In this tutorial lecture, I will start with an intuitive introduction to the optical properties of metamaterials. I will then discuss the possibility of creating 2-dimensional (2D) metamaterials from optically resonant nanoscale semiconductor and metallic building blocks. The resulting metamaterials and metasurfaces are ideal building blocks for optoelectronic devices that are commonly constructed from layered metal and semiconductor films.

Instructors
Nicholas A. Kotov, University of Michigan
Mark Luitzen Brongersma, Stanford University
Mark Stockman, Georgia State University

SESSION ED10.1: Active and Tunable Materials
Session Chairs: Viktoria Babicheva and Matthew Sheldon
Tuesday Morning, April 18, 2017
PCC North, 100 Level, Room 131 B

10:30 AM *ED10.1.01 Continuous Beam Steering at 1500 nm with Gate-Tunable Conducting Oxide Reconfigurable Metasurfaces
Ghazaleh Kafaie Shirmanesh, California Institute of Technology, United States.

10:45 AM *ED10.1.02 Ultrafast and Nonlinear Plasmonics with Alternative Material Platforms
Vladimir Shalaev, Purdue University, United States.

11:15 AM *ED10.1.03 Electrically Tunable Antennas
Mark L. Brongersma, Stanford University, United States.

11:45 AM ED10.1.04 Spatiotemporal Light Control in Dielectric Metasurfaces for Ultrafast Laser Beam Steering
Amr Shaltout; Stanford University, United States.

SESSION ED10.2: Optoelectronics and Hybrid Nanostructures
Session Chairs: Koray Aydin and Viktoria Babicheva
Tuesday Afternoon, April 18, 2017
PCC North, 100 Level, Room 131 B

1:30 PM *ED10.2.01 Nonlinear Optics with Metasurfaces—Integration with Semiconductor Heterostructures
Igal Brener; Sandia National Laboratories, United States; Center for Integrated Nanotechnologies, United States.

2:00 PM ED10.2.02 Bimodal Phase-Matching in Nonlinear Photonic-Plasmonic Waveguides
Taiki Hatakeyama; University of California, Berkeley, United States.

2:15 PM *ED10.2.03 Surface Plasmon Enhanced Optoelectronics
Pierre Berini; University of Ottawa, Canada; University of Ottawa, Canada; University of Ottawa, Canada.

2:45 PM ED10.2.04 Hot Electron Enhanced Thermionic Emission (HEETE) Converters for All-Metal Optical Power Generation
Matthew Sheldon; Texas A&M University, United States.

3:00 PM BREAK
ED10.4.01
Wideband Light Absorbers in the Visible by Ge\textsubscript{2}Sb\textsubscript{2}Te\textsubscript{3} and Al Nanogratings Weiling Dong; Singapore University of Technology and Design, Singapore.

ED10.4.02
Refractory Plasmonic Absorber for Efficient CZTS Solar Cells Omar A. Abdelnour; The American University in Cairo, Egypt.

ED10.4.03
Comparison of Different Phase-Change Materials for Mid-Infrared Antenna Resonance Frequency Tuning Thomas Taubner; RWTH Aachen University, Germany.

ED10.4.04
Ultrafast Mid-Infrared Modulator Based on Optically Controlled Graphene Metasurface Ali Basiri; Arizona State University, United States.

ED10.4.05
Scalable Energy-Tuned Plasmonic Nanoadditive Composites Mark Griep; US Army Research Lab, United States.

SESSION ED10.5: Metasurfaces and Metamaterials
Session Chairs: Viktoria Babicheva and Kevin MacDonald
Wednesday Morning, April 19, 2017
PCC North, 100 Level, Room 131 B

8:00 AM ED10.5.01
Gapless States in Microwave Artificial Graphene Yulia Dautova; University of Exeter, United Kingdom.

8:15 AM *ED10.5.02
Absorbers in the Flatland—From Plasmonic Metasurfaces to 2D Materials Koray Aydin; Northwestern University, United States.

8:45 AM *ED10.5.03
Recent Progress in Dielectric Metasurfaces Uriel Levy; Hebrew University of Jerusalem, Israel.

9:15 AM *ED10.5.04
Metamaterials for Nonlinear Optics Anatoly Zayats; King’s College London, United Kingdom.

9:45 AM BREAK

10:15 AM ED10.6.01
First Demonstration of Phase Tuning from a Mid-IR Graphene-Gold Metasurface Greater than 200 Degrees Philip Hon\textsuperscript{1}; 2 Northrop Grumman Corporation, NG Next, United States; 3 California Institute of Technology, United States.

10:30 AM ED10.6.02
Graphene-Coated Metasurface as a Tunable SERS Platform Vrinda Thacris; Stanford University, United States.

10:45 AM *ED10.6.03
Sculpting Nanosecond Laser Pulses In-Flight Using Graphene-integrated Metasurface Gennady Shvets; The University of Texas at Austin, United States.

11:15 AM *ED10.6.04
Probing Quantum Phenomena in Graphene by Infrared Nano-Imaging of Plasmonic Waves Dmitri Basov; Columbia University, United States.

11:45 AM ED10.6.05
Full Phase Control of Light Using Graphene Plasmons Achim Woessner; The Institute of Photonic Sciences (ICFO), Spain.

1:30 PM ED10.7.01
Dynamic Thermo-Optic Tuning of Infrared PbTe Mic Resonators Jon A. Schuller; University of California, Santa Barbara, United States.

1:45 PM *ED10.7.02
All-Chalcogenide Plasmonic and Dielectric Phase-Change Metadevices Nikolay I. Zheludev\textsuperscript{1}; 2 University of Southampton, United Kingdom; 3 Nanyang Technological University, Singapore.

2:15 PM ED10.7.03
Active Metadevices on Optical Fiber Platforms Kevin F. MacDonald; University of Southampton, United Kingdom.

2:30 PM BREAK

3:30 PM ED10.7.04
Reversible Switching of Highly Confined Phonon-Polaritons with an Ultrathin Phase-Change Material Thomas Taubner; RWTH Aachen University, Germany.

3:45 PM *ED10.7.05
Reconfigurable Metasurfaces Using Phase Change Materials Jacob Schmer; Tel-Aviv University, Israel.

4:15 PM *ED10.7.06
Approaches towards Actively Tunable Mid- to Far-Infrared Nanophotonics Joshua D. Caldwell; U.S. Naval Research Laboratory, United States.

4:45 PM ED10.7.07
Phase Change Metamaterial Pollution Sensor Weiling Dong; Singapore University of Technology and Design, Singapore.
ED10.8.01 Counterintuitive Optical Properties of Infrared-Plasmonic Oxide Superlattices by Atomic Layer Deposition Do-Joong Lee; Brown University, United States.

ED10.8.02 Plasmon to Exciton Energy Conversion in a Single Nanoparticle Natalia Kholmicheva; Bowling Green State University, United States.

ED10.8.03 Measuring of the Energy Transfer Efficiency between Plasmon Nanoparticles and Quantum Dots Using Sample-Transmitted Excitation Photoluminescence (STEP) Pavel Moroz; Bowling Green State University, United States.

ED10.8.04 Scalable Physical Coloration Based on Plasmonic Nanostructures Tianyi Shen; Brown University, United States.

ED10.8.05 Purcell-Like Effect for Actively Controlled Resonant Semiconductor Nanostructures Aaron Holsteen; Stanford University, United States.

SESSION ED10.9: Energy Harvesting and Sensing Applications

Session Chairs: Viktoriia Babicheva and Pavel Ginzburg

Thursday Morning, April 20, 2017
PCC North, 100 Level, Room 131 B

8:00 AM ED10.9.01 Metasurface Back Reflectors for External Control over Semiconductor Nanowire Resonances Jorik Van de Groep; Stanford University, United States.

8:15 AM ED10.9.02 Nanogrid Made Invisible by Texture for Thin Film Solar Cells Joon van Deelen; TNO, Netherlands.

8:30 AM ED10.9.03 Suppression of Infrared Absorption in Nanostructured Metals by Controlling Faraday Inductance and Electron Path Length Sang Hun Han1, 2; 1University of New Mexico, United States; 2University of New Mexico, United States.

8:45 AM *ED10.9.04 Complete Control over Reflected Fields with Gap Surface Plasmons Fei Ding; University of Southern Denmark, Denmark.

9:15 AM *ED10.9.05 Dielectric and Plasmonic Platforms for Surface-Enhanced Sensing, Nanochemistry and Nonlinear Optics Stefan A. Maier; Imperial College London, United Kingdom.

9:45 AM ED10.9.06 CMOS-Compatible Integrated Surface Enhanced Raman Scattering Sensors Cuong Nguyen; University of California, Irvine, United States.

10:00 AM BREAK

10:15 AM ED10.9.07 A Piezoplasmonic Response in Metal Nanoislands—Optical Sensing of Strain in Biological Environments Using Low-Dimensional Metamaterials Brandon C. Marr; University of California, San Diego, United States.

10:30 AM *ED10.9.08 Aluminum Plasmonics—New Wavelengths and New Versatility for Sensing Applications Naomi J. Halas; Rice University, United States.

11:00 AM ED10.9.09 Interdigitated Periodic Plasmonic Nanostructures for Electrochemical SERS Observation of Biomolecule Redox Dynamics Dym Adaljan; California Institute of Technology, United States.

11:15 AM ED10.9.10 Laser Processing of Low Optical Reflection Micro/Nano-Patterned Si Substrates for SERS Aarup Das; Indian Institute of Technology Delhi, India.

11:30 AM *ED10.9.11 Control of Light-Matter Interactions with Nonlocal Dielectric Environments Mikhail Noginov; Norfolk State University, United States.

SESSION ED10.10: Plasmonics and Metamaterials Applications

Session Chairs: Viktoriia Babicheva and Wenshan Cai

Thursday Afternoon, April 20, 2017
PCC North, 100 Level, Room 131 B

1:30 PM ED10.10.01 Plasmonic Transition Metal Nitrides for Harsh-Environment Applications Urcan Guler; Purdue University, United States.

1:45 PM ED10.10.02 Temperature and Phase Transition Sensing in Liquids with Fluorescent Probes Pavel Ginzburg1, 2; 1Tel Aviv University, Israel; 2ITMO, Russian Federation.

2:00 PM ED10.10.03 Scalably Manufactured Metamaterial for Effective Day-Time Radiative Cooling Yao Zhai; University of Colorado Boulder, United States.

2:15 PM ED10.10.04 Metaplatforms for Analog Computing Brian Edwards; University of Pennsylvania, United States.

2:30 PM ED10.10.05 Polarization-Resolved Spectroscopy Using Multiresonant Plasmonic Bull’s-Eye Antennas Eva De Leo; ETH Zurich, Switzerland.

2:45 PM BREAK

SESSION ED10.11: Optical Phenomena in Metasurfaces and Nanostructures

Session Chairs: Yohannes Abate and Pavel Ginzburg

Thursday Afternoon, April 20, 2017
PCC North, 100 Level, Room 131 B


3:30 PM ED10.11.02 Silicon Nanoantennas for Highly Directional Light Emission from Monolayer MoS2 Ahmet Fatih Cihan; Stanford University, United States.

3:45 PM *ED10.11.03 Magnetic Resonant Effects in High-Index Dielectric Nanostructures and Metasurfaces Arseniy Kuznetsov; Data Storage Institute, Singapore.

4:15 PM *ED10.11.04 Nanomaging of IR and THz Polaritons in 2D Materials Rainer Hillenbrand; CIC nanoGUNE, Spain.

4:45 PM ED10.11.05 Near-Field Edge Fringes in Nanolayer Materials Viktoriia Babicheva; Georgia State University, United States.
SESSION ED10.12: Poster Session III: Plasmonic Materials for Sensing
Thursday Afternoon, April 20, 2017
8:00 PM - 10:00 PM
Sheraton, Third Level, Phoenix Ballroom

ED10.12.01
Plasmonic Nanoantennas with Vertically Coupled Anisotropic Complementary Structures for Dual-Mode Infrared Molecule Sensing
Nanhu Chen1,2; 1Arizona State University, United States; 2Arizona State University, United States.

ED10.12.02
Dual-Resonant Perfect Absorber for Detecting Multiple Molecular Fingerprints
Habibe Durmaz1,2; 1Boston University, United States; 2Recep Tayyip Erdogan University, Turkey.

ED10.12.03
Nitrile-Based Surface Plasmon Resonance Biosensors
Kun-Yu Lai; National Central University, Taiwan.

ED10.12.04
Electrokinetic-Manipulation Integrated Plasmonic-Photonic Hybrid Raman Nanosensors with Dual Enhanced Sensitivity
Chao Liu; The University of Texas at Austin, United States.

ED10.12.05
Optical Contribution of Graphene in Enhanced Sensitivity of Graphene-Gold Coupled Surface Plasmon Resonance Sensing
Kyungwha Chung; Ewha Womans University, Korea (the Republic of).

SESSION ED10.13: Novel Plasmonic Materials and Metamaterials
Session Chairs: Pavel Ginzburg and Cheng Zhang
Friday Morning, April 21, 2017
PCC North, 100 Level, Room 131 B

8:15 AM ED10.13.01
Metal Germanides for Mid- and Long-Wave Infrared Plasmonics
Evans M. Smith1,2; 1Air Force Research Laboratory, United States; 2KBRwyle Laboratories, United States.

8:30 AM *ED10.13.02
New Materials for Infrared and Active Plasmonics
Otto L. Muskens; University of Southampton, United Kingdom.

9:00 AM ED10.13.03
High-Performance Doped Silver Films—Overcoming Fundamental Material Limits for Nanophotonic Applications
Cheng Zhang1,2; 1University of Michigan–Ann Arbor, United States; 2National Institute of Standards and Technology, United States.

9:15 AM ED10.13.04
Doped Cadmium Oxide Thin Films Provide a Broadly Tunable, Low-Loss and Scalable Plasmonic Material Platform
Evan L. Runnerstrom; North Carolina State University, United States.

9:30 AM *ED10.13.05
Plasmonic Metamaterials as a Self-Contained Platform for Optoelectronic Signal Processing
Wenxian Cai; Georgia Institute of Technology, United States.

10:00 AM BREAK

10:30 AM *ED10.13.06
Beyond Graphene Plasmonics
Tony Low; University of Minnesota, United States.

11:00 AM *ED10.13.07
Nanoscopy of Black Phosphorus
Yohannes Abate; Georgia State University, United States.

11:30 AM ED10.13.08
Impedance Spectroscopy Characterization of Colloidal Indium Tin Oxide Films and Related Materials
Rosario Gerhardt; Georgia Institute of Technology, United States. 11:45 AM ED10.13.09
Extracting Dielectric Function of Plasmonic Metal Oxide Using Synchrotron-Based Infrared Nano-Spectroscopy (SINS) on Single Nanocrystal Scale
Ankit Agrawal; The Univ. of Texas at Austin, United States.

SESSION ED10.14: Novel Fabrication Techniques
Session Chairs: Pavel Ginzburg and Tony Low
Friday Afternoon, April 21, 2017
PCC North, 100 Level, Room 131 B

1:30 PM ED10.14.01
Substrate Insensitive Plasmonic Titanium Nitride Film Deposited by Atomic Layer Deposition
Zu-Po Yang; National Chiao Tung University, Taiwan.

1:45 PM ED10.14.02
Nonthermal Plasma-Synthesized Titanium Nitride Nanocrystals with Gold-Like Plasmonic Properties for Biological Applications
Katelyn S. Schramke; University of Minnesota, United States.

2:00 PM ED10.14.03
Efficient Combination of Interference and Plasmon Resonance Raman Amplification by Optimized Heterostructures for Optical Microscopy and Molecule Detection
Alicia de Andres; ICMM- CSIC, Spain.

2:15 PM ED10.14.04
Directed Nanopatterning of Self-Organized Bravais Lattices
Onur Tokel; Bilkent University, Turkey.

2:30 PM ED10.14.05
Lithographically Patterned Plasmonic Au Nanotube Array for Solar Energy Harvesting
Hak-Jong Choi; Korea University, Korea (the Republic of).

2:45 PM ED10.14.06
Nanoimprinted Self-Folding Mid-IR Tunable Metasurfaces
Vivek Nagal; Johns Hopkins University, United States.

3:00 PM BREAK

SESSION ED10.15: Self-Assembly Methods for Nanostructures and Metamaterials
Session Chairs: Pavel Ginzburg and Cheng Zhang
Friday Afternoon, April 21, 2017
PCC North, 100 Level, Room 131 B

3:30 PM ED10.15.01
Mechanically-Assembled Meta-Materials Based on Atomically-Thin Crystals
Juyoung Leem; Univ. of Illinois at Urbana-Champaign, United States.

3:45 PM ED10.15.02
Engineering Nanoscale Structures with Nanometer Precision and Surface Uniformity for Plasmonic Devices
Farnaz Niroui; Massachusetts Institute of Technology, United States.

4:00 PM ED10.15.03
Engineering Disordered Metamaterials for Broadband High Optical Absorption
Sheldon Hewlett; Central Michigan University, United States.

4:15 PM ED10.15.04
Block-Copolymer Based Self-Assembled Hyperbolic Metamaterials in the Visible Range
Xuan Wang; Centre de Recherche Paul Pascal-Université de Bordeaux, France.

4:30 PM ED10.15.05
Dynamic Plasmonic Metamaterials with Broken Symmetry Created via Directed Self-Assembly
David B. Litt1,2; 1Lawrence Berkeley National Laboratory, United States; 2University of California, Berkeley, United States.

4:45 PM ED10.15.06
Continuous Flow Colloidal Synthesis and Stabilization of Gold-Poly styrene Patchy Particles and their Thin Film Assembly into Layers with Particle-Anisotropy Dependent Optical Properties
Robin N. Klupp Taylor; 1,2; 1Friedrich-Alexander-University of Erlangen-Nürnberg, Germany; 2Friedrich-Alexander-University of Erlangen-Nürnberg, Germany; 1Friedrich-Alexander-University of Erlangen-Nürnberg, Germany.