# Panel on Assessment of Energy Sciences

## Committee

## Levi T. Thompson

**Chair**

LEVI THOMPSON (NAE) is the Dean of the College of Engineering and Elizabeth Inez Kelley Professor of Chemical Engineering at the University of Delaware (UD). Before joining UD, Dr. Thompson was the Richard Balzhiser Professor of Chemical Engineering and Professor of Mechanical Engineering at the University of Michigan. He also served as Associate Dean for Undergraduate Education, Director of the Hydrogen Energy Technology Laboratory, and Director of the Michigan-Louis Stokes Alliance for Minority Participation. Dr. Thompson's research focuses on nanomaterials for catalytic and energy storage applications, and he is an author on more than 150 publications and co-inventor on more than 10 patents. He was elected as a member of the National Academy of Engineering and Fellow of the American Institute of Chemical Engineers and is recipient of awards including a 2006 Michiganian of the Year Award for his research, entrepreneurship, and teaching, and NSF Presidential Young Investigator Award. Dr. Thompson currently serves as an Associate Editor of the Proceedings of the National Academy of Sciences (PNAS) Nexus and on the Editorial Board of the Annual Review of Chemical and Biomolecular Engineering. He is an experienced consultant, and co-founder and founding CEO of T/J Technologies, a developer of nanomaterials for advanced batteries (acquired by A123 Systems). Dr. Thompson earned a B.S. in chemical engineering from the University of Delaware (1981), and an M.S. in chemical and nuclear engineering and Ph.D. in chemical engineering, both from the University of Michigan.

## Hector D. Abruna

**Member**

HECTOR D. ABRUÑA (NAS) is the Emile M. Chamot Professor of Chemistry at Cornell University. His group performs cutting-edge, interdisciplinary research to address problems of electrochemical interest, from fundamental studies of battery and fuel cell systems to molecular electronics. The group employs standard electrochemical techniques in addition to X-ray methods, scanned probe microscopies, nanoscale fabrication, electron microscopy, and a variety of spectroscopic techniques. The group also synthesizes novel, tailored inorganic complexes and organic battery materials to drive discovery of new chemical and electrochemical properties. Dr. Abruña is an AAAS Fellow and recipient of a Presidential Young Investigator Award, an Alfred P. Sloan Foundation Research Fellowship, a John S. Guggenheim Fellowship, the Tajima Prize of the International Society of Electrochemistry, a J. W. Fulbright Senior Research Fellow-ship and an Iberdrola Fellowship. Dr. Abruña completed his B.S. and M.S. at Rensselaer Polytechnic Institute, his Ph.D. with Royce W. Murray and Thomas J. Meyer at the University of North Carolina at Chapel Hill (1980), and was a postdoctoral research associate with Allen J. Bard at the University of Texas at Austin.

# Darren Bleuel

**Member**

DARREN BLEUEL is a staff scientist at Lawrence Livermore National Laboratory (LLNL), whose current research focuses primarily on neutron reactions. He performs direct neutron scattering and fission cross section measurements with the Gamma Energy Neutron Energy Spectrometer for Inelastic Scattering (GENESIS) at LBNL, indirect determination of neutron absorption cross sections through measurement of gamma strength functions and nuclear level densities, neutronics simulations with MCNP, and neutron/gamma-ray spectroscopy. Dr. Bleuel received his doctorate from the University of California, Berkeley (UCB), designing an optimal moderated neutron spectrum for Boron Neutron Capture Therapy. He then served as a postdoctoral researcher at the Lawrence Berkeley National Laboratory (LBNL) developing a deuteron-breakup facility at the 88-Inch Cyclotron. Subsequently, as a postdoc at Lawrence Livermore National Laboratory, he developed and led the neutron activation diagnostic program at the National Ignition Facility, which provided the first indication of implosion asymmetries. In 2012, Dr. Bleuel was awarded a highly competitive and prestigious “UCOP Management Fee” grant. Through this grant, he formed and led a team of graduate students, postdocs, research staff, and a number of undergraduates at the University of California at Berkeley, investigating high energy density plasma effects on nuclear reactions in astrophysical environments. This now-concluded effort formed a long-lasting collaboration between LLNL, LBNL, and UCB spanning a wide variety of nuclear physics fields, through which he continually mentors 2-5 students each year. Dr. Bleuel holds a B.S. (1993), M.S. (1997), and Ph.D. (2003) in nuclear engineering from the University of California at Berkeley.

## Ruyan Guo

**Member**

RUYAN GUO is Robert E. Clarke Endowed Professor of Electrical Engineering, University of Texas at San Antonio (UTSA). Prior to joining the faculty of UTSA in 2007, Dr. Guo was a tenured professor of Electrical Engineering of The Pennsylvania State University, being the first woman at the rank of a tenured full professor in the department history. Dr. Guo conducts cutting edge research in interdisciplinary areas of electronic and optoelectronic materials and devices, more recently on multiferrocis, lead-free electronic ceramics, and piezoelectric resonance controlled phenomena, with immense potential in sensor, actuator, and biomedical applications. Over the years Dr. Guo, as a PI or a Co-PI, has been awarded multiple research grants by the National Science Foundation, Department of Defense, Defense Advanced Research Projects Agency, and industries. She has guided more than 60 graduate students to completion in Masters' and Doctorate Research. She is the author/co-author of some 400+ technical publications and the editor/co-editor of 22 transaction books and professional proceeding volumes. Her contributions to the understanding of polarization phenomena in ferroelectric solid-solution systems have been well recognized in the research community. Dr. Guo currently serves as the director for UTSA's Interdisciplinary Graduate Program in Advanced Materials Engineering. Her leadership and professional services also include Director of a NSF funded Research Experience for Undergraduates Site program at the Dept. of EE, Penn State (2003-08); elected Division Chair (2002-03) and then the elected Division Trustee (2006-09) of the Electronics Division, ACerS; an elected member of the AdCom of IEEE-UFFC (2006-08) representing the ferroelectric community; Chair (interim), UTSA Dept. of Electrical and Computer Engineering (2010-12), founding Director (Interim) UTSA Chemical Engineering Program (2016-17). Dr. Guo is also active in the American Association for the Advancement of Science, American Society for Engineering Education, Materials Research Society, American Ceramic Society and Society of Women Engineers, for which she serves as faculty advisor since 2008. Dr. Guo holds both a B.S. (1982) and M.S. (1984) in electrical engineering from Xi'an Jiaotong University from Xi'an Jiaotong University and a Ph.D. in solid state science from The Pennsylvania State University (1990).

## Herbert L. Hess

**Member**

HERBERT HESS is Professor in the Electrical Engineering Department at the University of Idaho. His research is in the area of power electronic converters, great and small. These range from projects in wind turbine converters to motor drives to small power supplies to microbattery chargers. Each system has a need for converting power into a different form or level. Power electronics is often the preferred means to do this. Ongoing projects are the following: Power conversion circuits in CMOS SOI, High voltage CMOS silicon on insulator (SOI) switching devices, hybrid electric vehicle power conversion and drive systems, modeling and design of protection for matrix converters, innovative and compact battery chargers and monitors, distributed power generation and electronic conversion: wind, water, fuel cell, solar, flywheel, and power quality. Dr Hess holds a Ph.D. in electrical engineering from the University of Wisconsin-Madison (1993) and received his P.E. from the Commonwealth of Virginia (1984). He served in the US Army for 32 years in both active duty and Reserve assignments, including the US Military Academy faculty, CECOM-RDEC at Fort Monmouth, and ARL.

# Yongjie Hu

**Member**

YONGJIE HU is a professor and vice chair in the Department of Mechanical and Aerospace Engineering at the University of California, Los Angeles (UCLA). Renowned for his exceptional research contributions, he leads a cutting-edge research lab that exploits interdisciplinary experimental and theoretical approaches to investigate energy transport mechanisms and device applications. His current research interest emphasizes on the development of advanced materials, experimental metrologies, and computational methodologies, to better understand and characterize energy processes. His groundbreaking research achievements include the pioneering discovery of new energy materials, notably the semiconductor boron arsenide, which boasts the highest thermal conductivity among all semiconductors and metals. His research has been recognized by diverse esteemed societies, including Alfred P. Sloan Research Fellowship, ASME Bergles-Rohsenow Young Investigator Award, National Science Foundation’s CAREER Award, U.S. Air Force Young Investigator Award, and Watanabe Excellence in Research Award. He is also an alumnus of NAE FOE. Prior to joining the faculty of UCLA, Professor Hu earned his Ph.D. degree from Harvard University and received postdoctoral fellowship at Massachusetts Institute of Technology.

# C. Kumar N. Patel

**Member**

C. KUMAR N. PATEL (NAS/NAE) is the founder, CEO, and president of the board of Pranalytica, Inc., a Santa Monica-based company that is commercializing high-power quantum cascade lasers and highly sensitive and selective trace gas sensors for commercial, homeland security, and defense markets. He is also a distinguished professor at the University of Central Florida, as well as emeritus professor of physics, chemistry, and electrical engineering at University of California, Los Angeles (UCLA). From March 1993 to December 1999, he was the vice chancellor of research at UCLA. Until joining UCLA in March 1993, he was Executive Director, Research, Materials Science, Engineering, and Academic Affairs Division at AT&T Bell Laboratories, Murray Hill, New Jersey. Under his leadership, Bell Labs produced some of the most critical technologies for optical communications. He is the inventor of the carbon dioxide laser and other high power gas lasers. His work at AT&T Bell Laboratories led to the creation of the field of high-power molecular lasers, infrared nonlinear optics, ultra-small absorption measurement techniques for gases, solids, and liquids, and laser surgery. He has authored/co-authored over 270 publications and has been awarded 55 U.S. patents. He received the National Medal of Science given by the President of the United States in 1996. In 2012, he was inducted into the National Inventors' Hall of Fame. In recognition of the CO2 laser's importance to the medical field, he was elected as an honorary member of the Gynecologic Laser Surgery Society in 1980, and in 1985 he was elected an honorary member of the American Society for Laser Medicine and Surgery. In 2018, the American Laser Study Club established the Kumar Patel Prize for Laser Surgery in honor of his invention of the carbon dioxide laser and its critical importance in laser surgery. He was named the first recipient of the Prize. He is the past president of the American Physical Society (1995) and Sigma Xi, The Scientific Research Society (1993-1995). He co-chaired (with N. Bloembergen) the American Physical Society Study of the Science and Technology of Directed Energy Weapons. Dr. Patel received his B.E. in telecommunications from the College of Engineering in Poona, India (1958) and his M.S. and Ph.D. degrees in electrical engineering from Stanford University (1959 and 1961, respectively).

# Shad Roundy

**Member**

SHAD ROUNDY is an Associate Professor in the Department of Mechanical Engineering and an adjunct Associate Professor in the Department of Electrical and Computer Engineering at the University of Utah. He is the director of the Integrated Self-Powered Sensing lab at the University of Utah, which focuses on energy harvesting, wireless power transfer, and more generally applications of ubiquitous wireless sensing. After receiving his PhD in Mechanical Engineering from the U.C. Berkeley, Dr. Roundy moved to the Australian National University where he was a senior lecturer in the Systems Engineering Department. He spent the next several years working with startup companies LV Sensors and EcoHarvester developing MEMS pressure sensors, accelerometers, gyroscopes, and energy harvesting devices. In 2012, he joined the mechanical engineering faculty at the University of Utah. Dr. Roundy’s research has been funded by the National Science Foundation (NSF) (including the CAREER award), private industry, the National Aeronautics and Space Administration, and private foundations. He is a member of the NSF funded ASSIST Engineering Research Center (https://assistcenter.org/). He is an associate editor for Smart Materials and Structures and the International Journal of Precision Engineering and Manufacturing-Green Technology. Dr. Roundy holds a B.S. in mechanical engineering, Brigham Young University (1996), an M.S.in mechanical engineering, University of California, Berkeley (2000), and a Ph.D. in mechanical engineering, University of California, Berkeley (2003).

# Christine A. Wang

**Member**

CHRISTINE A. WANG (NAE) is a senior staff member in the Laser Technology and Applications Group at MIT Lincoln Laboratory, pursuing research in the optimization of III-V semiconductor materials for advanced optoelectronic devices. She pioneered the concepts used in the design of high-performance OMVPE (organometallic vapor phase epitaxy) reactors; led the investigation and use of nonconventional chemical compounds to enable epitaxial growth of high-quality metastable antimonide-based III-V semiconductors; and advanced the state of the art in the epitaxial growth of gallium arsenide-, gallium antimonide-, and indium phosphide-based optoelectronic devices, including diode lasers, quantum cascade lasers, and thermophotovoltaic cells. Dr. wang’s current research is focused on the development of high-power, continuous-wave quantum cascade lasers emitting in the long-wave infrared wavelength region. She has authored or coauthored more than 170 publications; has been granted eight patents; has given numerous invited talks at national and international conferences; and edited one book. She has chaired and organized numerous national and international conferences related to epitaxial crystal growth and mid-infrared materials. Dr. Wang received the 2017 American Association for Crystal Growth Award for her contributions to epitaxial crystal growth of III-V compound semiconductors and the design of high-performance OMVPE reactors and served as program co-chair for the International Conference on Crystal Growth and Epitaxy in 2019. Dr. Wang is currently a member of the National Academy of Engineering, the Executive Committee for the American Association of Crystal Growth, the International Advisory Committee for the International Conferences on Metalorganic Vapor Phase Epitaxy, the Electronic Materials Conference Committee, and a fellow of the National Academy of Inventors. She has also served as a mentor to many staff members at the Laboratory and advised numerous MIT undergraduate and graduate students. Dr. Wang holds an S.B. (1977), M.S. (1978), and Ph.D. (1984) degrees in materials science and engineering from MIT.