

## ALEXANDER A. BALANDIN

Distinguished Professor, Department of Electrical and Computer Engineering  
University of California Presidential Chair Professor  
Director, Phonon Optimized Engineered Materials (POEM) Center  
Director, Center for Nanoscale Science and Engineering (CNSE) Nanofabrication Facility  
Founding Chair, Materials Science and Engineering (MS&E) Program  
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### EDUCATION AND PROFESSIONAL PREPARATION

- Postdoctoral Research, University of California - Los Angeles, USA, 1997 – 1999
- Ph.D. in Electrical Engineering, University of Notre Dame, Notre Dame, USA, 1996
- M.S. in Electrical Engineering, University of Notre Dame, Notre Dame, USA, 1995
- M.S. in Applied Physics, Moscow Institute of Physics and Technology, Russia, 1991
- B.S. in Mathematics, Moscow Institute of Physics and Technology, Russia, 1989

### RESEARCH INTERESTS

Advanced materials and nanostructures for applications in electronics, optoelectronics and energy conversion; quantum computing, spintronics, emerging devices and alternative computational paradigms; Raman and Brillouin spectroscopy; graphene and low-dimensional van der Waals materials; phonon engineering and thermal transport; low-frequency electronic noise in materials and devices; electronic noise spectroscopy

### EMPLOYMENT HISTORY

- Director (2016 – present), Center for Nanoscale Science and Engineering (CNSE) Nanofabrication Facility, University of California, Riverside, California, USA
- Distinguished Professor (2016 – present), Department of Electrical and Computer Engineering, University of California, Riverside, California, USA
- University of California Presidential Chair Professor (2013 – present), Department of Electrical and Computer Engineering, University of California, Riverside, California, USA
- Founding Chair (2006 – 2011), Materials Science and Engineering Program, University of California, Riverside, California, USA
- Visiting Professor (2005 – 2006), Department of Engineering, University of Cambridge, Cambridge, United Kingdom
- Professor (2005 – 2016), Department of Electrical and Computer Engineering, University of California, Riverside, California, USA

- Associate Professor (2001 – 2005) Department of Electrical Engineering, University of California, Riverside, California, USA
- Assistant Professor (1999 – 2001), Department of Electrical Engineering, University of California, Riverside, California, USA
- Research Engineer (1997 – 1999), Electrical Engineering Department, University of California, Los Angeles, California, USA
- Research Associate (1996 – 1997), Department of Electrical Engineering, University of Nebraska, Lincoln, Nebraska, USA
- Research and Teaching Assistant (1993 – 1996), Department of Electrical Engineering, University of Notre Dame, Notre Dame, Indiana, USA
- Research Engineer (1991 – 1993), Moscow Institute of Physics and Technology, Dolgoprudny, Moscow, Russia
- Research Assistant (1989 – 1991), Institute of Radio-Engineering and Electronics, Russian Academy of Sciences, Moscow, Russia

## **SELECTED AWARDS AND RECOGNITIONS**

- Clarivate Analytics and Thomson Reuters Highly Cited Researcher, 2015 – present
- Deputy Editor-in-Chief, Applied Physics Letters (APL), 2016 – present
- Fellow of MRS – The Materials Research Society, 2014
- The MRS Medal – The Materials Research Society, 2013
- Fellow of IEEE – The Institute of Electrical and Electronics Engineering, 2013
- Fellow of APS – The American Physical Society, 2012
- Fellow of IOM3 – The Institute of Materials, Minerals and Mining, U.K., 2012
- Fellow of IOP – The Institute of Physics, U.K., 2012
- The Pioneer of Nanotechnology Award – IEEE, 2012
- Fellow of SPIE - The International Society for Optical Engineering, 2011
- Fellow of OSA - The Optical Society of America, 2011
- Invited Lecturer, IEEE Chapter, California, USA, 2010
- Semiconductor Research Corporation (SRC) Inventor Award, USA, 2009, 2010
- Distinguished Visiting Professor, Astrakhan State University, Russia, 2009
- Fellow of AAAS - The American Association for Advancement of Science, 2007
- Distinguished IEEE Lecturer, University of Texas, Arlington, USA, 2006
- Distinguished Lecturer, CNRS, Pierre and Marie Curie Institute, Paris, France, 2005
- Visiting Professor of Engineering, University of Cambridge, UK, 2005
- Visiting Fellow, Pembroke College, University of Cambridge, UK, 2005
- Office of Naval Research (ONR) Young Investigator Award, Arlington, USA, 2002
- National Science Foundation (NSF) Faculty CAREER Award, 2001
- University of California Regents Faculty Award, USA, 2000
- US Civil Research and Development Foundation (CRDF) Award, Arlington, USA, 1999
- Merrill Lynch Innovative Engineering Research Award, WTC, New York, USA, 1998
- Who's Who in Science and Engineering, Editions 1997 – present
- Outstanding Teaching Assistant Award, University of Notre Dame, USA, 1996

- Elected Member, *Eta Kappa Nu* Engineering Honor Society, 1994
- Yong Scientist Award, A. Popov Radio Society Conference, Moscow, Russia, 1992
- *Summa Cum Laude*, Moscow Institute of Physics and Technology, Russia, 1991

## **SELECTED PLENARY LECTURES, KEYNOTE AND INVITED CONFERENCE TALKS**

- Plenary Lecture, “Low-frequency noise in low-dimensional van der Waals materials: The charge-density-wave effects, unusual Lorentzians and more,” 5th International Conference on Noise and Fluctuations (ICNF), Neuchâtel, Switzerland, 2019
- Plenary Lecture, “Phonons and thermal transport in low dimensions: From 2D to 1D,” The 5th International Conference on Phononic Crystals, Metamaterials, Phonon Transport, and Topological Phononics (Phononics 2019), Tucson, Arizona, USA, 2019
- Invited Talk, “Two-dimensional charge-density-wave materials: Unique properties and potential applications,” Symposium—2D Materials—Tunable Physical Properties, Heterostructures and Device Applications, Materials Research Society (MRS) Spring Meeting, Phoenix, Arizona, USA, 2019
- Invited Talk, “Van der Waals bonded materials: From quasi-2D to quasi-1D,” American Physical Society (APS) March Meeting, Los Angeles, California, 2018
- Invited Talk “Transition from quasi-2D to quasi-1D van der Waals materials: Electronic properties of monoclinic TaSe<sub>3</sub> capped with BN layers”, Materials Research Society (MRS) Spring Meeting, Phoenix, Arizona, USA, 2017
- Invited Talk “Properties and device applications of two-dimensional charge density wave materials”, Materials Research Society (MRS) Spring Meeting, Phoenix, Arizona, USA, 2017
- Invited Talk, “2D and 1D van der Waals materials and devices,” Robert C. Haddon Memorial Symposium, University of California, Riverside, California, USA, 2017
- Invited Talk, “Phonons and magnons in NiO,” Workshop of the DOE Center Spins and Heat in Nanoscale Electronic Systems (SHINES), Palm Desert, California, USA 2017
- Keynote Talk, “Graphene thermal management technologies: State-of-the-art and future prospects,” Graphene World Summit, San Diego, California, USA, 2016
- Invited Talk, “Direct observation of the acoustic phonon spectrum modification in individual free-standing semiconductor nanowires,” Workshop on Innovative Nanoscale Devices and Systems (WINDS), Kona, Big Island, Hawaii, USA, 2016
- Invited Talk, “Thin film transistors with 2D materials for selective gas sensing,” Semiconductor Technology for Ultra Large Scale Integrated Circuits and Thin Film Transistors - V (ULSI-TFT), Lake Tahoe, California, USA, 2015
- Invited Talk, “Graphene based thermal coatings,” The International Conference on Metallurgical Coatings and Thin Films (ICMCTF) – Symposium on 2D Materials, San Diego, USA, 2015
- Invited Talk, “Graphene heat spreaders and interconnects for advanced electronics,” Semiconductor Technology for Ultra Large Scale Integrated Circuits and Thin Film Transistors - V (ULSI-TFT), Lake Tahoe, California, USA, 2015
- Invited Talk, “Low-frequency current fluctuations and 1/f noise in graphene,” Graphene Week, Gothenburg, Sweden, 2014

- Invited Talk, "Graphene chemical and gas sensors," CIMTEC 2014 - 13th International Conference on Modern Materials and Technologies - 6<sup>th</sup> Forum on New Materials, Montecatini Terme, Florence, Italy, 2014
- Invited Talk, "Graphene applications in thermal interface material," Fifteenth International Conference on the Science and Applications of Nanotubes, University of Southern California, Los Angeles, USA, 2014
- Invited Talk, "1/f Noise in graphene devices," Fifteenth International Conference on the Science and Applications of Nanotubes, University of Southern California, Los Angeles, USA, 2014
- Plenary Lecture, "Phonons in Graphene and van der Waals Materials" Materials Research Society (MRS) Fall Meeting, Boston, USA, 2013
- Keynote Conference Opening Talk, "Phononics in low-dimensional materials," International CECAM Workshop Nanophononics, University of Bremen, Germany, 2013
- Plenary Conference Opening Talk, "Thermal properties of graphene and applications in energy management," Advancements in Thermal Management, Denver, USA, 2013
- Invited Talk, "Graphene applications for thermal management of Li-ion batteries," 5th Symposium on Graphene, Ge/III-V, and Emerging Materials for Post-CMOS Applications, Electrochemical Society (ECS), Toronto, Canada, 2013
- Keynote Invited Lecture, "Thermal properties of graphene: applications in thermal management," PHONONS 2012, University of Michigan, Ann Arbor, USA, 2012
- Plenary Lecture, "Properties and applications of graphene," IEEE NANO – 11<sup>th</sup> International Conference on Nanotechnology, Portland, Oregon, USA, 2011
- Plenary Lecture, "Nanoscale phonon engineering," PHONONICS – International Conference on Phononic Crystals, Metamaterials and Optomechanics, Santa Fe, New Mexico, USA, 2011
- Invited Talk, "Phonon transport in graphene," The International Conference on the Science and Applications of Nanotubes, University of Cambridge, Cambridge, UK, 2011
- Keynote Talk, "Graphene applications for thermal management," Graphene: Road to Applications, Nature Publishing Group Conference, Boston, USA, 2011
- Invited Tutorial Talk, "Thermal conductivity of graphene: Prospects of thermal management applications," Semi-Therm Conference, San Jose, USA, 2011
- Invited Talk, "Electrical and noise characteristics of graphene transistors and sensors," SPIE Smart Structures Conference, San Diego, USA, 2011
- Invited Talk, "Graphene applications in thermal interface materials," 3<sup>rd</sup> Symposium on Graphene and Emerging Materials for Post-CMOS Applications, Electrochemical Society (ECS), Montreal, Canada, 2011
- Keynote Lecture, "Thermal properties of graphene," Graphene 2011 Conference – Imagine Nano, Bilbao, Spain, 2011 – the largest European event in Nanoscience and Nanotech
- Invited Lecture, "Phonon and thermal properties of graphene," International Winter School on Electronic Properties of Novel Materials (IWEPM), Tirol, Austria, 2011
- Invited Talk, "Phonon transport in graphene materials and devices," Symposium on Nanoscale Heat Transport – From Fundamentals to Devices, Materials Research Society (MRS) Spring Meeting, San Francisco, California, USA, 2011

- Invited Talk, "Phonon engineering with graphene," Massachusetts Institute of Technology Japan – U.S. Joint Seminar on Nanoscale Transport Phenomena, Tokyo, Japan, 2011
- Invited Talk, "Graphene applications in interconnects and heat spreaders," International Conference on Solid State Devices and Materials (SSDM), The University of Tokyo, Tokyo, Japan, 2010
- Keynote Lecture, "Phonon engineering: From nanowires and quantum dots to graphene and topological insulators," ICREA Workshop on Phonon Engineering, St Feliux de Guixol, Barcelona, Spain, 2010
- Invited Talk, "Graphene-like" exfoliation of atomically-thin films of  $\text{Bi}_2\text{Te}_3$  and related materials: Applications in thermoelectrics and topological Insulators," Symposium on Compound Semiconductors, Electrochemical Society (ECS), Las Vegas, USA, 2010
- Invited Talk, "New carbon materials for thermal management," SRC Carbon Based Electronics Workshop, University of Albany – SUNY, Albany, New York, USA, 2010
- Keynote Lecture, "Thermal conductivity of graphene and carbon materials," International Workshop on Nanocarbon Photonics and Optoelectronics, North Karelia, Finland, 2010
- Invited Talk, "Extraordinary thermal conductivity of graphene: Applications in thermal management," 2<sup>nd</sup> Symposium on Graphene and Emerging Materials for Post-CMOS Applications, Electrochemical Society (ECS), Vancouver, Canada, 2010
- Invited Talk, "Properties of mechanically exfoliated atomically-thin films of bismuth telluride," Conference on the Physics and Chemistry of Surfaces and Interfaces (PCSI), Santa Fe, New Mexico, USA, 2010
- Invited Session Opening Talk, "Phonon transport in graphene," Session on Thermal Properties of Graphene, Symposium on Graphene Materials and Devices, Materials Research Society (MRS) Spring Meeting, San Francisco, California, USA, 2010
- Invited Lecture on Nanotechnology, "New materials for thermal management," The Applied Power Electronics Conference and Exposition (APEC) and Inaugural Public Nanotechnology Initiative, Palm Springs, California, USA, 2010
- Keynote Lecture, "Graphene properties and possible micro- and nano-device applications," NATO Advanced Research Workshop (ARW) on Advanced Materials and Technologies for Micro/Nano-Devices, Sensors and Actuators, St. Petersburg, Russia, 2009
- Keynote Opening Lecture, "Thermal conductivity of graphene," Joint Session of The 30<sup>th</sup> International Thermal Conductivity Conference (ITCC) and The 18<sup>th</sup> International Thermal Expansion Symposium (ITES), Seven Springs Mountain Resort, Pennsylvania, USA, 2009
- Plenary Lecture, "Thermal conductivity of graphene," 9th Biennial International Conference on Fullerenes and Atomic Clusters, The Russian Academy of Sciences (RAS) and The Russian Foundation for Basic Research (RFBR), St. Petersburg, Russia, 2009
- Invited Session Opening Talk, "Phonon engineering with graphene and graphene multi-layers," Session on Phonon Transport in Nanostructures, Symposium on Phonon Engineering for Enhanced Materials Solutions, Materials Research Society (MRS) Fall Meeting, Boston, Massachusetts, USA, 2009
- Invited Lecture, "Thermal conductivity of graphene," The Graphene Week Conference, The European Science Foundation (ESF), Obergurgl, Austria, 2009

- Keynote Opening Lecture, "Graphene properties and possible device applications," The International Symposium on Graphene Devices: Technology, Physics, and Modeling (ISGD), Aizu-Wakamatsu, Japan, 2008
- Keynote Talk, "Development of the high-efficiency nanostructure-based solar cells," UC-Riverside – Tohoku University Tech Horizons Conference, Riverside, California, USA, 2008
- Invited Symposium Opening Talk, "Nanoscale phonon engineering: From nanowire transistors to graphene devices," Symposium on Phonon Engineering - Theory and Applications, Materials Research Society (MRS) Fall Meeting, Boston, Massachusetts, USA, 2007
- Invited Talk, "Extremely high thermal conductivity of graphene," Zing Nanomaterials Conference, Playa del Carmen, Cancun, Mexico, 2008
- Keynote Lecture, "Carrier transport in quantum dot superlattices: Applications in solar cells and thermoelectric," The Aerospace Corporation – NASA Space Power Workshop (SPW), Los Angeles, California, USA, 2007
- Invited Talk, "Phonons in semiconductor quantum dot materials," Symposium on Quantum Dot Physics and Materials, The International Society for Optical Engineers (SPIE) Optoelectronics: Quantum Dots and Nanoclusters, San Jose, California, USA, 2007
- Invited Talk, "Optimization of electron and phonon transport in quantum dot superlattices for thermoelectric applications," The 2<sup>nd</sup> International Energy Nanotechnology Conference, American Society of Mechanical Engineers (ASME), Santa Clara, California, USA, 2007
- Invited Talk, "Phonon engineering in nanowires with the acoustically mismatched barrier shells," Symposium on Nanoscale Heat Transport - From Fundamentals to Devices, Materials Research Society (MRS) Spring Meeting, San Francisco, California, USA, 2007
- Invited Talk, "Phonons and phonon engineering in nanostructures: From nanowire transistors to graphene devices," Virtual Conference on Nanoscale Science and Technology (VC-NST), Fayetteville, Arkansas, USA, 2007
- Invited Talk, "Modeling-based optimization of the quantum dot solar cells," UC-Riverside Tech Horizons Conference, Riverside, California, USA, 2007
- Keynote Lecture, "Solar cell nanotechnology for improved efficiency and radiation hardness," Symposium on Photonics for Space Environments, The International Society for Optical Engineering (SPIE), San Diego, California, USA, 2006
- Invited Talk, "Phonon engineering in semiconductor nanowires and quantum dot superlattices," Workshop on Nano-Technology and Information for Space Applications, The 2<sup>nd</sup> IEEE – NASA International Conference on Space Mission Challenges for Information Technology, Pasadena, California, USA, 2006
- Invited Talk, "Phonons in Si nanowires and Si/SiGe quantum dot superlattices," IEEE Silicon Nanoelectronics Workshop, Honolulu, Hawaii, USA, 2006
- Keynote Lecture, "Phonon engineering in nano-devices and virus-based nano-templates," Symposium on Noise and Information in Nanoelectronics, Sensors and Standards, The International Society for Optical Engineering (SPIE), Austin, Texas, USA, 2005
- Plenary Lecture, International Conference on Phonon Scattering in Condensed Matter Physics – The 11<sup>th</sup> PHONONS Conference, St. Petersburg, Russia, 2004

- Invited Talk, “Computational modeling of electron - phonon spectra in semiconductor quantum dot arrays,” The 3<sup>rd</sup> International Conference on Computational Modeling and Simulation of Materials (SIMTEC), Acireale, Sicily, Italy, 2004
- Invited Talk, “Carrier and phonon spectrum in quantum dot superlattices for optoelectronic and thermoelectric applications,” Nanotechnology Conference and Trade Show (NanoTech), San Francisco, California, USA, 2003
- Plenary Lecture, “Investigation of low-frequency noise in heterostructure field-effect transistors based on wide band gap semiconductors,” The 16<sup>th</sup> International Conference on Noise in Physical Systems and 1/f Fluctuations (ICNF), Gainesville, Florida, USA, 2001
- Plenary Talk, “1/f Noise in GaN devices,” The 7<sup>th</sup> Van der Ziel Symposium on Quantum 1/f Noise and Other Low Frequency Fluctuations in Electronic Devices, American Institute of Physics (AIP) Conference Series, St. Louis, Missouri, USA, 1999

### SELECTED INVITED UNIVERSITY SEMINARS AND COLLOQUIA

- Invited Colloquium Speaker, “Unique heat conduction properties of graphene: From fancy physics of phonon transport to applications in thermal management,” Department of Mechanical and Aerospace Engineering, University of California, Los Angeles, USA, 2019
- Invited Colloquium Speaker, “Thermal properties of graphene: Applications in thermal management of advanced electronics,” Department of Mechanical and Aerospace Engineering, University of California, Irvine, USA, 2019
- Invited Colloquium Speaker, “Quasi-2D and quasi-1D van der Waals materials and devices,” Condensed Matter Seminar Series, Department of Physics, University of California, Santa Cruz, USA, 2018
- Invited Colloquium Speaker, “Quasi-1D van der Waals nanowires: Prospects of interconnect applications,” Department of Electrical Engineering, University of California, Irvine, USA, 2018
- Invited Colloquium Speaker, “Two-dimensional charge-density-wave devices operating at room temperature,” California Institute of Technology, Pasadena, California, USA, 2017
- Invited Colloquium Speaker, “Properties and applications of two-dimensional materials,” Graphene Institute Lecture Series, University of Cambridge, Cambridge, U.K.
- Invited Colloquium Speaker, “Phonon transport in graphene: Applications in thermal management,” California Institute of Technology, Pasadena, California, USA, 2016
- Distinguished Colloquium Speaker, “Two-dimensional materials: From fancy physics to cool applications,” University of Southern California, Los Angeles, California, USA, 2015
- Invited Colloquium Speaker, “Two-dimensional materials: From physics to applications,” Department of Electrical and Computer Engineering, University of Texas – Austin, Texas, USA, 2015
- Invited Speaker, “Thermal properties and applications of graphene,” Chalmers Institute of Technology, Gothenburg, Sweden, 2014
- Invited Colloquium Speaker, “Phonon engineering in nanostructures and graphene,” Department of Mechanical Engineering, University of California, San Diego, California, USA, 2014



- Invited Speaker, "Phonon transport in graphene: Applications in thermal management," Skoltech Colloquium Series, Skolkovo Institute of Technology, Moscow, Russia, 2014
- Invited Colloquium Speaker, "Two-dimensional materials: Physical properties and practical applications," Department of Electrical Engineering, University of Houston, Texas, USA, 2013
- Invites Colloquium Speaker, "Graphene devices: Heat and noise," Materials Science Colloquium, California Institute of Technology, Pasadena, California, USA, 2012
- Invited Colloquium Speaker, "Thermal effects in graphene," Mechanical Engineering Colloquium, University of California – Berkeley, Berkeley, California, USA, 2012
- Invited Colloquium Speaker, "Noise and heat in graphene devices," Electrical Engineering Colloquium, University of Notre Dame, Notre Dame, Indiana, USA, 2012
- Invited Lecture, "Graphene: properties and device applications," Institute of Science and Technology, Vienna, Austria, 2011
- Invited Colloquium Speaker, "Properties and applications of graphene," Physical Chemistry Colloquium, California Institute of Technology, Pasadena, California, USA, 2010
- Distinguished Lecturer, "Overview of carbon materials and their properties: From diamond to graphene," Astrakhan State University, Astrakhan, Russia, 2010
- Invited Colloquium Speaker, "Two-dimensional phonon transport in graphene," Helsinki University of Technology, Helsinki, Finland, 2009
- Invited Colloquium Speaker, "Raman metrology of graphene", Department of Materials Science and Engineering, University of California, Los Angeles, California, USA, 2008
- Invited Speaker, "Nanostructured solar cells," Tohoku University, Sendai, Japan, 2007
- Invited Colloquium Speaker, "Semiconductor nanostructures: Properties and applications for the direct energy conversion," Department of Mechanical Engineering, University of California, Riverside, California, 2007
- Invited Speaker, "Properties of semiconductor quantum dot superlattices," Department of Semiconductor Physics, Moscow State University, Moscow, Russia, 2006
- Distinguished Lecturer, "Nanoscale phonon engineering: From concepts to devices applications," University of Texas – Arlington, Texas, USA, 2006
- Distinguished Lecturer, "Nanoscale phonon engineering: Fundamentals and applications," General Physics Institute of the Russian Academy of Sciences, Moscow, Russia, 2006
- Invited Colloquium Speaker, "GaN materials and devices: Traps, noise and heat," Department of Engineering, University of Cambridge, Cambridge, UK, 2005
- Distinguished Lecturer, "Phonon engineering at nanoscale," Pierre and Marie Curie Institute, CNRS, Paris, France, 2005
- Invited Colloquium Speaker, "Phonon engineering in acoustically mismatched nanowires," Department of Physics, University of Southern California, Los Angeles, California, 2005
- Invited Colloquium Speaker, "Phonon engineering in nanoscale devices," Department of Electrical Engineering, University of California, San Diego, California, 2004
- Invited Colloquium Speaker, "Phonon engineering: Physics and applications," Department of Physics, University of California, Irvine, California, 2004
- Invited Colloquium Speaker, "Low-frequency noise in GaN HFETs," Department of Electrical Engineering, University of Texas – Austin, Austin, Texas, 1999



- Invited Colloquium Speaker, “Noise in GaN transistors,” Department of Electrical Engineering, University of South Carolina, Columbia, South Carolina, 1998

## **SELECTED INVITED TALKS AT GOVERNMENT ORGANIZATIONS AND INDUSTRY**

- “Fabrication and testing of quasi-1D van der Waals metal interconnects,” Global Research Collaboration (GRC) Workshop, Semiconductor Research Corporation (SRC), USA, 2019
- “The noise of magnons,” Center on Spins and Heat in Nanoscale Electronic Systems (SHINES) Workshop, Riverside, California, USA 2019
- “Thermal interface materials with graphene,” Samsung, Irvine, California, USA, 2019
- “Charge-density-wave effects in van der Waals materials,” Project Review and Workshop, Center for Integrated Nanotechnologies (CINT), Sandia National Laboratories – Los Alamos National Laboratory, Albuquerque, New Mexico, USA, 2018
- “Novel switching phenomena in 2D materials,” National Science Foundation (NSF) Program Review and Workshop for 2-DARE and New-LAW EFRI, Sand Diego, California, USA 2018
- “Spin-phonon coupling in NiO,” Department of Energy (DOE) Program Review and Workshop, Center on Spins and Heat in Nanoscale Electronic Systems (SHINES), Sand Diego, California, USA 2018
- “2D and 1D van der Waals materials,” National Science Foundation (NSF) Program Review and Workshop for 2-DARE and New-LAW EFRI, Penn State University, State College, Pennsylvania, USA 2017
- “UV Raman spectroscopy of NiO,” Department of Energy (DOE) Program Review and Workshop, Center on Spins and Heat in Nanoscale Electronic Systems (SHINES), Riverside, California, USA 2017
- “Nanoscale phonon – magnon engineering and thermal transport,” Department of Energy (DOE) Program Review and Workshop, Washington, DC, USA, 2016
- “Graphene and 2D materials applications in thermal management and sensors,” Northrop Grumman Nanotechnology Workshop, Northrop Grumman, Redondo Beach, California, USA, 2015
- “Graphene enhanced thermal interface materials,” Henkel, Irvine, California, USA, 2015
- “Heat and noise van-der-Waals-materials and devices,” DARPA – SRC Center for Function Accelerated nano-Material Engineering (FAME), Los Angeles, California, USA, 2015
- “Graphene applications in thermal management technologies,” Bourns Inc., Riverside, California, USA, 2014
- “Electronic noise in van-der-Waals-materials devices,” DARPA – SRC Center for Function Accelerated nano-Material Engineering (FAME), Los Angeles, California, USA, 2013
- “Energy conversion in Van-der-Waals-materials,” DARPA – SRC Center for Function Accelerated nano-Material Engineering (FAME), UCLA, Los Angeles, California, USA, 2013
- “Low-noise topological insulator and graphene devices,” DARPA – SRC FCRP Program Review and Workshop, MIT, Boston, Massachusetts, USA, 2011

- “Graphene-like” exfoliated topological insulators: Optical, electrical and thermal characterization,” DARPA Workshop on Topological Insulators, UCLA, Los Angeles, California, USA, 2010
- “Graphene heat spreaders and composite substrates for improved thermal management,” Interconnect Focus Center (IFC) Seminar Series, Semiconductor Research Corporation (SRC) and Georgia Institute of Technology, Atlanta, Georgia, 2010
- “Phonon and thermal nano-engineering,” SRC – DARPA Functional Engineered Nano Architectonics Workshop, Los Angeles, California, USA, 2010
- “Overview of DoD funded solar power research at NDL” South California Research Institute for Solar Energy (SC-RISE), Riverside, USA, 2010
- “Phonon engineering: Innovative approaches for the electron mobility enhancement at nanoscale,” AFOSR Joint Electronics Program Review and Workshop, US Air Force Office of Scientific Research (AFOSR), Arlington, Virginia, USA, 2009
- “Highlights of graphene electronics research,” Intel – SRC – DARPA Advanced Electronics Workshop, Intel Corporation, Portland, Oregon, 2008
- “Carbon materials for thermal management,” SRC – DARPA Functional Engineered Nano Architectonics Workshop, San Diego, California, 2008
- “Acoustic phonon engineering in semiconductor nanostructures,” DARPA Workshop on Nanoscale Phonon Engineering (NOPE), Arlington, Virginia, USA 2005
- “Phonon engineering: From concept to device applications,” NSF Workshop on Silicon Nanoelectronics and Beyond, Arlington, Virginia, USA 2005
- “Micro-Raman characterization of stress/strain in semiconductors,” Raytheon Vision Systems (RVS), Goleta, California, USA, 2005
- “Nanoscale phonon engineering,” Superconducting Electronics Workshop and Program Review, Office of Naval Research (ONR), Red Bank, New Jersey, USA, 2005
- “Nanophononics: Concept and device applications,” California Nanosystems Institute (CNSI), UCLA, Los Angeles, California, USA, 2005
- “Thermal conductivity of AlGaN materials: Implications for high-power electronics,” NASA Jet Propulsion Laboratory (JPL), Pasadena, California, USA, 2004
- “Thermal properties of GaN films and AlGaN alloys,” Office of Naval Research Workshop on Advanced Materials, Tampa, Florida, USA, 2004
- “Phonon engineering for enhancement of device operation,” Workshop on Novel Device Concepts, Naval Postgraduate School, Monterey, California, USA, 2003
- “Phonon confinement effects in nanowires,” Ames Research Center, National Aeronautics and Space Administration (NASA), Moffett Field, USA, 2002

## HIGHLIGHTS OF FUNDED RESEARCH PROJECTS

- PI (\$1,850,000, total award): NSF 1433395; 11/01/2014 - 10/31/2019 (with Supplemental Funding); EFRI 2-DARE: Novel Switching Phenomena in Atomic Heterostructures for Multifunctional Applications
- PI (\$150,000, single PI): DARPA W911NF18-1-0041; 12/15/2017 –06/30/2019; Phonon Engineered Materials for Fine-Tuning the G-R Center and Auger Recombination

- Co-PI (~\$400,000, my share): DOE SC0012670; 08/01/18 - 07/31/20; EFRI Center Spin and Heat in Nanoscale Electronic Systems (SHINES) – Lead Organization: UCR; Extension Project: Raman and Brillouin Spectroscopy of Antiferromagnetic Materials
- PI (\$264,000, total award): SRC NM-2796; 01/01/2018 – 12/30/2010; One-Dimensional Single-Crystal van-der-Waals Metals: Ultimately-Downscaled Interconnects with Exceptional Current-Carrying Capacity and Reliability
- PI (\$168,000, my share): NSF 1404967; 07/15/2014 - 06/30/2018; CDS&E/Collaborative Research: Genetic Algorithm Driven Hybrid Computational/Experimental Engineering of Defects in Designer Materials
- PI (\$1,300,000 + \$200,000 matching industry gift, total award): NSF 1124733; 10/01/2011 - 09/30/2016; NEB: Charge-Density-Wave Computational Fabric: New State Variables and Alternative Material Implementation
- Co-PI (~\$800,000, my share): DOE SC0012670; 08/01/14 - 07/31/17; EFRI Center Spin and Heat in Nanoscale Electronic Systems (SHINES) – Lead Organization: UCR
- PI (\$360,000, total award): NSF 1307671; 08/01/2013 - 07/31/2016; Two Dimensional Performance with Three Dimensional Capacity: Engineering the Thermal Properties of Graphene
- PI (\$175,000, my share): NSF 1217382; 10/01/2012 - 09/30/2015; Collaborative Research: Graphene Circuits for Analog, Mixed-Signal, and RF Applications
- Co-PI (\$379,637, total award): NSF; 01/01/2012 – 01/01/2015; Spin Transport in Topological Insulators
- PI (\$75,000, my share): NSF 1549942; 09/01/2015 - 08/31/2017; EAGER: Enhancing Pyroelectric Effects in Nanostructured Materials for High-Efficiency Energy Conversion
- Co-PI (~\$800,000, my share): SRC and DARPA; 12/01/12 - 10/30/16; Functions-Accelerated Materials Engineering (FAME) – lead organization: UCLA
- Co-PI (\$109,531, my share): NSF 1128304; 09/01/2011 - 08/31/2014; Coupled Charge and Spin Transport in Topological Insulators
- PI (\$75,412): NSF 0552562; 04/01/2006 - 03/31/2009; REU Site: Education Through Research in Nanomaterials and Nanodevices
- Co-PI (\$121,420, my share): DARPA – DMEA; 01/01/2010 – 01/01/2011; Center for Nanoscale Science and Engineering - 3D Electronics
- PI (\$150,000): SRC – DARPA; 01/01/2010 – 01/01/2011; Transport and Thermoelectric Properties of Topological Insulators
- Co-PI (\$350,000, my share): SRC – DARPA; 01/01/2009 – 01/01/2011; FCRP Interconnect Focus Center (IFC) - Graphene Lateral Heat Spreaders and Composite Substrates for Interconnect Applications
- PI (\$450,000, single PI): ONR; 01/01/2009 – 01/01/2012; Graphene Quilts for Thermal Management of GaN Power Electronics
- Co-PI (\$565,000, my share): SRC – DARPA; 01/01/2009 – 01/01/2012; Low-Energy-Dissipation Low-Noise Carbon-Allotrope-Based Nanoelectronics
- PI (\$600,000, single PI): AFOSR; 01/01/2007 – 01/01/2010; Phonon-Engineered Heterostructures for Enhanced Carrier Mobility in Electronic and Optoelectronic Devices

- Co-PI (\$100,000, my share): DOE; 01/01/2007 – 01/01/2010); Nanostructured Materials for Concentrator Photovoltaic Solar Cells
- Co-PI (\$265,000, my share): AFOSR; 01/01/2007 – 01/01/2009; Modeling-Based Optimization of Nanostructures for Solar Cells and IR Photodetectors
- PI (\$110,550, single PI): ARO; 01/01/2006 – 01/01/2007; Time-Resolved Single Photon Spectroscopy of ZnO Nanostructures
- PI (\$100,000, single PI): NSF – SRC; 01/01/2005 – 01/01/2007; Nanophononics: A New Approach to Electron Transport Enhancement in Nanoscale Devices
- Co-PI (\$800,000, my share): SRC – DARPA; 01/01/2003 – 01/01/2009; FCRP Center on Functional Engineered Nano Architectonics (FENA) - Phonon Engineering in Hybrid Bio-Inorganic Nanoelectronics
- Co-PI (\$215,000, my share): NASA; 01/01/2006 – 01/01/2008); High Efficiency Radiation-Hard Nanostructure-Based Solar Cells
- PI (\$55,000, single PI): UC MICRO; 01/01/2005 – 01/01/2006); Micro-Raman Mapping of Strain Distribution in Heterostructures
- PI (\$410,000, single PI): NSF; 01/01/2001 – 01/01/2006; CAREER: Thermal Management at Nanoscale: Fine-Tuning the Phonons
- PI (\$225,656, single PI): ONR; 01/01/2003 – 01/01/2004; Temperature Distribution and Self-Heating in GaN Transistors
- PI (\$341,987, single PI): ONR; 01/01/2002 – 01/01/2005; Performance Enhancement of AlGaN High-Power Transistors – ONR Young Investigator Award
- PI (\$59,800, single PI): NSF; 01/01/2003 – 01/01/2005; Phonon Engineering Concepts for Nanoscale Devices and Circuits
- PI (\$80,000, single PI): NSF; 01/01/2001 – 01/01/2003; High-Efficiency Quantum Dot Superlattice Based Thermoelectric Devices
- PI (\$184,999, single PI): AFOSR; 01/01/2000 – 01/01/2002; Phonon Annihilation in Semiconductor Nanostructures

## TEACHING AND CURRICULUM DEVELOPMENT

- Developed the first courses and study plans for both undergraduate and graduate students specializing in the Nanoscale Materials, Devices, and Circuits (NMDC) area at the Department of Electrical and Computer Engineering, UC Riverside
- Directed preparation of a proposal for creation of the campus-wide undergraduate and graduate Materials Science and Engineering (MS&E) Program, served as a Founding Chair of MS&E Program, developed its curriculum, and introduced the first MS&E courses.
- Undergraduate courses taught:
  - EE116 Engineering Electromagnetics – I (required course for all EE majors)
  - EE117 Engineering Electromagnetics – II (developed laboratory for this course)
  - EE107 Solid-State Electronics (offered this course for the first time)
  - EE133 Solid-State Electronics (developed new course to replace EE107)
  - EE175 Senior Design Project
- Graduate courses taught:

- EE202 Fundamentals of Semiconductors and Nanostructures (developed new course and taught it from 2000 – 2018)
- EE207 Noise in Electronic Materials and Devices (developed new course)
- EE216 Nanoscale Phonon Engineering (developed new course)
- EE259 Colloquium in Electrical Engineering
- EE290 Directed Studies
- EE297 Dissertation Research

## **PARTIAL LIST OF GRADUATED DOCTORAL STUDENTS AND THEIR EMPLOYMENT**

- Dr. Ruben Salgado (PhD, MSE, 2019); Dissertation: “Electrical and thermal applications of low-dimensional materials,” employment: Intel Corporation, Portland, Oregon, USA
- Dr. Ece Aytan (PhD, MSE, 2019); Dissertation: “Spin-phonon coupling in antiferromagnetic NiO,” employment: Intel Corporation, Portland, Oregon, USA
- Dr. Mohammad Saadah (PhD, EE, 2018); Dissertation: “Thermal management of photovoltaic solar cell,” employment: King Abdullah University of Science and Technology, Thuwal, Saudi Arabia
- Dr. Fariborz Kargar (PhD, EE, 2017); Dissertation: “Experimental investigation of acoustic phonon confinement effects in nanostructured materials,” employment: University of California, Riverside, California, USA
- Dr. Chenglong Jiang (PhD, EE, 2017); Dissertation: “Phonon and electron properties of transition metal dichalcogenides: Applications in high-temperature electronics,” employment: Hermes Microvision, San Jose, California, USA
- Dr. Hoda Malekpour (PhD, EE, 2016); Dissertation: “Optothermal Raman studies of thermal properties of graphene based films,” employment: Broad Band, Los Gatos, California, USA
- Dr. Sylvester Ramirez (PhD, MSE, 2016); Dissertation: “Anisotropic thermal properties of nanostructured magnetic, carbon and hybrid magnetic-carbon materials,” employment: Raytheon, San Diego, California, USA
- Dr. Rameez Samnakay (PhD, MSE, 2016); Dissertation: “Two-dimensional electronic materials and devices,” employment: Intel Corporation, Portland, Oregon, USA
- Dr. Richard Gulotty (PhD, MSE, 2015); Dissertation: “Chemical vapor deposition and electronic device applications of graphene,” employment: Argonne National Laboratory, Chicago, USA
- Dr. Jackie Renteria (PhD, EE, 2014); Dissertation: “Electronic noise in van der Waals materials and devices,” employment: General Atomics, San Diego, California, USA
- Dr. P. Goli (PhD, MSE, 2014); Dissertation: “Graphene enhanced thermal interface materials for Li-ion batteries,” employment: Henkel, Irvine, California, USA
- Dr. Zhong Yan (PhD, EE, 2013); Dissertation: “Graphene heat spreader for high-power transistors,” employment: Nanjing University, China
- Dr. Farhan Shahil (PhD, EE, 2013); Dissertation: “Graphene-enhanced thermal interface materials for energy efficient electronics,” employment: Intel Corporation, Portland, Oregon, USA

- Dr. Craig Nolen (PhD, EE, 2012); Dissertation: "Large-area identification and quality control technology for graphene and two-dimensional materials," employment: Intel Corporation, Portland, Oregon, USA
- Zahid Hossain (PhD, EE, 2012); Dissertation: "Fabrication and characterization of transistors with 2D channels," employment: Micron Technology, Boise, Idaho, USA
- Dr. Guanxiong Liu (PhD, EE, 2012); Dissertation: "Fabrication and characterization of graphene devices," employment: Apple Corporation, Cupertino, California, USA
- Dr. Javed Khan (PhD, EE, 2012); Dissertation: "Nanostructured materials for energy generation," employment: Intel Corporation, Portland, Oregon, USA
- Jie Yu (PhD, EE, 2012); Dissertation: "Graphene-on-diamond electronic devices," employment: Lam Research, San Jose, California, USA
- Dr. Vivek Goyal (PhD, MSE, 2011); Dissertation: "Thermal characterization of nanostructured materials," employment: Intel Corporation, Portland, Oregon, USA
- Dr. Desalegne Teweldebrhan (PhD, EE, 2011); Dissertation: "Two-dimensional Dirac materials: From graphene to topological insulators," employment: Intel Corporation, Portland, Oregon, USA
- Dr. Suchismita Ghosh (PhD, EE, 2010); Dissertation: "Thermal conduction in graphene and graphene multi-layers," employment: Intel Corporation, Portland, Oregon, USA
- Dr. Muhammad Rahman (PhD, EE, 2010); Dissertation: "Fabrication and characterization of nanowire transistors with enhanced performance," employment: Intel Corporation, Portland, Oregon, USA
- Dr. Samia Sabrina (PhD, EE, 2010); Dissertation: "Modeling of thermal transport in graphene devices," employment: Bangladesh University of Engineering and Technology, Dhaka, Bangladesh
- Dr. Irene Calizo (PhD, EE, 2009); Dissertation: "Raman metrology of graphene," employment: Florida International University, Miami, Florida, USA
- Dr. Qinghui Shao (PhD, EE, 2009); Dissertation: "Optimized design and materials for nanostructure based solar cells," employment: Lawrence Livermore National Laboratory, Livermore, California, USA
- Dr. Manu Shamsa (PhD, EE, 2007); Dissertation: "Thermal transport in advanced engineered materials," employment: Intel Corporation, Portland, Oregon, USA
- Dr. Khan Alim (PhD, EE, 2006); Dissertation: "Raman characterization of hybrid nanostructures," employment: Bureau of Reclamations, Sacramento, California, USA
- Dr. Y. Bao (PhD, EE, 2005); Dissertation: "Electrical characterization and applications of quantum dot superlattices," employment: Semiconductor Technologies, China
- Dr. J. Zou (PhD, EE, 2002), Dissertation: "Thermal conduction in silicon nanowires and gallium nitride films," employment: East Illinois University, Illinois, USA

#### **PARTIAL LIST OF SUPERVISED POSTDOCTORAL RESEARCHERS**

- Dr. Fariborz Kargar (Postdoctoral, 2017 - 2019); employment: Research Professor and Project Scientist, University of California, Riverside, California, USA



- Dr. Jackie Renteria (Postdoctoral, 2014 - 2015); employment: Director of Engineering, ADTI Media, Temecula, California, USA
- Dr. D.L. Nika (Postdoctoral, 2006 – 2010); employment: Professor and Chair, Department of Physics, Moldova State University, Chisinau, Republic of Moldova
- Dr. I. Bejenari (Fulbright Scholar, 2008 – 2009); employment: Research Associate, Technical University of Moldova, Chisinau, Republic of Moldova
- Dr. W.L. Liu (Postdoctoral, 2003 – 2006); employment: Lead Engineer, Touch Down Technology, Los Angeles, California, USA
- Dr. V. Fonoberov (Postdoctoral, 2002 – 2006); employment: Lead Engineer, Aimdyn, Inc., Santa Barbara, California, USA
- Dr. V.O. Turin (Postdoctoral, 2003 – 2005); employment: Professor, Department of Electronics and Systems, Orel State Technological University, Orel, Russia
- Dr. S. Dmitriev (Visiting, 2003); employment: Professor, Moldova State University, Chisinau, Republic of Moldova
- Dr. O. Lazarenkova (Postdoctoral, 2001 – 2003); employment: Research Engineer, NASA Jet Propulsion Laboratory, Pasadena, California, USA

### **HIGHLIGHTS OF AWARDS RECEIVED BY GRADUATE STUDENTS**

- Fariborz Kargar, Editors' Choice and Cover of the March Issue of the Applied Physics Journal for the paper "The discrete noise of magnons," 2019
- Ece Aytan, The Best Poster Award for the presentation "Spin-phonon coupling in NiO", Department of Energy (DOE) Program Review and Workshop, Center on Spins and Heat in Nanoscale Electronic Systems (SHINES), Sand Diego, California, USA 2018
- Adane Geremew, The Hot Paper Recognition from the Editors of Nanoscale for the paper "Unique features of the generation–recombination noise in quasi-one-dimensional van der Waals nanoribbons," 2018
- Hoda Malekpour, The Most Downloaded Paper Recognition from the Editors of Journal of Raman Spectroscopy for the paper "Raman-based technique for measuring thermal conductivity of graphene and related materials", 2018
- Guanxiong Liu, The Best Poster Award for the presentation "Quasi-1D van der Waals materials: applications in interconnects," DARPA – SRC Center for Function Accelerated nanoMaterial Engineering (FAME) Review and Workshop, Los Angeles, USA, 2017
- Guanxiong Liu, The Best Poster Award for the presentation "Charge density waves in two-dimensional materials," Materials Research Society (MRS) Spring Meeting, Phoenix, Arizona, USA, 2016
- Zhong Yan, The Best Paper Award for the paper "Graphene heat spreader for thermal management of high power GaN transistors," International Microelectronics and Packaging Society (IMAPS) Conference, Los Gatos, California, 2012
- Desalegne Teweldebrhan, The Best Student Paper Award – MRS Silver Medal for the paper "Tuning graphene properties with electron-beam irradiation," Materials Research Society (MRS), San Francisco, California, USA, 2011



- Guanxiong Liu, The Best Student Paper Award – MRS Symposium on 2D Functional Materials for the paper “Flicker noise in graphene and 2D materials,” Materials Research Society (MRS), San Francisco, California, USA, 2011
- Javed Khan, The Best Student Paper Award – The 2<sup>nd</sup> Place Award for the paper “Graphene-like” exfoliation of TiTe<sub>2</sub> quasi-2D crystals,” The Annual Spring Meeting of the Electrochemical Society (ECS), Montreal, Canada, 2011
- Guanxiong Liu, The Young Scientist Award for the “Low-frequency noise in back-gated graphene field-effect transistors” at the 38<sup>th</sup> Conference on the Physics and Chemistry of Surfaces and Interfaces (PCSI), San Diego, California
- Zhong Yan, The Young Scientist Award for the “Few-layer graphene top-surface heat spreaders for high-power electronics” at the 38<sup>th</sup> Conference on the Physics and Chemistry of Surfaces and Interfaces (PCSI), San Diego, California
- Samia Subrina, The 2<sup>rd</sup> Place Award in the International Research Poster Competition for “Thermal management of 3D electronics with graphene heat spreaders,” Society of Women Engineers (SWE), Tampa, Florida, USA, 2010
- Guanxiong Liu, The Best Student Research Presentation Award for “Electronic noise in graphene transistors,” Advanced Workshop on Frontiers in Electronics (WOFE), Rincon, Puerto Rico, 2009
- Desalegne Teweldebrhan, UCR Alliance for Graduate Education and Professoriate Award to report “Irradiated graphene,” Graphene Week, College Park, Maryland, USA, 2009
- Suchismita Ghosh, The Inventor Recognition Award for “Graphene lateral heat spreaders,” TECHCON Conference, Austin, Texas, USA, 2009
- Javed Khan and Craig Nolen, The 2<sup>nd</sup> Place Award in the Graduate Student Competition for “Wireless sensor networks with graphene-based rechargeable power sources,” IEEE EDS Meeting at UC Riverside, California, 2009 (Judges: EDS Presidents C. Claeys and R. Jindal)
- Samia Subrina, The 3<sup>rd</sup> Place Award in the International Research Poster Competition for “Thermal management of electronics with graphene heat spreaders,” Society of Women Engineers (SWE), Long Beach, California, USA, 2009
- Vivek Goyal, The Best Research Poster Award for “Heat propagation in graphene: Theory and experiment,” DARPA –SRC Workshop and Review, Los Angeles, California, USA, 2009 – selected from ~ 50 entries from the top US universities
- Suchismita Ghosh, The 2<sup>rd</sup> Place Award in the International Research Poster Competition for “Giant thermal conductivity of graphene: Thermal management applications,” Society of Women Engineers (SWE), Baltimore, Maryland, USA, 2008
- Irene Calizo, Graduate Dean Dissertation Fellowship Award for her PhD dissertation “Raman nanometrology of graphene,” UC Riverside, California, USA, 2008
- Irene Calizo, The 2<sup>rd</sup> Place Award in the International Research Poster Competition for “Robust micro-Raman identification of the atomic layers of graphene,” Society of Women Engineers (SWE), Nashville, Tennessee, USA, 2008
- Manu Shamsa, The Best Student Paper Award – MRS Silver Medal for the paper “Thermal conductivity of nanocrystalline diamond films,” Materials Research Society (MRS), San Francisco, California, USA, 2007

- Manu Shamsa, IBM International Dissertation Fellowship Award, IBM T.J. Watson Research Center, Yorktown Heights, New York, USA, 2007 - 2009
- Manu Shamsa and Khan Alim, The 3<sup>rd</sup> Place Award in the Best Research Competition for the presentation “Functionalized nanostructures with the negative differential resistance,” DARPA –SRC Workshop and Review, Los Angeles, California, USA, 2006 – selected from ~ 50 entries from the top US universities
- Manu Shamsa, The Best Research Poster Award for the paper “Modeling of thermal conduction mechanisms in the amorphous inter-layer dielectrics,” Materials Research Society (MRS), San Francisco, California, USA, 2006
- Khan Alim and Mayank Varshney, The 2<sup>nd</sup> Place Award in the Best Research Competition for the presentation “New approaches for heat removal from beyond-CMOS nanoelectronic circuits,” DARPA –SRC Workshop and Review, Los Angeles, California, USA, 2005 – selected from ~ 50 entries from the top US universities
- Jie Zou, The Best Student Paper Award – MRS Silver Medal for the paper “The lattice thermal conductivity in semiconductor nanowires,” Materials Research Society (MRS), San Francisco, California, USA, 2002

## HIGHLIGHTS OF PROFESSIONAL SERVICE

- Deputy Editor-in-Chief, Applied Physics Letters (2015 – present)
- Associate Editor, Applied Physics Letters (2014 – 2015)
- Senior Editor, IEEE Transactions on Nanotechnology (2012 – 2014)
- Member, International Advisory Board, Advanced Electronic Materials (2015 – present)
- Member, Editorial Board, C – Journal of Carbon Research (2014 – present)
- Member, Scientific Advisory Board, Graphenea Inc., Spain (2013 – present)
- Member, IEEE Nanotechnology Award Committee (2011 – present)
- Member, SPIE Fellow Committee (2011 – 2014)
- Associate Editor, IEEE Transactions on Nanotechnology (2009 – 2012)
- Editor, Innovative Graphene Technologies: Development, Characterization and Evaluation (Smithers Rapra, London, U.K., 2013)
- Editor (with Andre Geim, Manchester University, 2010), Two-Dimensional Functional Materials (Cambridge Press, 2012) – Proceedings of MRS Fall Meeting Symposium on 2D Materials
- Editor (with K.L. Wang, UCLA), Handbook of Semiconductor Nanostructures and Nanodevices (ASP, Los Angeles, 2006), volumes: (1) Self-Assemblies, Quantum Dots, and Nanowires; (2) Nanofabrication and Nanoscale Characterization; (3) Spintronics and Nanoelectronics; (4) Nanophotonics and Optoelectronics; (5) Nanodevices and Circuits
- Editor, Noise and Fluctuations Control in Electronic Devices (ASP, Los Angeles, 2002)
- Member, Advisory Board, Advances in Nanotechnology (ASP, Los Angeles), 2000 – present
- Editor (with M. Jamal Dean, McMaster U.), Noise in Devices and Circuits III, Proceedings of SPIE, Vol. 5844, 2005
- Reviewer, Engineering Electromagnetics textbooks (undergraduate and graduate level) published by McGraw-Hill, Wiley, Oxford University Press and Prentice Hall, 2003 – 2008

## HIGHLIGHTS OF UNIVERSITY SERVICE

- Chair of the Faculty Search Committees in Spintronics, Magnonics, Phononics, 2015 – 2019
- Member of the Campus-Level Search Committees, 2016 - 2019
- Founding Chair, UCR Materials Science and Engineering Program (MS&E), 2006 – 2012  
Main Accomplishments: I wrote the MS&E program proposal and led the campus efforts for the program approval and development. The program, focused on materials for nanotechnology, energy and sustainability, included 40 faculty members from eight participating departments. The undergraduate program leading to BS in MS&E was approved by the UC Riverside Academic Senate in 2007. The inaugural class was welcomed in 2008. The first BS students graduated in 2010. The campus-wide graduate program leading to MS and PhD degrees in MS&E was approved by the University of California President on August 24, 2009. The first cohort of PhD graduate students was accepted for Fall quarter of 2010. The new Materials Science and Engineering (MSE) building was completed in 2011, substantially expanding MS&E research and teaching facilities. As a Founding Chair I led the program development for 6 years. In January 2012, I stepped down to focus on research and technology commercialization. In the beginning of 2012, MS&E program already had ~45 PhD students and enjoyed high US News & World Report ranking. It was considered a major success by all peers. In 2012, the program was selected for televised highlights at the Materials Research Society (MRS) Fall meeting in Boston. In 2018, UCR was ranked 28<sup>th</sup> in the world in “Materials Science & Engineering” category in Shanghai Ranking (for calibration, Caltech was ranked 23<sup>rd</sup> while the University of Tokyo was ranked 27<sup>th</sup>).
- Member, UCR Strategic Planning Committee, Subcommittee on Academic Excellence, 2009 – 2010; Activities: worked on strategic planning issues and provided input for the report “UCR 2020: The Path to Preeminence – A Living Document to Guide our Future.”
- Member, Materials Science and Engineering Faculty Search Committee, 2009 – 2010
- Chair, Materials Science and Engineering Faculty Search Committee, 2007 – 2009  
Major Accomplishments: lead the committee’s efforts to hire the first MS&E core faculty members, which resulted in three new professors joining the BCOE
- Principal Investigator, NSF Research Experience for Undergraduates (REU) Site on Nanomaterials and Devices, UCR, 2006 – 2009
- Member, Materials Science and Engineering (MSE) Building Committee, 2005 – 2010
- Director, Summer Undergraduate Research Institute in Science and Engineering (SUNRISE), Undergraduate Institute on Nanomaterials, NSF REU Site, UCR, 2006 – 2008
- Faculty Supervisor, UCR Student Chapter of ECS, 2011 – 2014
- Faculty Supervisor, UCR Student Chapter of OSA, 2010 – 2014
- Member, UC-Riverside Academic Senate Committee on Research, 2006 – 2008
- Chair, Electrical Engineering Graduate Committee, 2006 – 2008
- Graduate Advisor, Department of Electrical Engineering, 2006 - 2008
- Chair, Electrical Engineering Undergraduate Committee, 2003 – 2005

- Undergraduate Advisor, Computer Engineering, Joint Program offered by Department of Electrical Engineering and Department of Computer Science, 2004 – 2005
- Chair, ABET – 2000 Electrical Engineering Committee, 2003 – 2005
- Member, College of Engineering Dean Search Committee Member, 2004 – 2005
- Member, Electrical Engineering Faculty Search Committee, 1999 – 2003
- Member, UCR Focus Group on Nanotechnology, 1999 – 2005

## BRIEF DESCRIPTION OF RESEARCH ACHIEVEMENTS

**Thermal Properties of Graphene and Related Materials:** My research group developed an original thermal measurement technique based on micro-Raman spectroscopy, and, with the help of this technique, pioneered the study of thermal conductivity of graphene and 2D materials (Nano Lett., 2008). The optothermal Raman technique has been adopted by numerous laboratories worldwide and used for various 2D materials and thin films. Together with my group members, I have reported the first detailed theory of heat conduction in graphene, and explained why intrinsic thermal conductivity of graphene can be higher than that of bulk basal planes of graphite. My research group synthesized the first thermal interface materials (TIMs) with graphene, and conducted the first practical tests of graphene TIMs' utilization in desk-top computers and Li-ion battery packs. The technology has been patented, further developed by my start-up company, Quantum Seed LLC., and, later, adopted by other companies. The first report of the thermal conductivity of graphene (Nano Lett., 2008) was cited around 10,000 times. My review of graphene thermal properties (Nature Mat, 2011) was cited ~3,500 times. The graphene thermal field continues to be in the period of fast growth, shifting from fundamental science to engineering aspects and practical applications, *e.g.* thermal management. My contributions have been recognized with The MRS Medal from the Materials Research Society (2013).

**Low-Frequency Electronic Noise in 2D Materials and Devices:** The low-frequency  $1/f$  noise is a fascinating phenomenon, from both fundamental science and practical applications points of view ( $f$  is the frequency). My early contributions to the  $1/f$ -noise field included investigation of noise sources in GaN materials and devices, which led to the reduction in the noise level by several orders of magnitude owing to introduction of special device designs and doping. In 2002, I edited a book "Noise and Fluctuations Control in Electronic Devices" (ASP, 2002), which became a conventionally accepted popular reference source in the field. In 2009, I built a dedicated electronic noise laboratory at UC Riverside, and initiated research of low-frequency noise in graphene and other low-dimensional materials. The main research results included (i) understanding the mechanism of the  $1/f$  noise in graphene, different from that in conventional materials; (ii) the use of few-layer graphene to address the century old problem of surface vs. volume noise origin; (iii) understanding unusual effects of irradiation on noise in 2D materials; (iv) development of the low-frequency noise spectroscopy to investigate electron transport in 2D and 1D materials and devices; (v) the use of low-frequency noise as a sensing parameter in graphene-based chemical sensors. I wrote the first review paper of noise in graphene (Nature Nano, 2013).

**Acoustic Phonon Confinement Effects and Phonon Engineering:** Until 1998, acoustic phonon confinement effects in nanostructures have not been considered in the context of the phonon thermal transport. It has been always assumed that acoustic phonon dispersion remains bulk-like, and the only difference induced by nanostructure boundaries on thermal transport is related to the phonon – rough boundary scattering. In 1998, I introduced theoretically (Phys. Rev. B, 1998) a possibility of reduction of thermal conductivity due to the acoustic phonon confinement effects in a quantum well, owing to modifications in the phonon group velocity and density of states. This was different from the classical bulk phonon – boundary scattering, which required roughness and diffuse scattering of acoustic phonons for reduction of thermal conductivity. In the following work, I proposed the use of elastically dissimilar boundaries for individual nanostructures in order to induce favorable changes in the acoustic phonon group velocity and density of states, with the corresponding increase in the electron mobility or thermal conductivity (Nano Lett., 2005). My research group demonstrated the first direct evidence of the acoustic phonon confinement in individual nanostructures using Brillouin spectroscopy (Nature Com., 2016). It was discovered that such effects take place at the length scale, which is substantially larger than previously believed. The latter has important implications for fundamental science and engineering. My contributions have been recognized with IEEE Pioneer of Nanotechnology Award (2011).

**Device Applications of Graphene and 2D CDW Materials:** I proposed and, together with my research group members, experimentally demonstrated a number of electronic applications of graphene. They include including graphene interconnects, triple-mode graphene amplifier, gas-selective graphene sensor without surface functionalization, and non-Boolean graphene logic gates and circuits (see Appl. Phys. Lett., Nano Lett., Phys. Rev. B papers in 2009 – 2015 period. Inspired by graphene, I looked for other possible 2D materials with interesting properties. In 2010, my group published the first paper on exfoliation of individual quintuples of Bi<sub>2</sub>Te<sub>3</sub> family of materials, which revealed thermoelectric and topological insulator effects (Nano Letter, 2010). In 2012, my research group activities expanded 2D charge-density wave (CDW) materials and their device applications (Nano Lett., 2012). We have demonstrated the first CDW device – voltage controlled oscillator – operating at room temperature (Nature Nano, 2016). Following this line of research, my group demonstrated X-ray (Electron Dev. Lett., 2017) and proton bombardment (Nanoscale, 2019) irradiation immunity of 2D CDW devices, and proposed transistor-less logic implemented with CDW “all-metallic” thin-film devices (Electron Device Lett., 2018).

**Quasi-1D van der Waals Materials and Devices:** In 2016, my research group discovered that some quasi-1D van der Waals materials reveal unusually high breakdown current density (Nanoscale, 2016) and electromigration activation energies (Nano Lett., 2017). This initiated a new research direction, which deals with investigation of electron transport in atomic chains of quasi-1D materials, and prospects of these materials in ultimately downscaled interconnects (Electron Device Lett, 2018).

**Spin-Phonon Coupling in Antiferromagnetic Materials:** My research group used Raman and Brillouin scattering techniques to investigate phonon – magnon coupling in AF materials, which are of interest for spintronic device applications (Appl. Phys. Lett., 2017, 2018, 2019).

## HIGHLIGHTS OF JOURNAL PUBLICATIONS

### MOST RECENT PUBLICATIONS

#### Years 2019 and 2018

S. Rumyantsev, M. Balinskiy, F. Kargar, A. Khitun, A. A. Balandin, "The Discrete Noise of Magnons", Appl. Phys. Lett. 114, 090601 (2019).

A. Geremew, F. Kargar, E. X. Zhang, S. E. Zhao, E. Aytan, M. A. Bloodgood, T. T. Salguero, S. Rumyantsev, A. Fedoseyev, D. M. Fleetwood, A. A. Balandin, "Proton-irradiation-immune electronics implemented with two-dimensional charge-density-wave devices." Nanoscale, 11, 8380 (2019).

R. Salgado, A. Mohammadzadeh, F. Kargar, A. Geremew, C. Y. Huang, M. A. Bloodgood, S. Rumyantsev, T. T. Salguero, and A. A. Balandin, "Low-frequency noise spectroscopy of charge-density-wave phase transitions in vertical quasi-2D 1T-TaS<sub>2</sub> devices," Appl. Phys. Express, 18, 037001 (2019).

G. Liu, S. Rumyantsev, M. A. Bloodgood, T. T. Salguero, and A. A. Balandin, "Low-frequency current fluctuations and sliding of the charge density waves in two-dimensional materials," Nano Letters, 18, 3630 (2018).

F. Kargar, Z. Barani, R. Salgado, B. Debnath, J. S. Lewis, E. Aytan, R. K. Lake, and A. A. Balandin, "Thermal percolation threshold and thermal properties of composites with high loading of graphene and boron nitride fillers," ACS Appl. Mater. Interfaces, 10, 37555 (2018).

A. Geremew, M. A. Bloodgood, E. Aytan, B. W. K. Woo, S. R. Corber, G. Liu, K. Bozhilov, T. T. Salguero, S. Rumyantsev, M. P. Rao, and A. A. Balandin, "Current carrying capacity of quasi-1D ZrTe<sub>3</sub> van der Waals nanoribbons," IEEE Electron Device Lett., 39, 735 (2018).

F. Kargar, Z. Barani, M. Balinskiy, A. S. Magana, J. S. Lewis, and A. A. Balandin, "Dual-functional graphene composites for electromagnetic shielding and thermal management," Adv. Electron. Mater., 1800558 (2018).

A. K. Geremew, S. Rumyantsev, M. A. Bloodgood, T. T. Salguero, and A. A. Balandin, "Unique features of the generation–recombination noise in quasi-one-dimensional van der Waals nanoribbons," Nanoscale, 10, 19749 (2018).

H. Malekpour and A. A. Balandin, "Raman-based technique for measuring thermal conductivity of graphene and related materials", *J. Raman Spectroscopy*, 49, 106 (2018).

F. Kargar, E. H. Penilla, E. Aytan, J. S. Lewis, J. E. Garay, and A. A. Balandin, "Acoustic phonon spectrum engineering in bulk crystals via incorporation of dopant atoms," *Appl. Phys. Lett.*, 112, 191902 (2018).

A. G. Khitun, A. K. Geremew, and A. A. Balandin, "Transistor-less logic circuits implemented with 2-D charge density wave devices," *IEEE Electron Device Lett.*, 39, 1449 (2018).

E. Lee, R. A. Salgado, B. Lee, A. V. Sumant, T. Rajh, C. Johnson, A. A. Balandin, and E. V. Shevchenko, "Design of lithium cobalt oxide electrodes with high thermal conductivity and electrochemical performance using carbon nanotubes and diamond particles," *Carbon*, 129, 702 (2018).

M. Balinskiy, F. Kargar, H. Chiang, A. A. Balandin, and A. G. Khitun, "Brillouin-Mandelstam spectroscopy of standing spin waves in a ferrite waveguide," *AIP Adv.*, 8, 056017 (2018).

M. A. Bloodgood, P. Wei, E. Aytan, K. N. Bozhilov, A. A. Balandin, and T. T. Salguero, "Monoclinic structures of niobium trisulfide," *APL Mater.*, 6, 026602 (2018).

S. Exarhos, A. Alvarez-Barragan, E. Aytan, A. A. Balandin, and L. Mangolini, "Plasmonic core-shell zirconium nitride-silicon oxynitride nanoparticles," *ACS Energy Lett.*, 3, 2349 (2018).

K. Almeida, M. Wurch, A. Geremew, K. Yamaguchi, T. A. Empante, M. D. Valentin, M. Gomez, A. J. Berges, G. Stecklein, S. Rumyantsev, J. Martinez, A. A. Balandin, and L. Bartels, "High-vacuum particulate-free deposition of wafer-scale mono-, bi-, and trilayer molybdenum disulfide with superior transport properties," *ACS Appl. Mater. Interfaces*, 10, 33457 (2018).

## **SELECTED RECENT PUBLICATIONS IN REVERSE CHRONOLOGICAL ORDER**

### **Year 2017**

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