tilton College, New Hampshire, Jul. 2008.
46. **N. Yu**, “Coherent coupling of multiple transverse modes in a quantum cascade laser,” oral presentation in the Conference on Lasers and Electro-Optics, and Quantum Electronics and Laser Science conference (CLEO/QELS), San Jose, California, May 2008.
47. **N. Yu**, “Mid-infrared plasmonic laser antenna” and “Controlled modification of erbium lifetime in silicon dioxide film with metal coatings,” poster presentations in the Air Force Office of Scientific Research (AFOSR) Nano-Structure and Nano-Photonics Multidisciplinary University Research Initiative (MURI) Review Conference, Harvard University, Nov. 2007.
48. **N. Yu**, “Plasmonic quantum cascade laser antenna,” oral presentation in the Conference on Lasers and Electro-Optics, and Quantum Electronics and Laser Science (CLEO/QELS), Baltimore, Maryland, May 2007.
49. **N. Yu**, “Controlled modification of erbium lifetime in silicon dioxide film with chromium or titanium coatings,” oral presentation in the Materials Research Society (MRS) Fall Meeting, Boston, Massachusetts, Nov. 2007.
50. **N. Yu**, “Mid-infrared plasmonic laser antenna,” poster presentation in the Air Force Office of Scientific Research (AFOSR) Nano-Structure and Nano-Photonics Multidisciplinary University Research Initiative (MURI) Conference, San Francisco, California, Nov. 2006.

TEACHING & ADVISING

Teaching

Semester	Course	Enrollment	Evaluation
Fall 2013	Modern Optics	9	4.50/5
Spring 2014	Laser Physics	13	4.70/5
Fall 2014	Modern Optics	11	4.14/5
Spring 2015	Laser Physics	11	3.88/5
Fall 2015	Parental leave		
Spring 2016	Modern Optics	13	4.43/5
	Laser Physics	11	4.50/5
Fall 2016	Laser Physics	7	NA

Spring 2017	Modern Optics	15	4.58/5
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Graduate student advising

1. Zhaoyi Li: Graduated in Dec. 2017 and currently a postdoctoral researcher at Harvard. His PhD dissertation entitled “Functional Metasurfaces towards Applications: Optical Modulation, Integrated Photonics, and Biomolecular Sensing” was awarded 2018 Robert Simon Memorial Prize (best PhD thesis) by the Department of Applied Physics and Applied Mathematics, Columbia University.
2. Norman Nan Shi: Graduated in May 2018 and currently a postdoctoral researcher at Palo Alto Research Center (PARC). His PhD dissertation is entitled “Biological and Bioinspired Photonic Materials for Passive Radiative Cooling and Waveguiding”.
3. Adam Overvig: 5th-year graduate student in the Applied Physics program of APAM. His research focuses on passive and active devices based on metasurfaces. He is expected to graduate in 2019.
4. Sajan Shrestha: 5th-year graduate student in the Applied Physics program of APAM. His research focuses on passive devices based on metasurfaces. He is expected to graduate in 2019.
5. Cheng-Chia Tsai: 3rd-year graduate student in the Applied Physics program of APAM. His work focuses on biophotonics.
6. Michael Carter: 2nd-year graduate student in the Materials Science and Engineering program of APAM. His research focuses on woven metasurfaces.
7. Heqing Huang: 2nd-year graduate student in the Applied Physics program of APAM. His research focused on active integrated photonics.
8. Stephanie Claudia Malek: 1st-year graduate student in the Applied Physics program of APAM. Her research focuses on active devices based on metasurfaces.
9. Xiaoyan Huang: 1st-year graduate student in the Applied Physics program of APAM. His research focuses on passive devices based on metasurfaces.

Postdoc advising

- Myoung-Hwan Kim: conducted research on integrated photonics based on metasurfaces from May 2013 to Dec. 2015. He is now an assistant professor in the Department of Physics, the University of Texas Rio Grande Valley, Brownsville, Texas.
- Guozhen Liang: joined my lab since June 2017. His research focuses on active integrated photonics.

Undergrad advising:

- Supantho Rakshit (2018 summer - present): Columbia sophomore, Physics major.
- Rhyz Pereira (2016 fall): Columbia senior, Chemical Engineering major.
- Crystal Ren (2016 summer - 2017 spring): Columbia sophomore, Applied Physics major.
- Zofii Kaczmarek (2015 summer): Caltech junior, Bioengineering major.
- Minyong Han (2014 summer): Columbia senior, Physics major, currently PhD student at Harvard.
- Isabel Baransky (2013 summer): Columbia junior, Applied Physics major, supported by NSF REU.

FUNDING

NSF ECCS-1307948: “Reconfigurable flat optics”	June 1, 2013 - May 31, 2017	\$360k	Sole PI
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NSF PHY-1411445: “Collaborative research: Perception and use of infrared radiation by insects”	August 15, 2014 - August 14, 2017	\$400k	PI: Nanfang Yu (\$200k) Co-PI: Naomi Pierce (\$200k)
NSF DMR-1610215: “Collaborative Research: Phase-Change Materials for Strong Optical Modulation and Nonvolatile Optical Memory”	June 1, 2016 - May 31, 2019	\$500k	PI: Shriram Ramanathan (Purdue: \$250k) Co-PI: Nanfang Yu (\$250k)
AFOSR MURI (Multidisciplinary University Research Initiative) FA9550-14-1-0389: “Active Metasurfaces for Advanced Wavefront Engineering and Waveguiding”	Jul. 1, 2014 - Jun. 30, 2019	\$13 million	PI: Federico Capasso (Harvard) Co-PIs: Nanfang Yu (\$900k), Nader Engheta (UPenn), Mark Brongersma (Stanford), Alexandra Boltasseva (Purdue), Vlad Shalaev (Purdue), Marko Loncar (Harvard)
DARPA EXTREME: “Multifunctional Glass for Augmented Reality”	April. 1, 2017 - March 31, 2021	\$4.7 million	PI: Michal Lipson (Columbia) Co-PIs: Nanfang Yu (\$800k), Shanhui Fan (Stanford), Dmitri Basov, James Hone, Alexander Gaeta (Columbia)
DARPA Young Faculty Award D15AP00111: “Metasurface-Based Spatial Light Modulators”	Sept. 15, 2015 - Sept. 14, 2017	\$500k	Sole PI
DARPA Seedling HR0011-17-2-0017: “Superbroadband Achromatic Metasurface Lenses”	Nov. 22, 2016 - Feb. 21, 2018	\$180k	Sole PI
ONR Young Investigator Program Award N00014-16-1-2442: “Phase-Change Correlated Perovskites as a New Platform for Photonics”	June 1, 2016 - May 31, 2019	\$510k	Sole PI
AFOSR DURIP FA9550-16-1-0322 (Defense University Research Instrumentation Program): “Infrared Cameras and Broadly Tunable Light Sources for Research on Metasurface-Based Optoelectronic Devices and Biomimetic Optical Coatings”	July 15, 2016 - July 14, 2017	\$230k	Sole PI
DARPA Director’s Fellowship	Sept. 15, 2017 - Sept. 14, 2018	\$130k	Sole PI
PowerBridgeNY: “Cool roof coatings that reduce production costs by 50% and AC costs by 20%”	May 1, 2016 - April 30, 2017	\$150k	Sole PI
Columbia SEAS Interdisciplinary Research Seed (SIRS): “Inverse design of flat optics”	July 1, 2018 – July 1, 2019	\$80k	PI: Nanfang Yu (\$40k) Co-PI: Changxi Zheng (\$40k)
Total funds: ~\$4.2 million in the past 4 years			

PATENTS

- **N. Yu**, J. Mandal, and Y. Yang, “Hierarchically porous polymer for passive daytime radiative cooling,” provisional patent filed on Sept. 26, 2018.
- **N. Yu**, A. Overvig, and S. Shrestha, “Metasurfaces with complete control of the amplitude and phase of light at up to three wavelengths simultaneously,” PCT application filed on August 17, 2018.
- **N. Yu**, M. Tian, and N. N. Shi, “Radiative cooling fabrics,” PCT application filed on August 15, 2018.
- **N. Yu**, A. Overvig, and S. Shrestha, “Broadband achromatic flat optical components by dispersion-engineered dielectric metasurfaces,” PCT application filed on May 24, 2018. This patent is in the process of being licensed to a startup company.
- M. Lipson, I. Datta, S. H. Chae, J. Hone, D. Basov, and **N. Yu**, “Efficient phase shifters using electrorefractive modulation of monolayer TMDs in photonic structures,” provisional patent filed on March 26, 2018.
- **N. Yu** and M. Tian, “Integrated optical systems as a surveillance device for changes in physical parameters,” provisional patent filed on May 19, 2017.
- **N. Yu** and Z. Li, “Systems and methods for active photonic devices using correlated perovskites,” PCT application filed on August 29, 2017.
- **N. Yu**, J. Mandal, A. Overvig, N. N. Shi, “Methods and systems for radiative cooling and heating,” PCT application filed on December 14, 2017.
- **N. Yu**, Z. Li, M.-H. Kim, “Integrated photonic devices based on waveguide patterned with optical antenna arrays,” PCT application filed on June 24 2014.
- **N. Yu**, “System, apparatus and computer-accessible medium for providing a modulation of mid-infrared light using one or more graphene-metal plasmonic antennas,” PCT application filed on January 30, 2014.
- **N. Yu**, “Lightweight, miniature isolators and circulators,” provisional patent filed on July 2, 2013
- **N. Yu**, F. Capasso, Z. Gaburro, P. Genevet, M. A. Kats, and F. Aieta, “Amplitude, phase and polarization plate for photonics,” provisional patent filed on Aug. 31, 2011. Patent licensed to Samsung.
- Q. J. Wang, **N. Yu**, F. Capasso, J. Wiersig, and J. Unterhinninghofen, “Highly unidirectional microcavity lasers,” provisional patent filed on Nov. 29, 2010
- **N. Yu**, and F. Capasso, “Methods and apparatus for wavefront engineering,” provisional patent filed on Aug. 6, 2010
- F. Capasso, **N. Yu**, and R. Blanchard, “Active plasmonic polarizer,” provisional patent filed on Mar. 10, 2009
- F. Capasso, **N. Yu**, and J. Fan, “Methods and apparatus for improving collimation of radiation beams,” United States Patent No.: 20100226134, Publication Date: Sept. 9, 2009
- F. Capasso, K. Crozier, E. Cubukcu, E. Kort, **N. Yu**, and E. Smythe, “Active optical antenna,” United States Patent No.: 20070058686, Publication Date: Mar. 15, 2007

ENTREPRENEURSHIP

Created a startup company **MetaRE** in 2017 to: (1) develop and commercialize cool-roof coatings, which reduce roof temperature up to 40°C in the summer time by strongly reflecting solar radiation and efficiently dissipating heat through infrared radiation, and thereby saving electricity cost; (2) develop and commercialize radiative cooling fibers and textiles, which have optimal cooling capabilities by combining radiative, convective, and evaporative cooling mechanisms.

OUTREACH

- Taught one class of preschool children at Les Enfants Preschool, Fort Lee, NJ about the biology of butterflies on Feb. 17, 2017.
- Taught four classes of preschool children at Les Enfants Preschool, Fort Lee, NJ about the biology of butterflies and moths on April 6, 2016.
- Judge at the 2015 Tri-County Science & Technology Fair at White Plains High School.

NEWS COVERAGE

- “Polymer Coating Cools Down Buildings,” Columbia Engineering news, Sept. 27, 2018.
- “Columbia Engineering Announces Winning Proposals for Interdisciplinary Research and Translational Research,” Columbia Engineering news, June 6, 2018.
- “Researchers Mimic Comet Moth’s Silk Fibers to Make ‘Air-conditioned’ Fabric,” Columbia Engineering news, May 18, 2018.
- “Dr. Zhaoyi Li, a former Solid State Physics student in Prof. Nanfang Yu’s group, is the recipient of this year’s Robert Simon Memorial Prize in recognition of his outstanding dissertation,” Columbia APAM news, May 9, 2018.
- “Columbia Engineers Win \$4.7M DARPA Grant to Revolutionize Augmented Reality Glasses,” Columbia Engineering news, February 2, 2018.
- “Changing the color of light: An integrated metasurface converts colors of light over broadband inside a waveguide,” Harvard John A. Paulson School of Engineering and Applied Sciences news, January 31, 2018.
- “Yu Wins DARPA Director’s Fellowship,” Columbia Engineering Milestones, Columbia APAM news, May 12, 2017.
- “Columbia Engineers Invent Method to Control Light Propagation in Waveguides,” Columbia Engineering news, April 17, 2017.
- “Columbia Engineering Team Discovers New Optical Material that Offers Unprecedented Control of Light and Thermal Radiation,” Columbia Engineering news, Aug. 30, 2016; “Yu’s Team Discovers New Optical Material that Offers Unprecedented Control of Light and Thermal Radiation,” Columbia APAM news, Aug. 30, 2016.
- “Yu Wins PowerBridgeNY Grant,” Columbia APAM news, Apr. 18, 2016.
- “Yu Receives DURIP Grant from AFOSR,” Columbia APAM news, March 8, 2016.
- “Yu Wins 2016 Young Investigator Award from the Office of Naval Research,” Columbia APAM news, March 4, 2016.
- “Nanfang Yu Wins DARPA Young Faculty Award for his Research on Optoelectronics,” Columbia APAM news, October 2, 2015.
- “Staying Cool: Saharan Silver Ants,” Columbia Engineering news, June 18, 2015. Also featured in New York Times, Washington Post, National Geographic, Christian Science Monitor, Columbia Engineering Magazine, Columbia Magazine, Microscopy Today, New Scientist, etc.



- “Weinstein & Yu - Smooth Surfing of Optical Waves”, Columbia Engineering news, Dec. 08, 2015.
- “Professor Yu and Team Receive Air Force MURI Grant,” Columbia Engineering news, May 14, 2014
- “Yu Wins NSF Grant to Study the Perception and Use of Infrared Radiation by Insects,” Columbia APAM news, May 13 2014.
- “From a flat mirror, designer light,” Harvard School of Engineering and Applied Sciences (SEAS) news, Sept. 1, 2011.
- “Researchers demonstrate highly directional terahertz laser rays,” Harvard SEAS news, Aug. 8, 2010.
- “Scientists demonstrate multibeam, multi-functional lasers,” Harvard SEAS news, Nov. 30, 2009.
- “Scientists demonstrate laser with controlled polarization,” Harvard SEAS news, Apr. 13, 2009.
- “Scientists demonstrate highly directional semiconductor lasers,” Harvard SEAS news, Jul. 28, 2008.
- “Harvard University engineers demonstrate quantum cascade laser nanoantenna,” Harvard SEAS news, Oct. 22, 2007.

PROFESSIONAL SERVICE

- Serving as a committee member in Conference on Lasers and Electro-Optics (CLEO) Nano-Optics and Plasmonics Subcommittee (2013-2017).
- Panelists in NSF proposal review meetings (2014, 2017).
- Reviewer for scientific journals: *Science*, *Nature Physics*, *Nature Photonics*, *Nature Nanotechnology*, *Advanced Materials*, *ACS Photonics*, *Nano Letters*, *Laser & Photonics Reviews*, *IEEE Journal of Selected Topics in Quantum Electronics*, *IEEE Journal of Quantum Electronics*, *AIP Advances*, *IEEE Transaction on Nanotechnology*, *Physical Review Letters*, *Optics Letters*, *IEEE Photonics Technology Letters*, *Applied Physics Letters*, *Optics Express*, *Journal of Electromagnetic Waves and Applications* and *Progress in Electromagnetic Research*.

PROFESSIONAL ASSOCIATIONS

- 2007 – Present Optical Society of America (OSA), member
- 2007 – Present Institute of Electrical and Electronics Engineers (IEEE), member

- 2009 – Present IEEE Photonics Society, member
- 2009 – Present American Physical Society (APS), member
- 2007 – Present Materials Research Society (MRS), member

JOURNAL COVERS



