

## **ALEXANDER A. BALANDIN**

Distinguished Professor of Electrical and Computer Engineering  
University of California Presidential Chair Professor of Materials Science  
Founding Chair of Materials Science and Engineering 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 for applications in electronics and energy conversion; quasi-2D and quasi-1D van der Waals materials; charge-density-wave materials and devices; Raman and Brillouin spectroscopy; phonon engineering and thermal transport; low-frequency electronic noise in materials and devices; electronic noise spectroscopy; emerging electronic devices, spintronics, quantum computing and alternative computational paradigms.

## **EMPLOYMENT HISTORY**

- Distinguished Professor (2016 – present), Department of Electrical and Computer Engineering, University of California, Riverside, California, USA
- Director (2016 – 2020), UCR Nanofabrication Facility (NanoFab), 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), Associate Professor (2001 – 2005), Assistant Professor (1999 – 2001), Department of Electrical and Computer 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

- Teaching and Research Assistant (1993 – 1996), Department of Electrical Engineering, University of Notre Dame, Indiana, USA
- Research Assistant (1991 – 1993), Moscow Institute of Physics and Technology (MIPT) and the Russian Space Agency, Dolgoprudny, Moscow region, Russia

### **JOURNAL EDITOR AND ADVISORY SERVICE**

- Deputy Editor in Chief, Applied Physics Letters, 2016 – present
- Member of the Board of Advisors, Advanced Electronic Materials, 2016 – present
- Member of the Board of Advisors, Journal of Carbon Research, 2016 – present
- Associate Editor, Applied Physics Letters, 2015 – 2016
- Senior Editor, IEEE Transactions on Nanotechnology, 2013 – 2015
- Associate Editor, IEEE Transactions on Nanotechnology, 2010 – 2013
- Editor in Chief, Journal of Nanoelectronics and Optoelectronics, 2005 – 2010

### **AWARDS AND RECOGNITIONS**

- The Vannevar Bush Faculty Fellowship (VBFF) with \$3M research funding for the project One-Dimensional Quantum Materials – Department of Defense (DOD), Class of 2021
- Clarivate Analytics and Thomson Reuters Highly Cited Researcher, 2015 – present
- The Brillouin Medal – International Phononics Society (IPS), 2019  
“For discovery of unique phonon properties of graphene, and contributions to the development of graphene thermal management applications.”
- Fellow of MRS – The Materials Research Society, 2014
- The MRS Medal – The Materials Research Society, 2013  
“For discovery of the extraordinary high intrinsic thermal conductivity of graphene, development of an original optothermal measurement technique for investigation of thermal properties of graphene, and theoretical explanation of the unique features of the phonon transport in graphene”
- 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, 2011  
“For pioneering contributions to nanoscale phonon transport with applications in nanodevices, graphene devices, thermoelectric and thermal management of advanced electronics.”
- 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
- 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 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
- 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

## PUBLICATION RECORD

I am designated as a Clarivate Analytics (formerly Thomson Reuters) Highly Cited Researcher each year since 2015. For several years, I was selected as a Highly Cited Researcher in two categories: “Physics” and “Interdisciplinary”. This designation recognizes “the true pioneers in their fields over the last decade, demonstrated by the production of multiple highly-cited papers that rank in the top 1% by citations for field and year in the Web of Science. Of the world’s scientists, Clarivate™ Highly Cited Researchers truly are one in 1,000.” My h-index is 94 with the total number of citations above 55,000 (2021). My papers are cited more than 5,000 times per year. For the complete list of publications, visit my research group’s web-site at <https://balandingroup.ucr.edu/> or the Google Scholar: <https://scholar.google.com/>.

- **Journal Publications:** I have published more than 270 technical journal articles. My i10 index is 263, *i.e.* 263 of my papers were cited 10 times or more (Google Scholar; 2021). I publish in top interdisciplinary, applied physics and engineering journals such as Nature Nano, Nature Materials, Advanced Materials, Nature Communications, Nanoletters, Applied Physics Letters, Electron Device Letters, Physical Review B, IEEE Transactions on Nano.
- **Review Articles:** I wrote several high-profile review papers in different fields of research, which became quintessential reference sources. Examples include: A. A. Balandin, “Thermal properties of graphene and nanostructured carbon materials,” Nature Mater., 10, 569 (2011); A. A. Balandin, “Low-frequency 1/f noise in graphene devices,” Nature Nano, 8, 549 (2013); A. A. Balandin, “Phononics of graphene and related materials,” ACS Nano, 14, 5170 (2020).
- **Books and Book Chapters:** I authored more than 25 book chapters, and edited several books. The book “Noise and Fluctuations Control in Electronic Devices,” Editor A.A. Balandin (ASP, USA) became popular a must have reference source in the field.
- **Conference Proceedings:** I authored more than 350 conference abstracts and proceedings, and edited many conference proceedings volumes. Examples include A. Balandin, A. Geim, *et al.*, “Functional Two-Dimensional Layered Materials – From Graphene to Topological Insulators,” MRS Proceedings Volume 1344 (Cambridge Press. London, U.K.)

- **Patents:** I am an inventor of several key technologies in graphene thermal, graphene sensor, and nano-device fields. Examples include A.A. Balandin, “Graphene based thermal interface materials and methods of manufacturing the same,” US Patent 9,716,299; A.A. Balandin, “Graphene-based gas and bio sensor with high sensitivity and selectivity,” US Patent 9,678,036.

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

- Plenary Lecture, “Unique heat conduction properties of graphene – applications in thermal management,” The Israeli Graphene Consortium Conference – International Online Conference, Israel, 2021 – virtual live presentation
- Keynote Invited Lecture, “Two-dimensional charge-density-wave quantum materials,” Graphene and 2DM Online Conference: Fundamental Research Insights, Madrid, Spain, 2021 – virtual live presentation
- Invited Talk, “Engineering phonon spectrum via quantum confinement and dopant incorporation,” Workshop on Nanoscale Acoustics in the Thermal and Quantum Regimes, The University of Chicago, USA, 2021 – virtual live presentation
- Keynote Talk “Electronic properties and device applications of quasi-2D charge density wave materials,” Session - 2D Atomic and Molecular Sheets—Electronic and Photonic Properties and Device Applications, Materials Research Society (MRS) Fall Meeting, 2020 – virtual live presentation
- Invited Talk “Unique properties of quasi-one-dimensional and mixed dimensional van der Waals heterostructures,” Symposium – Advanced Manufacturing of Mixed Dimensional Heterostructures, Materials Research Society (MRS) Fall Meeting, 2020 – virtual live presentation; the talk is available on demand at MRS web-site
- Invited Talk "Monitoring and controlling charge-density-waves in 2D materials," American Physical Society (APS) March Meeting, Denver, Colorado, USA, 2020 – arxiv collection format due to the meeting cancelation
- 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, “Brillouin spectroscopy of confined phonons,” The 5th International Conference on Phononic Crystals, Metamaterials, Phonon Transport, and Topological Phononics (Phononics 2019), Tucson, Arizona, USA, 2019
- Plenary Lecture, “Phonons and thermal transport in graphene,” The 5th International Conference on Phononic Crystals, Metamaterials, Phonon Transport, and Topological Phononics (Phononics 2019), Tucson, Arizona, USA, 2019 – *The Brillouin Medal Talk*
- 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 – *The MRS Medal Talk*
- 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 Bi<sub>2</sub>Te<sub>3</sub> 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

### **INVITED UNIVERSITY SEMINARS AND COLLOQUIA**

- Distinguished Colloquium Speaker, “Two-dimensional charge-density-wave quantum materials,” Quantum Seminar Series, Rice University, 2021 – webinar
- Invited Lecture “Thermal management and electromagnetic interference shielding with graphene and low-dimensional van der Waals materials,” Swedish National Graphene Center, Chalmers University, Sweden, 2021 – webinar
- Invited Colloquium Speaker, “Quasi 2D and 1D van der Waals “quantum” materials,” Materials Science Research Lecture, California Institute of Technology, Pasadena, California, USA, 2020 – webinar



- 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 Colloquium 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 Colloquium 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
- Invited 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 Speaker, “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

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

- “Graphene and low-dimensional materials: Moving from physics to applications,” Microelectronics Colloquium, Argonne National Laboratory, Chicago, USA, 2021 – webinar
- “Thermal interface materials for high-power-density electronics,” Ultra Materials for a Resilient, Smart Electricity Grid – Department of Energy (DOE) EFRC ULTRA, Arizona State University, USA, 2021 – webinar
- “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, San 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), San 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**

I served as a Co-Director and Thrust Leader for the DOE Energy Frontier Research Center (EFRC) Spin and Heat in Integrated Nanoelectronic Systems (SHINES), and presently serves as a Thrust Co-Leader for the DOE EFRC Ultra Materials for a Resilient, Smart Electricity Grid (ULTRA). I led as a PI several multi-university NSF projects such as NSF Nanoelectronics 2020 and Beyond (NEB), NSF The Emerging Frontiers in Research and Innovation (EFRI) 2DARE, as UCR PI for NSF Designing Materials to Revolutionize and Engineer our Future (DMREF) and other multi-PI projects. I was co-PI in three SRC – DARPA funded research centers.

- PI (\$3,000,000 single PI): DOD; 08/01/2021 – 07/30/2026; The Vannevar Bush Faculty Fellowship (VBFF) – One-Dimensional Quantum Materials
- PI (\$497,455, single PI): DOE DE-SC0021020; 08/15/2020 – 08/14/2023; Physical Mechanisms and Electric-Bias Control of Phase Transitions in Quasi-2D Charge-Density-Wave Quantum Materials
- PI (\$741,000 total for two co-PIs): NSF 2019056; 10/01/2020 – 09/30/2022; Major Research Instrumentation (MRI): Development of a Cryogenic Integrated Micro-Raman-Brillouin-Mandelstam Spectrometer

- Co-PI (\$651,195, my share): DOE; 08/01/2020 – 07/30/2024; Energy Frontier Research Center (EFRC) – Ultra Materials for a Resilient, Smart Electricity Grid – Lead Organization: ASU; I am a Theme Leader for Thermal Transport in Wide-Band-Gap-Semiconductor Heterostructures
- PI (\$1,120,000 total award for two UCR co-PIs; collaboration with Stanford University, which has its own \$600,000 budget): NSF; 09/01/2019 – 08/31/2022; Designing Materials to Revolutionize and Engineer our Future (DMREF) Program entitled Collaborative Research: Data Driven Discovery of Synthesis Pathways and Distinguishing Electronic Phenomena of 1D van der Waals Bonded Solids
- 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
- PI (\$50,000): UCR Office of Technology Transfer; 01/01/2019 – 12/30/2020; Graphene Thermal Management Technologies
- Co-PI (~\$400,000, my share): DOE SC0012670; 08/01/18 - 07/31/20; Energy Frontier Research Center (EFRC) – 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
- Co-PI (\$300,000, my share; lead organization is UCLA): UCOP; 10/01/2017 – 09/30/2020; University of California – National Laboratory Collaborative Research and Training: Mesoscopic 2D Materials: From Many-Body Interactions to Device Applications
- 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; Energy Frontier Research Center (EFRC) – 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 AlGaIn 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 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, UCR
- Directed preparation of proposal for creation of the campus-wide undergraduate and graduate Materials Science and Engineering (MSE) Programs
- Served as a Founding Chair of the Materials Science and Engineering (MSE) Program, developed its curriculum, introduced first MSE courses, supervised educational laboratory development
  - The first cohort of ~10 PhD graduate students was accepted for Fall quarter of 2010. As a Founding Chair, I led the program development for the first six formative years.
  - In 2011, the new Materials Science and Engineering (MSE) building substantially expanded MSE Program research and teaching facilities.
  - In 2012, MSE program already had ~45 PhD students and enjoyed high inaugural US News & World Report ranking. The same year, the program was selected for televised highlights at the Materials Research Society Fall meeting in Boston.
  - In 2018, Shanghai Ranking's of Academic Subjects in Materials Science and Engineering category placed UCR as #28 in the world (University of Tokyo was #27)
- 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
  - EE133 Solid-State Electronics (developed new course to replace EE107)
  - EE175 Senior Design Project
  - EE138 Electrical Properties of Materials (required course for MSE majors)
- Graduate courses taught:
  - EE202 Fundamentals of Semiconductors and Nanostructures (developed a new course and taught it from 2000 to 2018)
  - EE207 Noise in Electronic Materials and Devices (developed a new course and taught it from 2005 to 2010)
  - EE216 Nanoscale Phonon Engineering (developed a new course)
  - EE259 Colloquium in Electrical Engineering
  - EE290 Directed Studies and EE297 Dissertation Research

## **GRADUATED DOCTORAL STUDENTS AND THEIR EMPLOYMENT**

I graduated 35 PhD students majoring in EE, MSE and CEE. All of them are successfully employed by the leading US companies, *e.g.* Intel, Apple, Raytheon, Northrop Grumman, General Atomics, Keysight Technologies, US government laboratories, *e.g.* LLNL, ANL, and universities. In addition, I supervised a large number of MS thesis students and undergraduate laboratory assistants (complete record is available upon request).



- Dr. Jacob Lewis (PhD, MSE, 2021); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Saba Baraghani (PhD, CEE, 2021); Lam Research, Fremont, California, USA
- Dr. Amir Mohammadzadeh (PhD, EE, 2021); Dixie Semiconductors, California, USA
- Dr. Sahar Naghibi (PhD, MSE, 2020); Keysight Technologies, Santa Clara, California, USA
- Dr. Jacob Lewis (PhD, MSE, 2020); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Tammy C.Y. Huang (PhD, MSE, 2020); ARL (internship), Adelphi, Maryland, USA
- Dr. Adane Geremew (PhD, EE, 2019); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Ruben Salgado (PhD, MSE, 2019); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Ece Aytan Coleman (PhD, MSE, 2019); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Mohammad Saadah (PhD, EE, 2018); Professor, KAUST, Thuwal, Saudi Arabia
- Dr. Fariborz Kargar (PhD, EE, 2017); Research Professor, UCR, California, USA
- Dr. Chenglong Jiang (PhD, EE, 2017); Hermes Microvision, San Jose, California, USA
- Dr. Hoda Malekpour (PhD, EE, 2016); Broad Band, Los Gatos, California, USA
- Dr. Sylvester Ramirez (PhD, MSE, 2016); Raytheon, San Diego, California, USA
- Dr. Rameez Samnakay (PhD, MSE, 2016); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Richard Gulotty (PhD, MSE, 2015); Argonne National Laboratory, Chicago, USA
- Dr. Jackie Renteria (PhD, EE, 2014); General Atomics, San Diego, California, USA
- Dr. P. Goli (PhD, MSE, 2014); Henkel, Irvine, California, USA
- Dr. Zhong Yan (PhD, EE, 2013); Professor, University, Nanjing, China
- Dr. Farhan Shahil (PhD, EE, 2013); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Craig Nolen (PhD, EE, 2012); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Zahid Hossain (PhD, EE, 2012); Micron Technology, Boise, Idaho, USA
- Dr. Guanxiong Liu (PhD, EE, 2012); Apple Corporation, Cupertino, California, USA
- Dr. Javed Khan (PhD, EE, 2012); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Jie Yu (PhD, EE, 2012); Lam Research, Fremont, California, USA
- Dr. Vivek Goyal (PhD, MSE, 2011); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Desalegne Teweldebrhan (PhD, EE, 2011); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Suchismita Ghosh (PhD, EE, 2010); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Muhhamad Rahman (PhD, EE, 2010); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Samia Sabrina (PhD, EE, 2010); Professor, BUET Dhaka, Bangladesh
- Dr. Irene Calizo (PhD, EE, 2009); Professor, FIU, Miami, Florida, USA
- Dr. Qinghui Shao (PhD, EE, 2009); LLNL, Livermore, California, USA
- Dr. Manu Shamsa (PhD, EE, 2007); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Khan Alim (PhD, EE, 2006); Bureau of Reclamations, Sacramento, California, USA
- Dr. Y. Bao (PhD, EE, 2005); Professor, University, China
- Dr. J. Zou (PhD, EE, 2002), Professor, East Illinois University, Illinois, USA

### **SUPERVISED POSTDOCTORAL RESEARCHERS**

- Dr. F. Kargar (Postdoctoral, 2017 - 2019); Research Professor, University of California, Riverside, California, USA

- Dr. G. Liu (Postdoctoral 2016 - 2018); Lead Engineer, Apple Corporation, Cupertino, California, USA
- Dr. J. Renteria (Postdoctoral, 2014 - 2015); Lead Engineer, General Atomics, San Diego, California, USA
- Dr. A. I. Cocemasov (Visiting Postdoctoral, 2011 – 2012); Research Scientist, Moldova State University, Chisinau, Republic of Moldova
- Dr. D.L. Nika (Postdoctoral, 2006 – 2010); Professor and Chair, Department of Physics, Moldova State University, Chisinau, Republic of Moldova
- Dr. I. Bejenari (Fulbright Scholar, 2008 – 2009); Research Scientist, Technical University of Moldova, Chisinau, Republic of Moldova
- Dr. W.L. Liu (Postdoctoral, 2003 – 2006); Lead Engineer, Touch Down Technology, Los Angeles, California, USA
- Dr. V. Fonoberov (Postdoctoral, 2002 – 2006); Lead Engineer, Aimdyn, Inc., Santa Barbara, California, USA
- Dr. V.O. Turin (Postdoctoral, 2003 – 2005); Professor, Department of Electronics and Systems, Orel State Technological University, Orel, Russia
- Dr. S. Dmitriev (Visiting, 2003); Professor, Moldova State University, Chisinau, Republic of Moldova
- Dr. O. Lazarenkova (Postdoctoral, 2001 – 2003); Research Engineer, NASA Jet Propulsion Laboratory, Pasadena, California, USA

## **PROFESSIONAL SERVICE**

- Chair, IEEE Nanotechnology Council Award Committee (2019 – present)
- Co-Director, International School on Quantum Technologies, The Ettore Majorana Foundation and Center for Scientific Culture, Italy (2019 – present)
- Member, IEEE Fellow Committee (2018 – present)
- Member, IEEE Nanotechnology Council (2016 – present)
- 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 A. Geim, Manchester University, 2010), Two-Dimensional Functional Materials (Cambridge Press, 2012) – Proceedings of MRS 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.J. 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

## UNIVERSITY SERVICE

- Chair, BCOE Strategic Planning Committee, 2019 – 2021
- Scientific Team Leader for the Bourns College of Engineering (BCOE) in the Regional Norco Photonics Center Initiative with the Office of Naval Research (ONR) and Universities, 2018 – 2019
- Chair of the Faculty Search Committees in Spintronics, Magnonics, Phononics, 2015 – 2019
- Area Lead for Advanced Materials and Electronics, Department of Electrical and Computer Engineering, 2017 – present
- Member of the Initiative Group for the UCR – US Army Research Laboratory (ARL) – West regional collaboration, 2017 – present
- Director, UCR Nanofabrication Facility (NanoFab), 2016 – 2020
- Member of the Campus-Level Search Committees for the Dean of Engineering, Vice-Chancellor for Research and Economic Development, 2016 - 2019
- Founding Chair, UCR Materials Science and Engineering Program (MSE), 2006 – 2012
- Member, UCR Strategic Planning Committee, Subcommittee on Academic Excellence, 2009
- Member, Materials Science and Engineering Faculty Search Committee, 2009 – 2010
- Chair, Materials Science and Engineering Faculty Search Committee, 2007 – 2009
- 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

## RESEARCH ACHIEVEMENTS AND IMPACT

**Nanoscale Phonon Engineering:** In 1997, I came up with an idea that by changing spectrum of acoustic phonons in nanostructures *via* spatial confinement one can modify the phonon heat conduction. Previously, everybody assumed the bulk dispersion for the acoustic phonons even in free-standing nanostructures, and considered the phonon – boundary scattering to be the only mechanism that affects the heat conduction. My *Phys. Rev. B* (1998) was the first that described the phonon confinement effect on thermal transport, and introduced the term *phonon engineering*. The idea of using phonon wave interference effects for tuning the phonon transport eventually became conventionally accepted. In *Nature Com.* (2016), we demonstrated experimentally spatial confinement of acoustic phonons in individual nanowires, proving that the phonon spectrum is strongly modified.

- **Impact:** The nanoscale phonon engineering approaches are incorporated in design of thermoelectric devices for increasing the efficiency of energy conversion; in electronic devices for enhancement of the electron mobility and improvement of heat removal; in photonic devices for optimization of light – matter interactions. The phonon engineering is considered for increasing coherence of qubits in the solid-state quantum computer designs.
- **Recognition:** *IEEE Pioneer in Nanotechnology Award* (2011); numerous plenary, keynote and invited talks at the top conferences such as international biannual *PHONONICS*, flagship *IEEE NANO*; invited reviews in *Materials Today* (2012), *MRS Bulletin* (2013).

**Graphene Thermal Field:** My research laid the foundation for the *graphene thermal field* and important discoveries in phonon transport in two-dimensional (2D) materials. Since 2004, after the first exfoliation of graphene and electrical measurements by K. Novoselov and A. Geim, the attention of the research community was focused on *electronic* properties of graphene. In 2008, I went into an entirely different direction by conducting pioneering studies of *thermal* properties of graphene. My seminal 2008 *Nano Letter* is cited more than 13,000 times. Following the experimental discovery, I explained theoretically the specifics of phonon transport in graphene in a series of papers in *Nature Mat.* (2010), *Phys. Rev. B* (2010) and *Nature Mat.* (2011). In 2011, moving from physics to engineering, my research group synthesized the first thermal interface materials with graphene and few-layer graphene, and demonstrated the use of graphene thermal technologies with computers, solar cells and battery packs – several U.S. patents were granted. The graphene thermal field is continuing its rapid growth, both in fundamental science and engineering aspects.

- **Impact:** graphene thermal technologies became the first large-scale practical applications of graphene – one can now buy thermal paste or epoxies with graphene fillers or a sport jacket with graphene-enhanced textile for better heat spreading. The *Raman optothermal technique*, which I invented for measurements of thermal conductivity of suspended graphene, became the standard technique for 2D materials in laboratories worldwide.
- **Recognition:** The *MRS Medal* from the Materials Research Society (2013); *The Brillouin Medal* (2019); numerous plenary, keynote and invited talks at the top conferences such as *Graphene Week*, *MRS Fall and Spring Meetings*, *Nature Research Conference*; invited reviews in *Nature Materials* (2011), *Reports on Progress in Physics* (2018); and *ACS Nano* (2020); a feature article in *IEEE Spectrum* (2010) and other magazines.

**Electronic Noise Spectroscopy:** In 1998, I entered the field of low-frequency electronic noise with the goal of reducing the level of  $1/f$  noise in GaN FETs to allow for their applications in high-frequency high-power communications ( $f$  is the frequency). I proposed several innovative ideas for noise reduction in GaN FETS, which were implemented in practice. In 2009, I started to work on noise reduction in graphene and other 2D materials to remove the barrier for their applications in sensor, detectors and communication devices. In *Nano Letter* (2012) my group demonstrated a graphene sensor, where the low-frequency noise was used as *signal* – allowing to distinguish different gases by characteristics peaks in the noise spectra. We were the first to explain the noise mechanism in graphene – different from that in semiconductors – and to use few-layer graphene for addressing the century old problem – distinguishing if  $1/f$  noise is a volume or surface phenomenon. I further developed approaches for the use of the electronic noise measurements as a characterization technique. We succeeded in monitoring the charge-density-wave (CDW) transitions in 2D materials using the *noise spectroscopy* – currents fluctuations are more sensitive to phase changes than the current-voltage characteristics.

- **Impact:** The low-frequency noise spectroscopy has become a well-established technique, which give a unique perspective on phase transitions and transport phenomena in low-dimensional materials.
- **Recognition:** Plenary talks at the top noise conference – International Conference on Noise and Fluctuations (ICNF) – Gainesville, USA on noise in GaN FETs (2001), and in Neuchâtel, Switzerland on noise in CDW materials (2019); serving as a General Chair of the SPIE Noise Conference (2005); editing a book *Noise and Fluctuations Control in Electronic Devices*, which became a standard reference source; invited review in *Nature Nano* (2013) on  $1/f$  noise in graphene.

**2D and 1D Quantum Materials and Devices:** Starting from 2012, I became interested in strongly-correlated phenomena in 2D materials. When everybody was trying to come up with 2D van der Waals material that has a band gap and can complement gap-less graphene, I focused on CDW quantum phenomena in 2D materials to achieve new device functionality. In *Nature Nano* (2016) we reported the first CDW device – a voltage-controlled oscillator (VCO) based on 1T-TaS<sub>2</sub> – operational at room temperature. In a series of follow up publications, we demonstrated radiation hardness of 2D CDW devices, and their possible use for information processing. Our work helped in renewal of interest to CDW materials, and moving this research field to the direction of practical applications. In 2015, I started to work on one-dimensional (1D) van der Waals materials such as TaSe<sub>3</sub> and related. In *Nanoscale* (2016), we reported the record high current density in quasi-1D bundles of exfoliated TaSe<sub>3</sub>. *Advanced Materials* (2021) reported the first composite with quasi-1D van der Waals fillers, which reveal extraordinary electromagnetic interference shielding.

- **Impact:** The quasi-1D TMT nanowires attracted attention of Semiconductor Research Corporation (SRC) and Intel Corporation for possible applications as interconnects.
- **Recognition:** Numerous invited talks on 2D CDWs and 1D materials at *MRS Spring Meetings*, *APS March Meetings*, and other top international conferences; *The Vannevar Bush Faculty Fellowship* (Class of 2021) to create a new field of research in 1D quantum materials.



For more information, please visit Balandin's group web-site: <https://balandingroup.ucr.edu/>

