

2021 NNI Strategic Planning Stakeholder Workshop

Speaker, Presenter, and Moderator Biographies

January 11 – 13, 2021

Daily runtime: 11:00 a.m. – 3:00 p.m. ET

Outlining the Vision – Jan. 11

Lisa Friedersdorf, National Nanotechnology Coordination Office & NSET Co-Chair

Lisa Friedersdorf is the Director of the National Nanotechnology Coordination Office (NNCO). She has been involved in nanotechnology for over twenty-five years, with a particular interest in advancing technology commercialization through university-industry-government collaboration. She is also a strong advocate for science, technology, engineering, and mathematics (STEM) education, and has over two decades of experience teaching at both the university and high school levels.

While at NNCO, Dr. Friedersdorf has focused on building community and enhancing communication in a variety of ways. With respect to coordinating research and development, her efforts have focused on the Nanotechnology Signature Initiatives in areas including nanoelectronics, nanomanufacturing, informatics, sensors, and water. A variety of mechanisms have been used to strengthen collaboration and communication among agency members, academic researchers, industry representatives, and other private sector entities, as appropriate, to advance the research goals in these important areas. Dr. Friedersdorf also led the establishment of a suite of education and outreach activities reaching millions of students, teachers, and the broader public. She continues to expand the use of targeted networks to bring people together in specific areas of interest, including the Nano and Emerging Technologies Student Network and the U.S.-EU Communities of Research focused on the environmental, health, and safety aspects of nanotechnology. Nanotechnology entrepreneurship and nanomedicine are areas where new communities of interest are developing.

Prior to joining NNCO, Dr. Friedersdorf served in a number of roles at the intersection of academia, industry, and government. At Lehigh University, Dr. Friedersdorf served as Associate Director of the Materials Research Center (now the Center for Advanced Materials and Nanotechnology) and Director of the industry liaison program, where she oversaw dozens of membership programs and was responsible for developing and coordinating multi-investigator interdisciplinary research programs, including a multimillion-dollar public-private partnership in microelectronics. As Director of the Virginia Nanotechnology Initiative, she led an alliance of academic institutions, industry, and government laboratories with an interest in nanotechnology across the Commonwealth of Virginia. At the University of Virginia, she served as Managing Director of the nanoSTAR Institute and led the development of pan-university initiatives as a Program Manager in the Office of the Vice President for Research. Additionally, Dr. Friedersdorf has been active in the start-up ecosystem, assisting small companies with business development and access to resources and as an advisor to vet emerging technologies for investors.

Dr. Friedersdorf earned her PhD and MSE in Materials Science and Engineering from the Johns Hopkins University and BS in Mechanical Engineering from the University of Central Florida.

World-Class Research Panel

Andrew Schwartz, Department of Energy & NSET Co-Chair

Andrew Schwartz has served as Senior Technical Advisor for the Department of Energy (DOE) Energy Frontier Research Centers (EFRCs) since June 2013, leading the team of DOE Basic Energy Sciences (BES) program managers and support staff that manages the EFRC program. From 2008 to 2013 Dr. Schwartz was the BES Program Manager for the Experimental Condensed Matter Physics (ECMP) program, one of the largest core research areas in BES, supporting a diverse research portfolio with major emphasis on topics such as superconductivity, magnetism, spin physics, and low-dimensional systems.

In addition to program management duties, Dr. Schwartz has represented BES in various other capacities. He served on the committee that developed and executed the inaugural DOE Office of Science Early Career Research Program solicitation and award process in 2010. Since 2009 he has represented DOE on the Nanoscale Science, Engineering, and Technology (NSET) Subcommittee of the National Science and Technology Council, the interagency group charged with coordination of Federal Government activities related to the National Nanotechnology Initiative (NNI), and since 2010 he has served as the lead DOE representative. In this role, Dr. Schwartz has coordinated all NNI-related activities for DOE, interfacing with personnel in other DOE offices, as well as with personnel at NNCO, the White House Office of Science and Technology Policy (OSTP), and the other Federal agencies involved in the NNI. He served on the NSET Task Force that authored the 2011 and 2014 NNI strategic plans.

Prior to joining BES, Dr. Schwartz spent seven years in industry leading a multidisciplinary scientific and engineering team in the research and development of a new technology for semiconductor metrology. In this role he was actively involved in project planning, strategic planning, budgeting, project execution, and business development.

Dr. Schwartz received a BA in Physics from Amherst College and MS and PhD degrees in Physics from the University of California, Los Angeles. His research focused on the electrodynamic response of various materials, including high-temperature superconductors, low-dimensional conductors, and colossal magnetoresistive oxides. Dr. Schwartz has co-authored over 30 technical papers and holds seven U.S. patents.

Pedro Alvarez, Rice University

Pedro J.J. Alvarez is the George R. Brown Professor of Civil and Environmental Engineering at Rice University, where he also serves as founding Director of the National Science Foundation (NSF) Engineering Research Center on Nanotechnology-Enabled Water Treatment (NEWTEC). His research interests include environmental implications and applications of nanotechnology, bioremediation, fate and transport of toxic chemicals, water footprint of biofuels, water treatment and reuse, and antibiotic resistance control. Dr. Alvarez received a BEng degree in Civil Engineering from McGill University and MS and PhD degrees in Environmental Engineering from the University of Michigan. He is the 2012 Clarke Prize laureate for outstanding research in water science and technology, and also won the American Academy of Environmental Engineers and Scientists (AAEES) Grand Prize for Excellence in Environmental Engineering and Science. Past honors include President of the Association of Environmental Engineering and Science Professors (AEESP), the Perry McCarty AEESP Founders' Award for Outstanding Contributions to Environmental Engineering Education and Practice, the AEESP Frontiers in Research Award, the Water Environmental Federation (WEF) McKee Medal for Groundwater Protection, the Department of Defense

Strategic Environmental Research and Development Program (SERDP) cleanup project of the year award, the Brown and Caldwell lifetime Achievement Award for Site Remediation, the American Society of Civil Engineers (ASCE) Simon Freese Award, and various best paper awards with his students. He is an Associate Editor of *Environmental Science and Technology* and previously served on the scientific advisory board of the Environmental Protection Agency (EPA) and of the advisory committee of the NSF Engineering Directorate. Dr. Alvarez was elected to the National Academy of Engineering for outstanding contributions to the practice and pedagogy of bioremediation and environmental nanotechnology.

Cherie R. Kagan, University of Pennsylvania

Cherie R. Kagan is the Stephen J. Angello Professor of Electrical and Systems Engineering, Professor of Materials Science and Engineering, and Professor of Chemistry at the University of Pennsylvania. She is also Penn Engineering's Associate Dean for Research, the President of the Materials Research Society, and an Associate Editor of *ACS Nano*. She graduated from the University of Pennsylvania in 1991 with a BSE in Materials Science and Engineering and a BA in Mathematics and earned her PhD in Materials Science and Engineering from the Massachusetts Institute of Technology in 1996. In 1996, she went to Bell Labs as a postdoctoral fellow, and in 1998, she joined IBM's T. J. Watson Research Center, where she most recently managed the "Molecular Assemblies and Devices Group." In 2007, she joined the faculty of the University of Pennsylvania. The Kagan group's research is focused on studying the chemical and physical properties of nanostructured materials and integrating these materials in electronic, optoelectronic, and optical devices. The group combines the flexibility of chemistry and bottom-up assembly with top-down fabrication techniques to design novel materials and devices, and explores the structure and function of these materials and their devices. Kagan is the Director of a newly awarded NSF Engineering Research Center on the Internet of Things for Precision Agriculture.

Kurt W. Kolasinski, West Chester University

Kurt Kolasinski's research focuses on the development of new methods for production of nanostructures and porous solids by the application of etching (wet-chemical and laser-assisted), laser ablation, and growth. Of particular interest are porous silicon, nano- and mesoscopic pillars of Si, and nanostructured semiconducting metal oxides for energy, drug delivery, sensor, photocatalytic, and other applications. Investigations include photoluminescence from nanostructured semiconductors, e.g., porous silicon. Dr. Kolasinski also has experience with ultrafast sum frequency generation (SFG) studies of Si and por-Si interfaces, molecular beam investigations of adsorption dynamics on metal and semiconductor surfaces, and laser spectroscopic investigations of photochemistry at surfaces and laser/surface interactions. He also developed the world's first high-harmonic generation source for the initiation and study of surface photochemistry.

Carmen L. Gomes, Iowa State University

Carmen Gomes's laboratory focuses on both fundamental and more immediately applied research in functional delivery systems and biosensors in the areas of food safety, shelf-life extension of food products, and nutrient bioavailability. The overall research emphasis is to design novel nanoscale materials using biopolymers for biotechnology and food applications. The study of stimuli-responsive biopolymer nanostructures is of particular interest. These stimuli-responsive nanostructures have been investigated in food-safety applications as delivery systems of antimicrobials and as platforms for foodborne pathogen detection (biosensors).

Nanotechnology Development Pathway Panel

Katherine Tyner, Office of Science and Technology Policy

Katherine Tyner is a current White House Leadership Development (WHLDP) Fellow, performing her fellowship within the Office of Science and Technology Policy within the Executive Office of the President. As a WHLDP Fellow, Dr. Tyner's focus is on the Lab-to-Market Cross-Agency Priority (CAP) Goal, and she works closely with key Office of Management and Budget and agency stakeholders.

In her home agency, Dr. Tyner is the Acting Associate Director for Science in the Office of Pharmaceutical Quality (OPQ), Center for Drug Evaluation and Research (CDER) within the Food and Drug Administration (FDA). In this capacity, she coordinates the intersection between science, review, and policy in OPQ.

Dr. Tyner is an expert in complex drug formulations. She leads the CDER Nanotechnology Working Group, and represents CDER in a variety of national and international fora on the use of nanomaterials in drug products. Prior to joining OPQ, Dr. Tyner served as a principal investigator studying the quality, safety, and efficacy of complex drug products. Dr. Tyner has authored multiple book chapters, journal articles, and guidances on the appropriate characterization and biological impact of nanoparticle therapeutics and other complex products.

Joe Sprengard Jr., Veelo Technologies

Joe Sprengard Jr. is the co-founder and CEO of Veelo Technologies. Prior to starting the company, he was an accomplished strategy consultant, commercial banker, and legislative analyst in the United States House of Representatives. Since co-founding the company in 2008, Mr. Sprengard has led the vision and strategy at Veelo Technologies, including execution from early-stage research and development to successful commercialization, facility expansion, and building a high-caliber team and winning culture. Dr. Sprengard has also built a top-tier Board of Directors and implemented capitalization strategies resulting in the successful close of Seed, Series A, and Series B investment rounds. Mr. Sprengard is a graduate of the University of Illinois, Urbana-Champaign, a scholarship athlete, and a proud husband and father. He enjoys coaching his kids' sports, skiing, and traveling with friends and family.

Michael Goergen, U.S. Endowment for Forestry and Communities

Michael Goergen joined the U.S. Endowment for Forestry and Communities in September 2013 to lead its efforts in innovation and technology. Currently, his projects include taking cellulosic nanotechnology from the lab to the market, advancing mass timber construction, and bringing together partners in the public and private sectors to accelerate the development of new uses of forest materials. His efforts in this space are gaining public awareness, including securing a spot on the TEDx stage to discuss the opportunities that new forest technologies present.

Before joining the Endowment, Mr. Goergen was Executive Vice President and CEO of the Society of American Foresters (SAF). He has also served as Chair of the External Review Panel of the Sustainable Forestry Initiative, Vice President of the Communities Committee, and Chair, Binational American National Standards Institute (ANSI) Process on Carbon and Forest Accounting Standards. He graduated from the SUNY College of Environmental Science and Forestry, where he received a BS degree in Environmental Policy and Management and an MS degree in Forest Resource Policy and Management.

Mr. Goergen is a recipient of the National Association of State Foresters Award for Outstanding Service in Forest Public Policy, SAF's Young Forester Leadership Award, and SAF's President's Leadership Award. Mr. Goergen and his wife Mila have two children, Maria and Michael Anthony. His interests outside forest and family include competing in triathlons and cooking for friends and family.

Heike E. Riel, IBM Research

Heike Riel is IBM Fellow, Head of Science & Technology, and Lead of IBM Research Quantum Europe at IBM Research. She is responsible for leading the research agenda of the Science & Technology Department aiming to create scientific and technological breakthroughs in quantum computing, physics of artificial intelligence, nanoscience and nanotechnology, precision diagnostics, and smart system integration.

Dr. Riel is a distinguished expert in nanotechnology and nanosciences and focuses her research on advancing the frontiers of information technology through the physical sciences. She contributed to advancements in the science and technology of nanoscale electronics, in particular the exploration and development of semiconducting nanowires and nanostructures for applications in future electronic and optoelectronic devices, in molecular electronics for future nanoscale switches and memory applications, and organic light-emitting diodes for display applications. Her current research interests include new materials and device concepts for future nanoelectronics for applications in quantum computing and neuromorphic computing. She also serves as the Deputy Director of the new Swiss National Competence Center for Research on Silicon Spin Qubits.

In 2013, Dr. Riel was named IBM Fellow, the company's highest technical distinction, and inducted into IBM's Academy of Technology. She was thus recognized for her seminal contributions to and fundamental achievements in the science and technology of nanoscale electronics, in particular the exploration and development of semiconducting nanowires for applications in future electronic devices, molecular electronics for future nanoscale switches and memory applications, and organic light-emitting diodes for display applications. She has authored more than 140 peer-reviewed publications, filed more than 50 patents, and delivered plenary, keynote, and invited talks at international prestigious conferences.

Dr. Riel studied physics at the University of Erlangen-Nuremberg (Germany) and received a PhD from the University of Bayreuth (Germany) in 2003 for her work on optimizing multilayer organic light-emitting devices performed at IBM Research. In 2010, Dr. Riel graduated with an MBA from Henley Business School.

Baratunde Cola, Carbice Corporation

Baratunde Cola received his BE and MS degrees from Vanderbilt University, while playing on the football team as a starting fullback, and his PhD from Purdue University, all in Mechanical Engineering. He is likely the only person in the history of football to tear his ACL twice as a walk-on, serve two years as an equipment manager while rehabbing, and, under a new coaching staff in his final year, beat out five players to earn a scholarship and starting position. He won a top dissertation award at Purdue for his seminal work on carbon nanotube thermal interfaces.

Dr. Cola directs the Nanoengineered Systems and Transport Lab at the Georgia Institute of Technology, which helped to start Carbice Corporation, TCpoly, and the Academic and Research Leadership Network. He has published numerous highly cited papers and patents related to energy transfer and nanotechnology. In 2017, he was named the top scientist or engineer in the country under 35 years old

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by the National Science Foundation, through the Alan T. Waterman Award. He is an award-winning public speaker and frequent keynote presenter.

Dr. Cola is a Professor of Mechanical Engineering with a courtesy appointment in Materials Science, and he is the Faculty Athletics Representative at Georgia Tech, where he oversees academic integrity for athletics and reports to the President. He is the CEO and Chairman of the Board of Carbice Corporation and has raised over \$4 million for this commercial enterprise. He is a Fellow of the American Association for the Advancement of Science (AAAS), a member of the American Society of Mechanical Engineers (ASME), and a lifetime member of the National Society of Black Engineers (NSBE). He is a member of the International Semiconductor Industry Heterogeneous Integration Roadmap (HIR) Thermal Working Group. Dr. Cola is on the Board of Advisors for the Smithsonian Museum of Natural History.

Dr. Cola lives in Atlanta, Georgia, with his wife and two daughters.

Laying the Groundwork – Jan. 12

Keynote

Sangeeta Bhatia, Massachusetts Institute of Technology

Sangeeta Bhatia is a biomedical researcher, Massachusetts Institute of Technology (MIT) professor, and biotech entrepreneur who works to adapt technologies developed in the computer industry for medical innovation. Trained as both a physician and engineer at Harvard, MIT, and Brown University, Dr. Bhatia leverages “tiny technologies” of miniaturization to yield inventions such as human microfluidics that model human drug metabolism and liver disease, as well as responsive nanoparticles and nanoporous materials that can be engineered to diagnose, study, and treat a variety of diseases, including cancer. She and her trainees have launched multiple biotechnology companies to improve human health. As a prolific inventor and passionate advocate for diversity in science and engineering, Dr. Bhatia has received many honors, including the Lemelson-MIT Prize, known as the “Oscar for inventors,” and the Heinz Medal for groundbreaking inventions and advocacy for women in STEM fields. She is a Howard Hughes Medical Institute Investigator, the Director of the Marble Center for Cancer Nanomedicine at the Koch Institute for Integrative Cancer Research at MIT, and an elected member of the National Academy of Sciences, the National Academy of Engineering, the American Academy of Arts and Science, the National Academy of Inventors, the National Academy of Medicine, and Brown University's Board of Trustees.

Breakout Session Moderators

Kristin Persson, Lawrence Berkeley National Laboratory

Kristin Persson uses atomistic and first-principles computational methods coupled with high-performance computing technology and machine learning to advance materials for clean energy production and storage. She is the Director of the Materials Project, which is a multinational effort to compute the properties of all inorganic materials and provide the data and associated analysis algorithms free of charge. The ultimate goal of the initiative is to drastically reduce the time needed to invent new materials to serve societal needs, in particular advancing clean energy solutions. The Persson group leverages the software and data infrastructure of the Materials Project together with the group's expertise in materials informatics to study the physics and chemistry of materials, particularly for energy production and storage applications. Current focus areas include design of novel photocatalysts, multivalent battery electrode materials, Li-ion battery electrode materials, polar materials, and liquid electrolytes for Li energy storage solutions and beyond.

Landon Mertz, Cerion Nanomaterials

Landon Mertz is the Chief Executive Officer of Cerion Nanomaterials and is a member of its Board of Directors. Under his leadership for over 10 years, he has overseen a period of expansive business growth and investment into innovations to make advanced expertise in custom nanomaterial design, scale-up, and manufacturing accessible and cost-effective for use by industry.

Mr. Mertz has been frequently recognized for his work and is a passionate champion of advancing the growth and maturity of the nanomaterials industry. He is the Chairman and board member of the Nanotechnology Industries Association (NIA), the leading trade association representing users and makers of nanomaterials. He is also a frequent keynote speaker, moderator, panelist, and contributor within the

industry to organizations including the National Nanotechnology Initiative, Nanotechnology Industries Association, Advanced Material Show, Nanotechnology Show, and Ceramics Expo. He is also regularly featured in industry magazines such as *Wired*, *R&D World*, *Specialty Chemicals Magazine*, and others.

Mr. Mertz has over 20 years of experience building and monetizing new, innovative businesses across a diverse set of industries. Prior to Cerion, he was the Chief Operating Officer of Festival Network, a firm that develops and acquires large-scale, multi-day music festivals in geographically unique destinations around the globe. Prior to Festival Network, he was the Chief Executive Officer of Intermedia, an experiential event marketing firm that produces events, meetings, and product launches on behalf of Fortune 500 and 1000 companies.

Jennifer Dionne, Stanford University

Jennifer Dionne is the Senior Associate Vice Provost of Research Platforms/Shared Facilities and an Associate Professor of Materials Science and Engineering and of Radiology (by courtesy) at Stanford. Dr. Dionne received her PhD in Applied Physics at the California Institute of Technology, advised by Harry Atwater, and BS degrees in Physics and Systems & Electrical Engineering from Washington University in St. Louis. Prior to joining Stanford, she served as a postdoctoral researcher in chemistry at UC Berkeley, advised by Paul Alivisatos. Dr. Dionne's research develops nanophotonic methods to observe and control chemical and biological processes as they unfold with nanometer-scale resolution, emphasizing critical challenges in global health and sustainability. Her work has been recognized with the Alan T. Waterman Award (2019), a National Institutes of Health (NIH) Director's New Innovator Award (2019), a Moore Inventor Fellowship (2017), the Materials Research Society Young Investigator Award (2017), Adolph Lomb Medal (2016), Sloan Foundation Fellowship (2015), and the Presidential Early Career Award for Scientists and Engineers (2014), and was featured on Oprah's list of "50 Things that will make you say 'Wow!'"

Jared Ashcroft, Pasadena City College

Jared Ashcroft is a Professor of Chemistry at Pasadena City College and the Center Director for the Micro Nano Technology (MNT) Education Center, actively involved in bringing MNT technical education programs to community colleges. He earned his BS in Chemistry from California State University, Long Beach, and Doctorate in Chemistry from Rice University. His doctorate work and subsequent studies at the Lawrence Berkeley National Lab focused on nanotechnology-based medical diagnostics and therapeutics. His current undergraduate research group focuses on using active learning in conjunction with remote instrumentation to increase success and engagement in science.

Gretchen Mahler, Binghamton University

In 2002, Gretchen Mahler earned her BS in Chemical Engineering from the University of Massachusetts, Amherst. She completed her honors thesis with Dr. Susan Roberts. Dr. Mahler completed her PhD in Chemical and Biomolecular Engineering with Dr. Michael Shuler at Cornell University in 2008. In 2011, Dr. Mahler completed a postdoctoral fellowship at Cornell University in the Biomedical Engineering Department with Dr. Jonathan Butcher. Dr. Mahler joined the Biomedical Engineering Department at Binghamton University in 2011. She was promoted to Associate Professor in 2017 and became the Associate Dean of the Graduate School in 2018. Dr. Mahler has broad training in chemical and biomedical engineering and specialized training in the development, characterization and validation of cell culture organ and tissue microfluidic models. Her current research includes the development of body-on-a-chip and barrier tissue models, including the GI tract, liver, kidney, and vascular and valvular endothelium, for mechanobiological and toxicity testing.

Ensuring Success – Jan. 13

Antti Makinen, Office of Naval Research & NSET Co-Chair

Antti Makinen joined the Naval Materials Division of the Office of Naval Research (ONR) as a Program Officer in 2015. At ONR he manages basic and applied research programs in structural and functional nanomaterials. Prior to ONR he worked for 15 years as a research scientist at the Naval Research Laboratory, where his work focused on optoelectronic materials. He received his MS degree in Engineering Physics from Aalto University, Helsinki, Finland, and his PhD in Physics from the University of Rochester, Rochester, NY.

Measuring Impact Panel

Piotr Grodzinski, National Cancer Institute

Piotr Grodzinski is a Chief of the Nanodelivery Systems and Devices Branch (NSDB) within the Cancer Imaging Program, Division of Cancer Treatment and Diagnosis, National Cancer Institute (NCI), National Institutes of Health. He directs the NCI Alliance for Nanotechnology in Cancer program dedicated to the development of nanotechnology-based cancer interventions.

Dr. Grodzinski graduated from the University of Science and Technology (AGH) in Krakow, Poland, and continued his studies at the University of Southern California in Los Angeles, where he researched novel semiconductor materials used in low-threshold lasers. In the mid-1990s, Dr. Grodzinski left the world of semiconductor research and got interested in biotechnology. He built a large microfluidics program at Motorola Corporate R&D in Arizona. The group made important contributions to the development of integrated microfluidics for genetic sample preparation, with its work being featured in Highlights of *Chemical and Engineering News* and *Nature* reviews. After his tenure at Motorola, Dr. Grodzinski was with the Bioscience Division of Los Alamos National Laboratory, where he served as a Group Leader and an interim Chief Scientist for the DOE Center for Integrated Nanotechnologies (CINT). At the National Institutes of Health, in addition to his programmatic responsibilities, he has co-chaired Trans-NIH Nanotechnology Task Force, which is coordinating the nanotechnology efforts across 27 institutes of the agency.

Dr. Grodzinski received PhD in Materials Science from the University of Southern California, Los Angeles, in 1992. He is an inventor on 17 patents and published over 70 peer-reviewed papers and 10 book chapters. Dr. Grodzinski was inducted into the College of Fellows of the American Institute for Medical and Biological Engineering (AIMBE) and the American Association for the Advancement of Science.

John Joannopoulos, Institute for Soldier Nanotechnologies

John D. Joannopoulos is the Francis Wright Davis Professor of Physics and the Director of the Institute for Soldier Nanotechnologies at MIT. He received his BA in 1968 from the University of California, Berkeley, his MA in 1970 from the University of California, Davis, and his PhD in 1974 from the University of California, Berkeley, with all degrees in Physics. In 1974 he was appointed as Assistant Professor of Physics at MIT and has remained on the faculty at MIT ever since. He is an elected Member of the U.S. National Academy of Sciences, American Academy of Arts and Sciences, and elected Fellow of the American Association for the Advancement of Science, American Physical Society, and World Technology Network. He has been an Alfred P. Sloan Fellow (1976-1980), a John S. Guggenheim Fellow (1981-1982), and has been on the Thompson Reuters Web of Science Most Highly Cited Researchers List since 2003. He is the

recipient of the MIT School of Science Graduate Teaching Award (1991), the William Buechner Teaching Prize of the Department of Physics (1996), the David Adler Award of the American Physical Society (1997), the Aneesur Rahman Prize of the American Physical Society (2015), and the Max Born Medal Award of the Optical Society of America (2015).

The research of Dr. Joannopoulos has spanned two major directions in the field of condensed matter physics. The first is devoted to creating a realistic and microscopic theoretical description of the properties of material systems. He is responsible for the development of numerous theoretical methods to enable tractable and accurate calculations of elementary excitations in complex many-particle systems. The second major direction, and current major thrust, involves the development of a new class of materials called photonic crystals, which are designed to affect the properties of photons in much the same way that semiconductors effect the properties of electrons. These materials provide new mechanisms in the ability to control and mold the flow of light that are impossible with conventional optics.

Dr. Joannopoulos is the author of over 670 technical journal articles, 4 textbooks (3 on *Photonic Crystals*, 1 on *Quantum Theory of Materials*) and holds over 125 U.S. patents. He is also co-founder of 6 startup companies: OmniGuide Inc., Luminus Devices, Inc., WiTricity Corporation, Typhoon HIL, Inc., Lux Labs, Inc., and Lightelligence Inc. He was Chair of Applied Physical Sciences at the U.S. National Academy of Sciences (2013-2016) and a former Divisional Associate Editor of *Physical Review Letters*, and former Member of the Editorial Board of *Reviews of Modern Physics*.

Christopher K. Ober, Cornell University

Christopher Kemper Ober is the Francis Bard Professor of Materials Engineering at Cornell University. He received his BSc (Honours Chemistry) from the University of Waterloo, Canada, and his PhD in Polymer Science & Engineering at UMass, Amherst. After several years at the Xerox Research Centre of Canada working in marking technology, Dr. Ober arrived at Cornell University in 1986. His research is focused on lithography, patterning, the biology-materials interface, and control of surface structure in thin films. As a reflection of his contributions to lithography, Dr. Ober was honored in 2015 with the Photopolymer Science & Technology Outstanding Contribution Award. He is the 2006 winner of the American Chemical Society Award in Applied Polymer Science and received a Humboldt Research Prize in 2007. In 2009, Dr. Ober was named a Fellow of the American Chemical Society and was awarded the Gutenberg Research Prize by the University of Mainz. From 1995 to 2010 he was an associate editor of the American Chemical Society (ACS) journal *Macromolecules*. Dr. Ober served as Interim Dean of Engineering, 2009–2010. In 2014 he was a Japan Society for the Promotion of Science (JSPS) Fellow in Japan. More recently he was elected a Fellow of the American Physical Society (2014) and the American Association for the Advancement of Science (2015) and made a SPIE Senior Member (2018). He is an elected member of the Executive Committee of the International Union of Pure and Applied Chemistry. He is currently the Director of the Cornell Nanoscale Facility.

Julia M. Phillips, National Science Board

Julia M. Phillips retired in 2015 from Sandia National Laboratories after nearly 20 years, serving in multiple roles including as Vice President and Chief Technology Officer, when she led the laboratory's internally funded research and development program, research strategy, and intellectual property protection and deployment. Other positions at Sandia included Director of Nuclear Weapons Science and Technology Programs; Director of the Physical, Chemical, and Nano Sciences Center; and Director of the DOE Center for Integrated Nanotechnologies at Sandia and Los Alamos national laboratories. Prior to her time at

Sandia, she spent 14 years at AT&T Bell Laboratories, where she performed leading-edge research in thin-film epitaxial electronic materials and complex oxides.

Dr. Phillips is a member of the National Academy of Engineering (NAE) and Fellow of the American Academy of Arts and Sciences and several other professional societies. In 2008 Phillips received the George E. Pake Prize from the American Physical Society (APS) for her leadership and pioneering research in materials physics for industrial and national security applications. She has served on the editorial boards of the *Journal of Materials Research*, *Journal of Applied Physics*, and *Applied Physics Reviews*. She is a member of the National Science Board Class of 2016–2022.

Michael Russo, SEMI

As Vice President of Industry Advancement and Government Programs, Michael Russo is responsible for strategy development, programs, and government partnerships intended to address the priority issues faced by SEMI's membership.

Mr. Russo spent nearly a decade leading Government Affairs in the U.S. for GLOBALFOUNDRIES, the nation's largest contract semiconductor chip maker, overseeing government relations, regulatory affairs, and strategic initiatives. Mr. Russo has also served as a private sector advisor to the U.S. Government in the areas of manufacturing and industrial base policy and lead the private sector advisory group for the National Network of Manufacturing Innovation Institutes under the President's Advanced Manufacturing Partnership. Mr. Russo has also served as a senior staffer in both the U.S. Senate and House of Representatives. With more than three decades experience in manufacturing, Mr. Russo has extensive experience in workforce and organizational development, supply chain innovation and security, and infrastructure development.

Mr. Russo holds a BS degree from the State University of New York (SUNY) in Political Science, with interdisciplinary studies in Government and Labor.

Paul Weiss, University of California, Los Angeles

Paul S. Weiss holds a UC Presidential Chair and is a distinguished professor of chemistry & biochemistry and of materials science & engineering at the University of California, Los Angeles (UCLA). He received his SB and SM degrees in Chemistry from MIT in 1980 and his PhD in Chemistry from the University of California at Berkeley in 1986. He was a postdoctoral member of technical staff at Bell Laboratories from 1986–88 and a visiting scientist at IBM Almaden Research Center from 1988–89. He served as the Director of the California NanoSystems Institute and held the Fred Kavli Chair in NanoSystems Sciences at UCLA from 2009–14. Before coming to UCLA, he was a Distinguished Professor of Chemistry and Physics at the Pennsylvania State University, where he began his academic career in 1989. His interdisciplinary research group includes chemists, physicists, biologists, materials scientists, mathematicians, electrical and mechanical engineers, computer scientists, clinicians, and physician scientists. They focus on the ultimate limits of miniaturization, exploring the atomic-scale chemical, physical, optical, mechanical, and electronic properties of surfaces, interfaces, and supramolecular assemblies. Two major themes in his laboratory are cooperativity in functional molecules and single-molecule/assembly biological structural and functional measurements. He has written over 400 publications, holds over 30 patents, and has given over 700 invited, plenary, keynote, and named lectures.

Dr. Weiss has been awarded an NSF Presidential Young Investigator Award (1991–96), the Scanning Microscopy International Presidential Scholarship (1994), the B. F. Goodrich Collegiate Inventors Award (1994), an Alfred P. Sloan Foundation Fellowship (1995–97), the American Chemical Society (ACS) Nobel Laureate Signature Award for Graduate Education in Chemistry (1996), a John Simon Guggenheim Memorial Foundation Fellowship (1997), a NSF Creativity Award (1997–99), the ACS Award in Colloid and Surface Chemistry (2015), the ACS Southern California Section Tolman Medal (2017), and the ACS Patterson-Crane Award in Chemical Information (2018), among others. He was elected a Fellow of the American Association for the Advancement of Science (2000), the American Physical Society (2002), the American Vacuum Society (2007), the ACS (2010), the American Academy of Arts and Sciences (2014), the American Institute for Medical and Biological Engineering (2016), the Canadian Academy of Engineering (2017), and an Honorary Fellow of the Chinese Chemical Society (2010). He was also elected a senior member of the IEEE (2009). He received Penn State's University Teaching Award from the Schreyer Honors College (2004), was named a Nanofabrication Fellow at Penn State (2005), and won the Alpha Chi Sigma Outstanding Professor Award (2007). He was a visiting professor at the University of Washington, Department of Molecular Biotechnology (1996–97) and Kyoto University, Electronic Science and Engineering Department and Venture Business Laboratory (1998 and 2000), and a distinguished visiting professor at the Kavli Nanoscience Institute and the Joint Center for Artificial Photosynthesis at Caltech (2015). He is a visiting scholar at the Kavli Institute for Bionano Science & Technology and the Wyss Institute for Biologically Inspired Engineering at Harvard University (2015–18). He held the Institut National de la Recherche Scientifique (INRS) Chaire d'excellence Jacques Beaulieu at the Centre for Energy, Materials and Telecommunications (2016–17) and was a Fulbright Specialist for the Czech Republic (2017). Dr. Weiss was a member of the U.S. National Committee to the International Union of Pure and Applied Chemistry (2000–05). He has been the technical co-chair of the Foundations of Nanoscience Meetings, thematic chair of the Spring 2009 and Fall 2018 ACS National Meetings. He was the senior editor of *IEEE Electron Device Letters* for molecular and organic electronics (2005–07) and is the founding editor-in-chief of *ACS Nano* (2007–). At *ACS Nano*, he won the Association of American Publishers, Professional Scholarly Publishing PROSE Award for 2008, Best New Journal in Science, Technology, and Medicine, and ISI's Rising Star Award a record ten times.

Keynote

Chad A. Mirkin, Northwestern University

Chad A. Mirkin is the Director of the International Institute for Nanotechnology and the George B. Rathmann Professor of Chemistry, Chemical and Biological Engineering, Biomedical Engineering, Materials Science & Engineering, and Medicine at Northwestern University. He is a chemist and a world-renowned nanoscience expert who is known for his discovery and development of spherical nucleic acids (SNAs) and SNA-based biodetection and therapeutic schemes, dip-pen nanolithography (DPN) and related cantilever-free nanopatterning methodologies, on-wire lithography (OWL) and co-axial lithography (COAL), and contributions to supramolecular chemistry and nanoparticle synthesis. Dr. Mirkin received his BS degree from Dickinson College (1986) and a PhD degree from the Penn State University (1989). He was an NSF Postdoctoral Fellow at MIT prior to becoming a professor at Northwestern University in 1991. He has authored over 790 manuscripts and over 1,200 patent applications worldwide (over 360 issued) and founded multiple companies, including AuraSense, Excure, TERA-print, and Azul 3D. Dr. Mirkin has been recognized with over 230 national and international awards, including the Kabiller Prize in Nanoscience

and Nanomedicine, the SCI Perkin Medal, the Wilhelm Exner Medal, the RUSNANOPRIZE, the Dan David Prize, and the Sackler Prize in Convergence Research. He served for eight years on the President's Council of Advisors on Science and Technology, and he is one of very few scientists to be elected to all three U.S. National Academies. Dr. Mirkin has served on the Editorial Advisory Boards of over 20 scholarly journals, and he is the founding editor of the journal *Small*. At present, he is an Associate Editor of *Journal of the American Chemical Society* and a *Proceedings of the National Academy of Sciences* Editorial Board Member. He has given over 740 invited lectures and educated over 290 graduate students and postdoctoral fellows, of whom over 110 are now faculty members at top institutions around the world.

Closing Discussion

J. Alexander Liddle, National Institute of Standards and Technology

J. Alexander Liddle is Scientific Director of the Microsystems and Nanotechnology Division at the National Institute of Standards and Technology (NIST). He received his BA and DPhil degrees in Materials Science from the University of Oxford. After his appointment in 1990 as a postdoctoral fellow at Bell Laboratories, he spent the next decade there, where his primary efforts were directed towards the research, development, and eventual commercialization of a novel electron-beam lithography technology. He then spent four years at Lawrence Berkeley National Laboratory in the Center for X-ray Optics, and then as Lead Scientist of the Nanofabrication Facility in the Molecular Foundry.

At NIST, his division works in a variety of areas, ranging from quantum nanophotonics to biology. His personal research focus is on nanofabrication and self-assembly for nanomanufacturing. He has published over 275 papers in areas ranging from electron-beam lithography to DNA-controlled nanoparticle assembly and holds 19 U.S. patents. He is a Fellow of the APS and the Washington Academy of Sciences, and a member of the AVS and the Materials Research Society (MRS). He has served on numerous advisory and program evaluation committees, including those for NSF, DOE, and the Semiconductor Research Corporation, and is a member of the program committees of several advanced patterning technology conferences.

Anil Patri, U.S. Food and Drug Administration

Anil Patri serves as the Chair, Nanotechnology Task Force and Director of Nanocore, National Center for Toxicological Research, U.S. Food and Drug Administration. His laboratory is very active in regulatory science research to understand material characteristics, safety, and efficacy of products containing nanomaterial, and provides training to scientists and reviewers at FDA. He serves on the U.S. National Nanotechnology Initiative NSET Subcommittee and NSET's Nanotechnology Environmental and Health Implications (NEHI) Working Group for interagency coordination. He is a member of the International Organization for Standardization (ISO) Technical Committee (TC) 229 (Nanotechnologies) and serves on the executive committee of ASTM International Committee E56 to facilitate standards development in nanotechnology. He co-chairs the EU-U.S. Nanomedicine and Characterization Communities of Research.

Prior to joining FDA in 2014, Dr. Patri served as the Deputy Director, Nanotechnology Characterization Laboratory (NCL) at the National Cancer Institute. In a decade-long tenure at NCL, he assisted collaborators from industry and academia towards clinical translation of drug products utilizing nanotechnology. From 2006–2014, he also served as a guest scientist at the National Institute of Standards and Technology. Dr. Patri developed nanotechnology-based targeted drug delivery and imaging agents

for cancer until 2004 at the Center for Biologic Nanotechnology, University of Michigan Medical School. He obtained his PhD from the University of South Florida, conducting basic research on dendritic nanomaterials.

Dr. Patri is a principal investigator on several ongoing research projects and a co-author of over 70 peer-reviewed publications.

Emilie Siochi, National Aeronautics and Space Administration

Emilie "Mia" Siochi is a senior materials scientist in the Advanced Materials and Processing Branch at the National Aeronautics and Space Administration (NASA) Langley Research Center in Hampton, Virginia. Her research interests include structural nanomaterials, bioinspired materials, extreme temperature materials, repurposable structural materials, self-healing materials, antifouling engineered surfaces, and energy harvesting. She has been involved in emerging materials research for the past 20 years. She coordinates efforts across academia, industry, and NASA to advance the manufacturing and technology readiness maturation of structural carbon nanotubes for aerospace applications. Her team is actively involved in the development of processing methods to capitalize on retention of unique nanoscale properties of carbon nanotubes in macroscale structural aerospace articles. Dr. Siochi holds a BS in Chemistry from the Ateneo de Manila University in the Philippines and an MS in Chemistry and a PhD in Materials Engineering Science, both from Virginia Tech.