

A Third DMMI Workshop Series: Workshop on What Does Quantum Exploration Bring to New Materials Design

Committee

Haydn N. Wadley

Chair

HAYDN WADLEY is the University Professor and the Edgar A. Starke Professor of Materials Science and Engineering at the University of Virginia in Charlottesville, Virginia. He has very broad interests in materials science, mechanics and thermal transport. His current research explores high temperature thermal protection systems (thermal barrier coatings, liquid metal heat plates for hypersonic vehicle leading edges, jet blast deflectors) and new materials for the mitigation of high intensity dynamic loads (ballistic and blast protection materials and structures). He has addressed many fundamental questions associated with the atomic assembly of nanoscopic materials from the vapor phase, the topological structuring of cellular materials and the processing of high performance composites. These fundamental studies have been used to develop models and numerical simulations that reveal the linkages between a materials composition/synthesis and its performance. Some of these models have been coupled with in-situ (ultrasonic and electromagnetic) sensors and nonlinear, feedback control algorithms to implement intelligent process control concepts. He has invented and commercialized several vapor deposition technologies that enable the growth of novel thin films and coatings, and numerous multifunctional cellular materials including those that support stress whilst also serving as impact energy absorbers, heat exchange media, electro-chemical power storage systems or shape morphing structures. His research group has spun out two companies; one that develop novel coatings and another that manufactures high performance cellular materials. He has served on the Defense Science Board's Summer Study, and is a current member of the Defense Materials, Manufacturing and Infrastructure Committee and the National Materials and Manufacturing Board. He has been a member of the Defense Science Research Council since 1998 and led studies on a wide variety of topics including Jungle Warfare Technology, Exploitation of Space, Counter Ambush Technologies, Blast Injury Mitigation, Novel Concepts for Protection from EFP's, Compact Power Systems, Electrotextiles, Countermeasures to Non Traditional Threat Agents, and Technologies for Stabilization, Reconstruction and Humanitarian Relief Operations. He has published 448 papers, co-authored a book on cellular materials, holds 21 US patents, and is a fellow of the American Society for Materials.

Robert Hull

Member

ROBERT HULL is the head of the Materials Science and Engineering Department and the Henry Burlage Professor of Engineering at Rensselaer Polytechnic Institute. Prior to that he spent about a decade at Bell Laboratories in the Physics Research Division, and twelve years at the University of Virginia, where he was the director of an NSF MRSEC Center and director of the UVA Institute for Nanoscale and Quantum Science. He received his Ph.D. in materials science from Oxford University in 1983. Hull is highly active in engineering and materials science societies and professional groups. He is a fellow of the American Physical Society and of the Materials Research Society, and in 1997 served as president of the Materials Research Society. He has also chaired a Gordon Research Conference on Thin Films, and chaired the Committee of Visitors for the National Science Foundation's Division of Materials Research. Within the realms of materials and nanoscience, Hull's research focuses on the relationships between structure and property in electronic materials, fundamental mechanisms of thin film growth, and the self-assembly of nanoscale structures. Other areas of interest include degradation modes in electronic and optoelectronic devices, the properties of dislocations in semiconductors, nanoscale fabrication techniques, nanoscale tomographic reconstruction techniques, development of new nanoelectronic architectures, and the theory and application of electron and ion beams.

E. Ward Plummer

Member

WARD PLUMMER (NAS) is a professor of physics and a special assistant to the Vice Chancellor for Research at Louisiana State University. Plummer worked as a postdoctoral student with NIST, was the William Smith Professor of Physics at the University of Pennsylvania, and also became the director of the Materials Research Laboratory in 1990. He was joint appointed to the University of Tennessee as a distinguished professor and to Oak Ridge National Laboratory as a distinguished scientist. Plummer has served on many national and international committees both to review existing scientific programs and to identify future directions for science and technology. Plummer has served as chair of DOE-sponsored Workshop on "Soft X-Ray Science in the Next Millennium: The Future of Photon-In/Photon-Out Experiments", Pikeville, Tennessee, March 15-18, 2000. He was the chair of DOE-BESAC (Basic Energy Sciences Advisory Committee) subpanel for the evaluation of the Intense Pulsed Neutron Source (IPNS) at Argonne National Laboratory and the Los Alamos Neutron Science Center (LANSCE) Manuel Lujan Jr. Neutron Scattering Center. He served as a member of the DOE-Basic Energy Sciences Advisory Committee, 2001-2007. Plummer chaired the Chinese Academy of Science Expert Assessment Committee of the Institute of Physics in Beijing, December 2013.

Stephen Rossnagel

Member

STEPHEN ROSSNAGEL, is currently a visiting professor in the Department of Materials Science and Engineering at the University of Virginia. Prior to that role, he spent 35 years at the IBM T.J. Watson Research Center in Yorktown Heights. While at IBM, he was most recently in the Quantum Computing hardware group, focusing on Qubit integration and fabrication, materials and processes. Prior projects included a large effort on DNA Nanopore devices and many years working on interconnect materials; device integration and fabrication; nanometer-scale films and devices; including basic work on the size, effect, and the development of novel sputtering technologies, several of which are in broad manufacturing usage at virtually all semiconductor manufacturers. Prior to IBM, he held a visiting scientist position at the Max Plank institute in Garching and was on the faculty at Princeton University in the Plasma Physics program. He has received the Peter Mark Award, the R. Bunshah Award, fellow and honorary member awards from the AVS, along with internal IBM awards for I-PVD, silicides, and DNA technology. He has chaired the International Conference on Thin Films, the Annual Symposium of the AVS, was a founder of the Atomic Layer Deposition Conference, and served as president and later treasurer of the AVS. He has published more than 150 manuscripts (45% first author, h-factor = 58), six edited or authored books, was the series editor for two book series (Noyes, Academic), and has been granted 154 U.S. and international patents.

Susan B. Sinnott

Member

SUSAN SINNOTT is a professor and department head of Materials Science and Engineering at Pennsylvania State University. She received her B.S. in chemistry from the University of Texas at Austin and her Ph.D. in physical chemistry from Iowa State University. She was a National Research Council Postdoctoral Associate at the Naval Research Laboratory and was on the faculty at the University of Kentucky prior to joining the University of Florida (UF) in 2000. Susan's research is focused on the use of electronic structure calculations and atomistic simulations to optimize the processing and properties of materials. Her research interests include examining the chemical modification of polymer surfaces through mass-selected ion-beam deposition, exploring the dynamics associated with the growth of thin films; developing new methodologies for the atomistic simulation of materials; using atomic-scale simulations to study the catalytic behavior of metal clusters; investigating the molecular origin of friction and wear at interfaces; and combining electronic structure and thermodynamic calculations to predict defect formation in metal oxides. Susan is the author of over 160 technical publications, including over 140 journal publications and eight book chapters; she has also delivered over 120 invited presentations. She is a member of the American Vacuum Society (AVS), American Ceramic Society (ACerS), American Chemical Society (ACS), American Physical Society (APS), Materials Research Society (MRS), and American Association for the Advancement of Science (AAAS), and was named a fellow of AVS in 2005. She was named a fellow of ACerS in 2011 and a fellow of the AAAS in 2010.

Edwin L. Thomas

Member

EDWIN L. THOMAS [NAE] is the William and Stephanie Sick Dean of the George R. Brown School of Engineering at Rice University. He holds joint appointments in the Departments of Materials Science and Nanoengineering and Chemical and Biomolecular Engineering and collaborates with scientists and engineers in the Richard E. Smalley Institute for Nanoscale Science and Technology at Rice. Thomas is a materials scientist and mechanical engineer and is passionate about promoting engineering leadership and student design competitions. His research is currently focused on using 2D and 3D lithography, direct-write and self-assembly techniques for creating metamaterials with unprecedented mechanical and thermal properties. Thomas is the former head of the Department of Materials Science and Engineering at the Massachusetts Institute of Technology, a position he held from 2006 until his appointment at Rice in July 2011. He was named Morris Cohen Professor of Materials Science and Engineering in 1989 and is the founder and former director of the MIT Institute for Soldier Nanotechnology (2002-2006). Before joining MIT, Thomas founded and served as co-director of the Institute for Interface Science and was head of the Department of Polymer Science and Engineering at the University of Massachusetts. He is a recipient of the 1991 High Polymer Physics Prize of the American Physical Society and the 1985 American Chemical Society Creative Polymer Chemist award. He was elected to the National Academy of Engineering and the American Academy of Arts and Sciences in 2009, Inaugural Fellow of the Materials Society in 2008, fellow of the American Association for the Advancement of Science in 2003 and fellow of the American Physical Society in 1986. He wrote the undergraduate textbook, *The Structure of Materials*, and has coauthored more than 420 papers and holds 16 patents. Thomas received a B.S. in mechanical engineering from the University of Massachusetts and his Ph.D. in materials science and engineering from Cornell University.

Elias Towe

Member

ELIAS TOWE, is the Grobstein Professor of Materials Science and Engineering and Professor of Electrical and Computer Engineering at Carnegie Mellon University. He is also part of the Pittsburgh Quantum Institute. Towe's group pursues research in basic optical and quantum phenomena in materials for applications in novel photonic devices that enable a new generation of information processing systems for communication, computation, and sensing. Towe's current focus is on the use of phenomena (such as three-dimensional quantum-confinement effects in nanometer-scale structures) in the study of novel devices. Examples include: quantum-dot infrared detectors and imaging sensors, electrically-pumped photonic crystal micro-cavity lasers with quantum-dot active regions, multi-spectral solar energy conversion devices, plasmonic bio-sensors, and fluorescence bio-sensing devices. Prof. Towe was educated at the Massachusetts Institute of Technology (MIT) where he received the S.B., S.M., and Ph.D. degrees from the Department of Electrical Engineering and Computer Science, where he was also a Viton Hayes Fellow.

Alan E. Willner

Member

ALAN E. WILLNER [NAE] is the Steven and Kathryn Sample Chaired Professor in Engineering in the Ming Hsieh Department of Electrical Engineering of the Viterbi School of Engineering at the University of Southern California. Prof. Willner has been: a visiting professor at Columbia University, the University College London, and the Weizmann Institute of Science; and a visiting scholar at Yeshiva University. He is a member of the U.S. Army Science Board, was a member of the Defense Sciences Research Council (a 16-member body that provides reports to the DARPA Director and Office Directors), has served on many scientific advisory boards for small companies, and has advised several venture capital firms. Additionally, Prof. Willner was founder and CTO of Phaethon Communications. He received a Ph.D. (1988) in Electrical Engineering from Columbia University, as well as a B.A. (1982) in Physics and an Honorary Degree (Honoris Causa, 2012) from Yeshiva University. He has received many awards some of which are: member of the U.S. National Academy of Engineering, International Fellow of the U.K. Royal Academy of Engineering, Presidential Faculty Fellows Award from the White House, IEEE Eric E. Sumner Award, John Simon Guggenheim Foundation Fellowship, David & Lucile Packard Foundation Fellowship in Science & Engineering. Professor Willner has more than 1300 publications, including one book, nine edited books, more than 35 U.S. patents, more than 39 keynotes/plenaries, more than 23 book chapters, more than 375 refereed journal papers, and more than 225 invited papers/presentations. His research is in optical technologies, including: communications, signal processing, networks, and subsystems.

Rudy Wojtecki

Member

RUDY WOJTECKI is a research staff member at the IBM Almaden Research Center. Dr. Wojtecki has over a decade of experience in polymer chemistry, with a focus on polymer synthesis and electronic materials. Ongoing research on applied materials for lithography and patterning schemes in semiconductor manufacturing. Recent work centers the development of new selective deposition schemes using atomic layer deposition and optimization of existing patterning materials. In addition, continued contributions to this field provides significant experience in the patent process, he is co-inventor on over 30 issued patents and recognized as a 2017 IBM Master Inventor. He recently completed the Massachusetts Institute of Technology professional certificate program in applications of quantum computing.