

High Temperature Materials Systems, Emerging Applications, Materials and Science Gaps: A Workshop

Committee

Carlos Levi

Chair

CARLOS LEVI (Chair) is the associate chair of the materials department and the Departmental Graduate Advisor at University of California Santa Barbara. He holds Ph.D. (1981) and M.Sc. (1977) degrees in metallurgical engineering from the University of Illinois at Urbana-Champaign, as well as a degree in chemical engineering from the Universidad Autónoma de Nuevo Leon, México (1972). Professor Levi joined the faculty at the University of California, Santa Barbara, in 1984 and is currently Mehrabian Distinguished Professor of Materials. The overarching theme of his research is the understanding of the microstructure of materials and its evolution during processing and service, with emphasis on the performance and durability of structural materials at high temperature and in severe environments. His expertise in materials processing includes physical vapor deposition, powder processing and solidification technologies, fabrication processes for inorganic composites, and synthesis of inorganics from precursors. His research is currently funded by NSF, ONR, NASA, Honeywell Aerospace, Pratt & Whitney and Siemens Corporate Technology. He has extensive industrial interactions as leader of the NSF/FRG/Goali program with GE Research and the Honeywell-UCSB Alliance on Thermal Barrier Coatings, is co-PI in the Pratt & Whitney Center of Excellence in Ceramic Composites, and is also in the Siemens-UCSB initiative on High Temperature Oxide Composites and Coatings. He is a participant in the Center for Multifunctional Materials and Structures and the Institute for Energy Efficiency at UCSB. He is a fellow of the American Ceramic Society (2012) and a member of the The Minerals, Metals and Materials Society (TMS), where he currently serves in the Committee on Public and Governmental Relations. He is also a member of the American Ceramic Society, ASM International, and the Materials Research Society. He has served in the board of Review of Metallurgical and Materials Transactions and the editorial board of Materials Science and Engineering. He is a member of the Arconic Power and Propulsion Technology Advisory Board, a consultant for Pratt & Whitney and CRAFTech, and periodically serves as a consultant for GE Research, GE Aviation and various other organizations.

Brent Carey

Member

BRENT CAREY is a senior materials scientist at Battelle, where he works on carbon-carbon materials. His current efforts are focused on carbon-carbon composites and other ultra high-temperature materials for hypersonic applications including the setup of a high temperature materials R&D lab, and leading the Manufacturing of Carbon-Carbon Composites for Hypersonic Applications (MOC3HA) program through AFRL. Prior to Battelle he worked at Owens Corning as a program leader for advanced manufacturing. At Corning the activities comprised of individual projects spanning investment in automation technologies, material sourcing initiatives, product form innovation, and production efficiency gains enabled by advanced manufacturing analytics. He was also a global portfolio leader for the composites business with accountability spanning new products, processes, and business development opportunities globally and regionally. He also coordinated, led, and served as gatekeeper in project gate reviews with senior leadership and participated in long range planning. He was also a fellow of the NASA graduate student researchers program and a recipient of the "Sallyport Award", the highest commencement award given by the Association of Rice Alumni as well as a NASEM Christine Mirzayan Fellow.

Dianne Chong

Member

DIANNE CHONG [NAE] is the retired vice president of Materials Assembly, Factory and Support Technology, an organization within Boeing Research and Technology, which is the company's central research and development unit. Dr. Chong's team provided materials and processes engineering and manufacturing support for Boeing, including the company's two major business units: Boeing Commercial Airplanes and Boeing Defense, Space and Security. Her team is responsible for providing non-destructive evaluation for programs such as the Boeing 787 Dreamliner. In addition, her organization researches and develops advanced assembly and integration concepts. Dr. Chong supports many professional societies and serves on several university boards and industry committees. She is a member TMS, AIAA, ASM International, SME, SWE, Beta Gamma Sigma, and Tau Beta Pi and is a commissioner to the Accreditation Board for Engineering and Technology (ABET). In 2010, she was presented with the Asian-American Executive of the Year Award by the Chinese Institute of Engineers, USA. An expert in metallurgical engineering, she holds a Ph.D. and master's degree in metallurgical engineering, and bachelor's degrees in biology and psychology from the University of Illinois at Urbana-Champaign. She also holds of an executive master's degree in Manufacturing Management from Washington University, and in 2017 she was elected to the National Academy of Engineering.

Katherine T. Faber

Member

KATHERINE T. FABER is the Simon Ramo Professor of Materials Science at Caltech. She is interested in the fracture of brittle materials as well as the mechanisms by which such materials can be toughened and strengthened through composite strategies such as gradients and designed topology, often using synchrotron radiation for internal stress measurement. Her studies comprise materials for energy-related applications including thermal and environmental barrier coatings for power generation components and porous solids for filters and flow. Her team is also developing an understanding of the solidification and the chemistry of freeze-casting systems, creating versatile pore topologies thereby expanding the use of porous materials for environmental and energy needs. Dr. Faber has also worked with the Art Institute of Chicago to establish the Northwestern University/Art Institute of Chicago Center for Scientific Studies in the Arts where advanced materials characterization and analytical techniques are used in support of conservation science. She has served on the Scientific Advisory Committee of the Advanced Photon Source at Argonne National Lab from 2005 to 2007, is a fellow of ASM International, and received the YWCA Achievement Award for Education in 1997. Her Ph.D. is in materials science from University of California at Berkeley, and her M.S. in ceramic science is from Penn State.

David B. Marshall

Member

DAVID B. MARSHALL [NAE] is a research professor with dual appointments in the College of Engineering and Applied Science and Mechanical Engineering at University of Colorado Boulder. His research interests are related to Materials Science; Design of Materials for High Temperature Structures; Modeling and Testing of Thermal, Mechanical and Environmental Responses; Processing/Properties of Ceramics and Ceramic Composites. His education is a Ph.D. Physics, from Monash University, Australia and a BSc (Hons. I) in Physics, from Monash University, in Australia. Current work at the university include oxide materials for battery applications and development of textilebased ceramic composite materials for use in power generation, aerospace propulsion systems, hypersonic flight, and thermal protection. Activities in the latter area include system performance analysis, composite microstructure design and processing, development of new material systems (oxide composites) for oxidation resistance, and advanced thermal, mechanical and environmental testing and modeling. Other research topics have included fracture phenomena, strengthening, toughening, environmental stability and reliability of advanced structural materials, with emphasis on ceramic and intermetallic matrix composites, ultra hard materials (cBN), transformationtoughened materials and monolithic ceramics.

Lourdes Salamanca-Riba

Member

LOURDES SALAMANCA-RIBA is a professor of materials science and engineering at the University of Maryland's Energy Innovation Institute. She received her B.S. in physics from the Universidad Nacional Autonoma de Mexico and her Ph.D. in physics from Massachusetts Institute of Technology. Dr. Salamanca-Riba's research is in the areas of: advanced manufacturing of 3D microstructures and their characterization using computational methods and data analysis; self-assembly of semiconductor nanowires and liquid crystal nanocomposites for hybrid photovoltaic applications; DNA-based biosensors and radiation sensors on GaAs; high carbon content nanocarbon materials called "covetics;" and wide band gap semiconductors for high power, high temperature electronics. Dr. Salamanca-Riba's research involves the use of the transmission electron microscopes and the atomic force microscope at the Advanced Imaging and Microscopy (AIM) Laboratory. She is a member of the American Physical Society (APS), the Electron Microscopy Society of America, and the Materials Research Society (MRS).

Subhash C. Singhal

Member

SUBHASH SINGHAL [NAE] retired as a Battelle Fellow and fuel cell director at the Department of Energy's Pacific Northwest National Laboratory (PNNL). Dr. Singhal also serves as adjunct professor in the Department of Materials Science and Engineering at the University of Utah. Dr. Singhal is a recognized expert in solid oxide fuel cells. He provides senior technical, managerial, and commercialization leadership to PNNL's fuel cell program. He joined the PNNL in 2000 after nearly 30 years leading fuel cell development at Siemens Power Generation (formerly Westinghouse Electric Corporation). He is a member of the National Academy of Engineering and a fellow of four professional societies: American Association for the Advancement of Science, American Ceramic Society, ASM International, and Electrochemical Society. He has authored and edited numerous scientific publications and has acquired many patents. He received a bachelor's degree in metallurgy from the Indian Institute of Science, a bachelor's in physics, chemistry, and mathematics from Agra University, India, an MBA from the University of Pittsburgh, and a PhD in materials science engineering from the University of Pennsylvania.

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). She was named a fellow of AVS in 2005, a fellow of ACerS in 2011, and a fellow of the AAAS in 2010.

Edwin L. Thomas

Member

EDWIN L. THOMAS [NAE] is the TEES Eminent Professor of Engineering in Materials Science and Engineering at Texas A&M University-College Station. He was previously the William and Stephanie Sick Dean of the George R. Brown School of Engineering at Rice University, where he held 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. Dr. 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.

Haydn N. Wadley

Member

HAYDN N.G. 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, and shape morphing structures. His research group has spun out two companies; these include one that develops 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 both 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 close to 700 papers, co-authored a book on cellular materials, holds 21 U.S. patents, and is a fellow of the American Society for Materials.

Erik B. Svedberg

Staff Officer

ERIK SVEDBERG is a senior program officer of the National Materials and Manufacturing Board at the National Academies of Science, Engineering and Medicine a position he has held since 2008. In this role, he works with experts from across the nation to develop, negotiate, and oversee scientific and technical advisory studies for federal agencies related to questions of materials science, manufacturing and engineering design. His previous and current activities at the National Academies includes work as a Study Director for; Materials Needs and R&D Strategy for Future Aerospace Propulsion Systems; Corrosion Research Grand Challenges; Opportunities in Protection Materials; Optics and Photonics, Essential Technologies for Our Nation; Review of the National Nanotechnology Initiative; Airport Passenger Screening; Frontiers of Materials Research, A decadal Survey; Participation by DOD in its Manufacturing USA Institutes; and High Performance Bolting Technology for Offshore Oil and Gas Operations. As well as overseeing workshops such as: Big Data in Materials Research and Development; Limited Affordable Low-Volume Manufacturing; Materials and Manufacturing Capabilities for Sustaining Defense Systems; New and Novel Processes that are on the Verge of Industrial Modernization; and Emerging Needs in Quantum-Enabled Systems. Dr. Svedberg has a decade of industry experience with both small and large companies in the materials science area and has been a guest researcher at NIST for several years. He has been awarded and overseen five research grants and has published over 80 scientific articles, been granted two patents and is cited over 1,600 times with an h-index of 22. His Ph.D. and masters are in materials science and he is a fellow of the American Association for the Advancement of Science (AAAS), the American Vacuum Society (AVS), and the Washington Academy of Science (WAS) including being their 2019 leadership in material science award recipient.