

ALEXANDER A. BALANDIN

Distinguished Professor
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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

RESEARCH INTERESTS

Advanced materials for applications in electronics and energy conversion; quantum, strongly correlated, and topological materials; Raman and Brillouin spectroscopy; thermal properties of materials, thermal management; nanoscale phonon engineering and phonon transport; electromagnetics, antenna design, and electromagnetic interference shielding materials; electronic noise in materials and devices; emerging electronic nanodevices; thermoelectric materials and cooling technologies; quantum computing and alternative computational paradigms

EMPLOYMENT HISTORY

- Distinguished Professor (2023 – present), Department of Materials Science and Engineering, University of California, Los Angeles, California, USA
- Distinguished Professor (2016 – 2023), Department of Electrical and Computer Engineering, University of California, Riverside, California, USA
- Director (2017 – 2020), Interim Director (2016 – 2017), Nanofabrication Facility, University of California, Riverside, California, USA
- University of California Presidential Chair Professor (2013 – 2023), University of California, Riverside, California, USA
- Associate Director (2014 – 2018), Spin and Heat in Nanoscale Electronic Systems (SHINES) Center – DOE Energy Frontier Research Center (EFRC), University of California, Riverside, California, USA
- Director (2013 – 2023), Phonon Optimized Engineered Materials (POEM) Center, 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), Dolgoprudny, Moscow, 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 \$3,000,000 research funding for the project One-Dimensional Quantum Materials – Office of Naval Research (ONR), Department of Defense (DOD), 2021 – 2026
- The Brillouin Medal – International Phononics Society (IPS), 2019
“For the discovery of unique phonon properties of graphene, and contributions to the development of graphene thermal management applications.”
- Clarivate Analytics Highly Cited Researcher, 2016 – present (each year)
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 are one in 1,000.”
- Thomson Reuters Highly Cited Researcher, 2015, 2016
- Fellow of MRS – The Materials Research Society, 2014
- The MRS Medal – The Materials Research Society, 2013

“For the 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 Chapters, California, USA 2010; Oregon, USA 2021
- 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
- The 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, New York, USA, 1998
- Outstanding Teaching Assistant Award, University of Notre Dame, USA, 1996
- Elected Member, Eta Kappa Nu Engineering Honor Society, Notre Dame, USA, 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 have been designated as Thomson Reuters and Clarivate Analytics Highly Cited Researcher every year since 2015. 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 ≥ 103 , with a total number of citations above 65,300 (2023). My i10 index is ≥ 283 , *i.e.* 283 of my publications were cited 10 times or more (Google Scholar; 2023). My citation record is entirely due to my research work together with my Ph.D. students during my tenure as a professor at the University of California.

A complete list of publications is provided at the end of this CV. One can access my papers via my research group's website at <https://balandingroup.ucr.edu/> or at Google Scholar: <https://scholar.google.com/>.

- **Technical Publications:** Publons and Web of Science track >330 of my technical publications. I publish in the top and well-established materials science, applied physics, engineering, and chemistry journals such as Nature Materials, Advanced Materials, Nano Letters, ACS Nano, Applied Physics Letters, and Electron Device Letters. The journal selection reflects the interdisciplinary nature of my research.
- **Review Articles:** I wrote several highly cited review articles in different research fields, which became quintessential reference sources. Examples include:
 - A. A. Balandin, "Thermal properties of graphene and nanostructured carbon materials," Nature Materials, 10, 569 (2011);
 - A. A. Balandin, "Low-frequency $1/f$ noise in graphene devices," Nature Nanotechnology, 8, 549 (2013);
 - A. A. Balandin, "Phononics of graphene and related materials," ACS Nano, 14, 5170 (2020);
 - F. Kargar and A. A. Balandin, "Advances in Brillouin–Mandelstam light-scattering spectroscopy," Nature Photonics, 15, 720 (2021);
 - A. A. Balandin, *et al.*, "One-dimensional van der Waals quantum materials," Materials Today, 55, 74 (2022).
- **Books and Book Chapters:** I authored more than 25 book chapters, and edited several books. Examples include:
 - "Noise and Fluctuations Control in Electronic Devices," Editor A.A. Balandin (ASP, Los Angeles, USA) – a popular and must-have reference source in the electronic noise field.
 - "Handbook of Semiconductor Nanostructures and Nanodevices," Editors A.A. Balandin and K.L. Wang (ASP, Los Angeles, USA) – five-volume essential reference source used as a reading assignment in graduate courses.
- **Conference Proceedings:** I authored more than 350 conference abstracts and proceedings, and edited many conference proceedings volumes. Examples include:
 - A. A. Balandin (UC Riverside), A. Geim (University of Manchester), *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 or co-inventor of several key technologies in graphene thermal, graphene sensor, and nano-device fields. Examples include:
 - "Graphene-based thermal interface materials and methods of manufacturing the same," US Patent 9,716,299;
 - "Graphene-based gas and biosensor with high sensitivity and selectivity," US Patent 9,678,036;
 - "Thermally conductive lithium-ion electrodes and batteries," US Patent 9,991,512;

- “Graphene layer formation on a carbon-based substrate,” US Patent US 8,652,946;
- “Nanometer-scale transistor architecture providing enhanced carrier mobility,” US Patent 8,097,922
- **Editorials and Special Journal Issues:** I served as a Guest Editor and coauthored invited editorials for several high-profile special journal issues. Examples include:
 - A.A. Balandin, S.V. Zaitsev-Zotov, and G. Grüner, “Charge-density-wave quantum materials and devices—New developments and prospects,” *Appl. Phys. Lett.* (2021).
 - A. A. Balandin, R. K. Lake, and T. T. Salguero, “One-dimensional van der Waals materials—Advent of a new research field,” *Appl. Phys. Lett.* (2022).
 - A.C. Ferrari and A. A. Balandin, “Phononics of graphene, layered materials, and heterostructures,” *Appl. Phys. Lett.* (2023).
- **Educational and Popular Science Publications:** I wrote several popular science and educational papers. Examples include:
 - A. A. Balandin, “Chill out,” *IEEE Spectrum*, 46, 34 (2009) – about the discovery of graphene thermal properties and prospects of thermal management applications.
 - R. Abbashian and A. A. Balandin, “Materials education in the new century—Experience in creating an interdepartmental materials science and engineering program,” *Journal of Materials Education*, 44, 1 (2022).

PLENARY, KEYNOTE, AND INVITED CONFERENCE TALKS

- Plenary Conference Opening Talk, “Phonons and thermal transport in graphene,” International Conference on Phonon Scattering in Condensed Matter (PHONONS 2023), Paris, France, 2023 – in-person presentation
- Plenary Talk, “Two-dimensional charge-density-wave quantum materials and devices,” International Conference on Advances in Functional Materials (AAAFM-UCLA), Los Angeles, USA, 2023 – in-person presentation
- Invited Talk, “Charge-density-wave phase transitions in quasi-2D 1T-TaS₂ devices,” Low-Dimensional Materials and Devices Conference, SPIE Optics + Photonics, San Diego, USA, 2022 – in-person presentation
- Plenary Conference Opening Talk, “The 1/f noise – Fundamentals and device applications,” 1/f Noise from Condensed Matter Physics to Quantum Technologies, Ettore Majorana Foundation and Centre for Scientific Culture (EMFCSC), Erice, Sicily, Italy, 2022 – in-person presentation
- Invited Talk, “Graphene composites for thermal management and electromagnetic interference shielding,” The 22nd International Conference on the Science and Applications of Carbon Nanotubes and Low-Dimensional Materials, Sungkyunkwan University, Suwon, Republic of Korea, 2022 – recorded virtual presentation
- Invited Talk, “Thermal properties of graphene”, ICTP Workshop on Recent Progress in Thermal Transport Theory and Experiments, The Abdus Salam International Centre for Theoretical Physics, Trieste, Italy, 2022 – virtual presentation

- Invited Talk, “Thermally-driven charge-density-wave quantum devices for radiation-hard environments,” Symposium – Thermal Processes and Management Under Unconventional Conditions, Materials Research Society (MRS) Spring Meeting, Honolulu, Hawai’i, USA, 2022 – virtual presentation (changed from an in-person talk at my request)
- Plenary Lecture, “Two-dimensional charge-density-wave quantum materials and devices,” Global Summit and Expo on Graphene and 2D Materials (2DMAT), Paris, France, 2021 – virtual presentation
- Invited Talk, “One-dimensional van der Waals materials,” Symposium – Heterostructures of Various Dimensional Materials, Materials Research Society (MRS) Fall Meeting, Boston, USA, 2021 – virtual presentation
- Keynote Talk, “Quasi 2D and 1D van der Waals quantum materials,” Low-Dimensional Materials and Devices Conference, SPIE Optics + Photonics, San Diego, USA, 2021 – in-person presentation
- Plenary Lecture, “Unique heat conduction properties of graphene – applications in thermal management,” The Israeli Graphene Consortium Conference – International Online Conference, Israel, 2021 – virtual presentation
- Keynote Lecture, “Two-dimensional charge-density-wave quantum materials,” Graphene and 2DM Online Conference: Fundamental Research Insights, Madrid, Spain, 2021 – virtual 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 presentation
- Keynote Talk “Electronic properties and device applications of quasi-2D charge density wave materials,” Symposium – 2D Atomic and Molecular Sheets, Session – Electronic and Photonic Properties and Device Applications, Materials Research Society (MRS) Fall Meeting, 2020 – virtual 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 presentation; available on-demand at MRS website
- 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 Phonics (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 Phonics (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 TaSe₃ 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,” Spins and Heat in Nanoscale Electronic Systems (SHINES) Workshop, Palm Desert, California, USA, 2017
- Keynote Talk, “Graphene thermal management technologies: State-of-the-art and 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 - 6th 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 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 and Emerging Materials for Post-CMOS Applications, Electrochemical Society (ECS), Toronto, Canada, 2013
- Keynote Talk, “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 – 11th International Conference on Nanotechnology, Portland, Oregon, USA, 2011 – *The IEEE Pioneer of Nanotechnology Award Lecture*
- 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,” 3rd 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
- Invited Lecture, “Phonon and thermal properties of graphene,” International Winter School on Electronic Properties of Novel Materials (IWEPNM), 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 Felix de Guixol, Barcelona, Spain, 2010
- Invited Talk, “Graphene-like” exfoliation of atomically-thin films of Bi₂Te₃ 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,” 2nd 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 30th International Thermal Conductivity Conference (ITCC) and the 18th 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 multilayers,” 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 – 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 2nd 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 – 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 2nd 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, “Nanoscale phonon engineering,” International Conference on Phonon Scattering in Condensed Matter Physics – The 11th PHONONS Conference, St. Petersburg, Russia, 2004
- Invited Talk, “Computational modeling of electron-phonon spectra in semiconductor quantum dot arrays,” The 3rd 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 Talk, “Investigation of low-frequency noise in heterostructure field-effect transistors based on wide bandgap semiconductors,” The 16th International Conference on Noise in Physical Systems and 1/f Fluctuations (ICNF), Gainesville, Florida, USA, 2001

- Plenary Talk, “Low-frequency $1/f$ noise in GaN devices,” The 7th 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

Note: A list of more than 350 contributed conference talks with abstracts or proceedings is available upon request.

INVITED UNIVERSITY SEMINARS AND COLLOQUIA

- Invited Seminar Speaker, “Unique properties of quasi-2D van der Waals materials – From phonons in graphene to charge-density-waves in TMDs,” Department of Chemistry and Biochemistry, University of South Carolina, Columbia, USA, 2022 – webinar
- Invited Seminar Speaker, “Quasi 2D and 1D van der Waals materials – Properties and device applications,” Department of Materials Science and Engineering, Samueli College of Engineering, University of California – Los Angeles, USA, 2021 – webinar
- Invited Colloquium Speaker, “Two-dimensional quantum materials and devices,” Joint Materials Seminar Series, The University of Arizona and Arizona State University, USA, 2021 – webinar
- Distinguished Colloquium Speaker, “Two-dimensional charge-density-wave quantum materials,” Quantum Seminar Series, Rice University, USA, 2021 – webinar
- Invited Colloquium Speaker, “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, “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
- 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, USA, 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, USA, 2005
- Invited Colloquium Speaker, “Phonon engineering in nanoscale devices,” Department of Electrical Engineering, University of California, San Diego, California, USA, 2004
- Invited Colloquium Speaker, “Phonon engineering: Physics and applications,” Department of Physics, University of California, Irvine, California, USA, 2004
- Invited Colloquium Speaker, “Low-frequency noise in GaN HFETs,” Department of Electrical Engineering, University of Texas – Austin, Austin, Texas, USA, 1999
- Invited Colloquium Speaker, “Noise in GaN transistors,” Department of Electrical Engineering, University of South Carolina, Columbia, South Carolina, USA, 1998

INVITED TALKS AT GOVERNMENT ORGANIZATIONS AND INDUSTRY

- Invited Speaker, “Physical mechanisms and electric-bias control of phase transitions in quasi-2D charge-density-wave quantum materials,” Physical Behavior of Materials Program, DOE-BES Division of Materials Sciences and Engineering, 2023 – virtual talk opening the Electronic Behavior of Materials session
- Invited Speaker, “Noise and heat in diamond materials and devices,” Workshop “Ultrawide Bandgap Materials for Microelectronics,” Argonne National Laboratory, Chicago, 2022 – webinar
- Invited Colloquium Speaker, “Quasi 2D and 1D van der Waals quantum materials – From physics to device applications,” IEEE Nano – IEEE Oregon Nanotechnology Chapter, Hillsboro, Oregon, USA, 2021 – webinar
- Invited Colloquium Speaker, “Graphene and low-dimensional materials: Moving from physics to applications,” Microelectronics Colloquium, Argonne National Laboratory, Chicago, USA, 2021 – webinar
- Invited Speaker, “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
- Invited Speaker, “Graphene thermal interface materials and coatings,” Nitto Denko Technical Corporation, Oceanside, USA, 2020
- Invited Speaker “Fabrication and testing of quasi-1D van der Waals metal interconnects,” Global Research Collaboration (GRC) Workshop, Semiconductor Research Corporation (SRC), USA, 2019
- Invited Speaker, “The noise of magnons,” Center on Spins and Heat in Nanoscale Electronic Systems (SHINES) Workshop, Riverside, California, USA 2019
- Invited Colloquium Speaker, “Thermal interface materials with graphene,” Samsung, Irvine, California, USA, 2019
- Invited Speaker, “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

- Invited Speaker, “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
- Invited Speaker, “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
- Invited Speaker, “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
- Invited Speaker, “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
- Invited Speaker, “Nanoscale phonon – magnon engineering and thermal transport,” Department of Energy (DOE) Program Review and Workshop, Washington, DC, USA, 2016
- Invited Colloquium Speaker, “Graphene and 2D materials applications in thermal management and sensors,” Northrop Grumman Nanotechnology Workshop, Northrop Grumman, Redondo Beach, California, USA, 2015
- Invited Colloquium Speaker, “Graphene enhanced thermal interface materials,” Henkel, Irvine, California, USA, 2015
- Invited Speaker, “Heat and noise van-der-Waals-materials and devices,” DARPA – SRC Center for Function Accelerated nano-Material Engineering (FAME), Los Angeles, California, USA, 2015
- Invited Colloquium Speaker, “Graphene applications in thermal management technologies,” Bourns Inc., Riverside, California, USA, 2014
- Invited Speaker, “Electronic noise in van-der-Waals-materials devices,” DARPA – SRC Center for Function Accelerated nano-Material Engineering (FAME), Los Angeles, California, USA, 2013
- Invited Speaker, “Energy conversion in Van-der-Waals-materials,” DARPA – SRC Center for Function Accelerated nano-Material Engineering (FAME), UCLA, Los Angeles, California, USA, 2013
- Invited Speaker, “Low-noise topological insulator and graphene devices,” DARPA – SRC FCRP Program Review and Workshop, MIT, Boston, Massachusetts, USA, 2011
- Invited Speaker, “Graphene-like” exfoliated topological insulators: Optical, electrical and thermal characterization,” DARPA Workshop on Topological Insulators, UCLA, Los Angeles, California, USA, 2010
- Invited Speaker, “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
- Invited Speaker, “Phonon and thermal nano-engineering,” SRC – DARPA Functional Engineered Nano Architectonics Workshop, Los Angeles, California, USA, 2010
- Invited Colloquium Speaker, “Overview of DoD funded solar power research at NDL” South California Research Institute for Solar Energy (SC-RISE), Riverside, USA, 2010

- Invited Speaker, “Phonon engineering: Innovative approaches for the electron mobility enhancement at the nanoscale,” AFOSR Joint Electronics Program Review and Workshop, US Air Force Office of Scientific Research (AFOSR), Arlington, Virginia, USA, 2009
- Invited Colloquium Speaker, “Highlights of graphene electronics research,” Intel – SRC – DARPA Advanced Electronics Workshop, Intel Corporation, Portland, Oregon, 2008
- Invited Speaker, “Carbon materials for thermal management,” SRC – DARPA Functional Engineered Nano Architectonics Workshop, San Diego, California, 2008
- Invited Speaker, “Acoustic phonon engineering in semiconductor nanostructures,” DARPA Workshop on Nanoscale Phonon Engineering (NOPE), Arlington, Virginia, USA 2005
- Invited Speaker, “Phonon engineering: From concept to device applications,” NSF Workshop on Silicon Nanoelectronics and Beyond, Arlington, Virginia, USA 2005
- Invited Colloquium Speaker, “Micro-Raman characterization of stress/strain in semiconductors,” Raytheon Vision Systems (RVS), Goleta, California, USA, 2005
- Invited Speaker, “Nanoscale phonon engineering,” Superconducting Electronics Workshop and Program Review, Office of Naval Research (ONR), Red Bank, New Jersey, USA, 2005
- Invited Colloquium Speaker, “Nanophonics: Concept and device applications,” California Nanosystems Institute (CNSI), UCLA, Los Angeles, California, USA, 2005
- Invited Colloquium Speaker, “Thermal conductivity of AlGaN materials: Implications for high-power electronics,” NASA Jet Propulsion Laboratory (JPL), Pasadena, California, USA, 2004
- Invited Speaker, “Thermal properties of GaN films and AlGaN alloys,” Office of Naval Research Workshop on Advanced Materials, Tampa, Florida, USA, 2004
- Invited Colloquium Speaker, “Phonon engineering for enhancement of device operation,” Workshop on Novel Device Concepts, Naval Postgraduate School, Monterey, California, USA, 2003
- Invited Colloquium Speaker, “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) at UCR and presently serve as a Leader for the Thermal Thrust of the DOE EFRC Ultra Materials for a Resilient, Smart Electricity Grid (ULTRA) at ASU. 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 – FENA, IFC, and FAME.

- Co-PI (\$473,000 total for two co-PIs; PI is a Research Professor with my POEM Center): NSF; 03/01/2023 – 02/28/2026; Controlling Electron, Magnon, and Phonon States in Quasi-2D Antiferromagnetic Semiconductors for Enabling Novel Device Functionalities

- 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; 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; 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; 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; 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; 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; 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; the 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; 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; 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; 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; 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; 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; 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; 09/01/2011 - 08/31/2014; Coupled Charge and Spin Transport in Topological Insulators
- PI (\$75,412): NSF; 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

- As the first faculty member hired in the area of Nanoscale Materials, Devices, and Circuits (NMDC), I developed the courses and study plans for both undergraduate and graduate students specializing in this area at the Department of Electrical and Computer Engineering at the University of California, Riverside.
- Served as a Founding Chair of the Interdepartmental Materials Science and Engineering (MSE) Program (2006 – 2011)
 - Developed MSE curriculum, introduced the first MSE courses and study plans
 - Supervised MSE educational laboratory development
- Wrote proposals for the creation of the campus-wide undergraduate and graduate Materials Science and Engineering (MSE) Programs (2006 – 2007).
 - Coordinated MSE curriculum among five College of Engineering departments and two outside departments: The Department of Chemistry, and the Department of Physics and Astronomy
- Undergraduate courses taught:
 - EE116 Engineering Electromagnetics – I (required course for EE majors)
 - EE117 Engineering Electromagnetics – II (developed laboratory for the course)
 - EE107 Solid-State Electronics
 - EE133 Solid-State Electronics (developed a 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 and taught it from 2005 to 2015)
 - EE259 Colloquium in Electrical Engineering
 - EE290 Directed Studies and EE297 Dissertation Research
 - EE260 Seminar in Low-Dimensional Materials

GRADUATED DOCTORAL STUDENTS AND THEIR EMPLOYMENT

I have directed dissertation research of 40 Ph.D. students majoring in EE, MSE, and CEE. They are employed by 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 M.S. thesis students and undergraduate laboratory assistants (the list is available upon request).

- Dr. Sriharsha Sudhindra (Ph.D., EE, 2023); IBM Research, Albany, New York, USA
- Dr. Zahra Barani (Ph.D., EE, 2022); Nitto Corporation, California, USA
- Dr. Subhajit Ghosh (Ph.D., EE, 2022); Postdoctoral Researcher, UCR, California, USA
- Dr. Jacob Lewis (Ph.D., MSE, 2021); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Saba Baraghani (Ph.D., CEE, 2021); Lam Research, Fremont, California, USA
- Dr. Amir Mohammadzadeh (Ph.D., EE, 2021); Indie Semiconductor, Aliso, California, USA
- Dr. Chun-Yu Huang (Ph.D., MSE, 2020); ARL (internship), Adelphi, Maryland, USA
- Dr. Sahar Naghibi (Ph.D., MSE, 2020); Keysight Tech, Santa Clara, California, USA
- Dr. Adane Geremew (Ph.D., EE, 2019); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Ruben Salgado (Ph.D., MSE, 2019); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Ece Aytan Coleman (Ph.D., MSE, 2019); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Howard Chiang (Ph.D., EE, 2018); Semiconductor Industry, Anaheim, California, USA
- Dr. Mohammad Saadah (PhD, EE, 2018); Professor, KAUST, Thuwal, Saudi Arabia
- Dr. Fariborz Kargar (Ph.D., EE, 2017); Research Professor, UCR, California, USA
- Dr. Chenglong Jiang (Ph.D., EE, 2017); Hermes Microvision, San Jose, California, USA
- Dr. Hoda Malekpour (Ph.D., EE, 2016); Broad Band, Los Gatos, California, USA
- Dr. Sylvester Ramirez (Ph.D., MSE, 2016); Raytheon, San Diego, California, USA
- Dr. Rameez Samnakay (Ph.D., MSE, 2016); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Richard Gulotty (Ph.D., MSE, 2015); Argonne National Laboratory, Chicago, USA
- Dr. Jackie Renteria (Ph.D., EE, 2014); General Atomics, San Diego, California, USA
- Dr. Pradyumna Goli (Ph.D., MSE, 2014); Henkel, Irvine, California, USA
- Dr. Zhong Yan (Ph.D., EE, 2013); Professor, Nanjing University of Science and Tech, China
- Dr. Farhan Shahil (Ph.D., EE, 2013); AMD, Austin, Texas, USA
- Dr. Craig Nolen (Ph.D., EE, 2012); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Zahid Hossain (Ph.D., EE, 2012); Micron Technology, Boise, Idaho, USA
- Dr. Guanxiong Liu (Ph.D., EE, 2012); Apple Corporation, Cupertino, California, USA
- Dr. Javed Khan (Ph.D., EE, 2012); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Jie Yu (Ph.D., EE, 2012); Lam Research, Fremont, California, USA
- Dr. Vivek Goyal (Ph.D., MSE, 2011); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Desalegne Teweldebrhan (Ph.D., EE, 2011); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Suchismita Ghosh (Ph.D., EE, 2010); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Muhhamad Rahman (Ph.D., EE, 2010); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Samia Sabrina (Ph.D., EE, 2010); Professor, BUET, Dhaka, Bangladesh

- Dr. Irene Calizo (Ph.D., EE, 2009); Professor, Miami, Florida, USA
- Dr. Qinghui Shao (Ph.D., EE, 2009); LLNL, Livermore, California, USA
- Dr. Manu Shamsa (Ph.D., EE, 2007); Intel Corporation, Hillsboro, Oregon, USA
- Dr. Khan Alim (Ph.D., EE, 2006); Bureau of Reclamations, Sacramento, California, USA
- Dr. Young Bao (Ph.D., EE, 2005); Professor, University, China
- Dr. Jie Zou (Ph.D., EE, 2002), Professor, East Illinois University, Illinois, USA

CURRENT DOCTORAL STUDENTS

- Dylan Wright – Brillouin spectroscopy; nanotechnology
- Erick Guzman – Brillouin and Raman spectroscopy of advanced materials
- Tekwam Geremew – thermal composite materials; materials characterization
- Jonas Brown – nanofabrication; 2D and 1D quantum materials
- Maedeh Taheri – nanofabrication; 2D and 1D quantum materials
- Zahra Ebrahim Nataj – thermal and Raman materials characterization
- Jordan Teeter – nanotechnology; 1D quantum materials

SUPERVISED POSTDOCTORAL RESEARCHERS

- Dr. Klaudia Zeranska (Visiting Researcher, 2023 – present); Warsaw University of Technology, Warsaw, Poland
- Dr. S. Ghosh (Postdoctoral, 2022 – present); University of California, Riverside, California, USA
- Dr. M. Wurch (Postdoctoral, 2021 – 2022); Senior Microfabrication Process Engineer, MKS Instruments
- 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 Postdoctoral, 2003); Professor, Moldova State University, Chisinau, Republic of Moldova
- Dr. O. Lazarenkova (Postdoctoral, 2001 – 2003); Research Engineer, NASA Jet Propulsion Laboratory, Pasadena, California, USA

HIGHLIGHTS OF PROFESSIONAL SERVICE

- The US Co-Chair for the Workshop on Innovative Nanoscale Devices and Systems (WINDS), Kona, Big Island, Hawaii, USA, 2023 – 2024
- Member, International Program Committee, Unsolved Problems of Noise (UPON) Conference, Óbuda University, Budapest, Hungary, 2023 – 2024
- Member, Program Committee for the March Meeting of the American Physical Society (APS) – Symposium on Electron, Exciton, and Phonon Transport in Nanostructures, Las Vegas, Nevada, 2022 – 2023
- Invited Panelist, NSF commissioned Forum “Platform for the Accelerated Realization, Analysis, and Discovery of Interface Materials” – The Forum produced a report “An Accelerated, Data-Driven, Materials Discovery Future,” Washington, DC – virtual meeting
- Chair of the Committee for Graduate External Program Review for Engineering Programs, University of South Carolina, Columbia, USA, 2022 – virtual meetings
- Guest Editor for the Special Issue of Applied Physics Letters on Electronic Noise – From Advanced Materials to Quantum Technologies (with E. Paladino, University of Palermo, Italy, and P. Hakonen, Aalto University, Finland), 2022
- Member, Technical Committee for the 22nd IEEE International Conference on Nanotechnology (IEEE Nano 2022), Palma De Mallorca, Spain, 2022
- Guest Editor for the Special Issue of Applied Physics Letters on Phononics of Graphene, Layered Materials, and Heterostructures (with A.C. Ferrari, University of Cambridge, U.K.), 2022
- Member of the Technical Committee for the Special Session on 2D Materials, Workshop on Innovative Nanoscale Devices and Systems (WINDS), Kauai, Hawaii, USA, 2022.
- Guest Editor for the Special Issue of Applied Physics Letters on One-Dimensional van der Waals Materials (with R.K. Lake, UC Riverside, and T. Salguero, University of Georgia), 2021 – 2022
- Guest Editor for Special Issue of Applied Physics Letters on Charge-Density-Wave Quantum Materials and Devices (with G. Grüner, UCLA, and S. Zaitsev-Zotov, Kotelnikov Radio-Electronics Institute of the Russian Academy of Sciences), 2020 – 2021
- Chair, IEEE Nanotechnology Council Award Committee, 2019 – 2021
- Co-Director, International School on Quantum Technologies, The Ettore Majorana Foundation and Center for Scientific Culture, Italy, 2019 – 2022
- Member, IEEE Fellow Committee, 2018 – present
- Member, International Organizing Committee, Workshop on Innovative Nanoscale Devices and Systems (WINDS), Hawaii, USA, 2015 – present
- Member, International Symposium on Advanced Nanodevices and Nanotechnology (ISANN), Hawaii, USA, 2015 – 2018

- 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 – 2018
- Member, IEEE Nanotechnology Award Committee, 2011 – 2019
- 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

- Member, Advisory Committee to the Chair, Department of Electrical and Computer Engineering, 2021 – 2022
- Chair, Bourns College of Engineering (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 – 2022
- Member of the Initiative Group for the UCR – US Army Research Laboratory (ARL) – West regional collaboration, 2017 – 2023
- Director, UCR Nanofabrication Facility (NanoFab), 2016 – 2021
- 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, Interdepartmental Faculty Search Committee to hire the core faculty members for the MSE Program, 2007 – 2009
- Founding Chair, Materials Science and Engineering (MSE) Program, 2006 – 2011
 - I wrote the proposals for creating the interdepartmental undergraduate and graduate MSE Program at UCR; led the efforts for the program approval coordinating among five BCOE departments and two CNAS departments; introduced the first MSE study plans; supervised educational laboratory development and the program advertisement; led the preparations for the first program accreditation
 - In 2007, the undergraduate MSE Program was approved and welcomed the first students.
 - The first cohort of Ph.D. graduate students was accepted for the Fall quarter of 2010.
 - As a Founding Chair, I led the MSE program development for the first six formative years, hiring the first staff members and graduating the first students.
 - In 2011, the new Materials Science and Engineering (MSE) building substantially expanded MSE Program research and teaching facilities. I represented MSE on the building committee.
 - In 2012, the MSE program already had ~45 Ph.D. students and enjoyed high inaugural US News and World Report ranking. The same year, the program was selected for televised highlights at the Materials Research Society Fall meeting in Boston.
 - In 2018, the Shanghai Ranking of Academic Subjects in the “Materials Science and Engineering” category placed UCR as #28 in the world (For calibration, The University of Tokyo was #27)
- Chair, Electrical Engineering Graduate Committee, 2006 – 2008
- Graduate Advisor, Department of Electrical Engineering, 2006 – 2008
- Chair, Interdepartmental Committee for Establishing the Materials Science and Engineering Program, 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

NANOPHONONICS: In 1997, I came up with an idea that by changing the spectrum of acoustic phonons in nanostructures *via* spatial confinement one can modify the phonon thermal conductivity as well as the interaction of phonons with defects and other elemental excitations. Previously, it was conventionally assumed that acoustic phonons have the “bulk” energy dispersion even in free-standing nanostructures. The phonon–boundary scattering was considered the only nanoscale-related mechanism affecting heat conduction in nanostructures. Our Phys. Rev. B (1998) was the first report that described the acoustic phonon confinement effect on thermal transport, and introduced the term “phonon engineering”. The idea of using the phonon wave-interference effects for tuning the phonon transport eventually became conventionally accepted. In Nature Comm. (2016), we demonstrated experimentally the spatial confinement of acoustic phonons in individual nanowires, proving that the acoustic phonon spectrum is strongly modified.

- **Impact:** The phonon engineering concepts and approaches are incorporated in the design of thermoelectric devices for increasing the efficiency of energy conversion; in electronic devices for the enhancement of electron mobility and improvement of heat removal; in photonic devices for tuning the light-matter interactions. Phonon engineering is considered for increasing the coherence of qubits in quantum computer designs. The phonon engineering concept became the mainstream research direction with numerous practical applications.
- **Recognition:** IEEE NTC Pioneer in Nanotechnology Award (2011); Fellow of IEEE; 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); several US patents granted in the field.

GRAPHENE THERMAL FIELD: My research laid the foundation for the graphene thermal field. 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 the electronic properties of graphene. In 2008, I went in an entirely different direction by conducting pioneering studies of the thermal properties of graphene. My first paper on the subject – Nano Letter (2008) – is cited more than 15,000 times. Following the experimental discovery that the thermal conductivity of graphene can be higher than that of the basal planes of graphite, I explained this fact theoretically by the specifics of the two-dimensional phonon transport in graphene in Nature Mat. (2010), Phys. Rev. B (2010) and Nature Mat. (2011). In 2011, expanding this research field to materials science and engineering applications, my 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. A new method for measuring thermal conductivity, which I introduced for graphene, has been extended to other 2D materials and adopted in many laboratories

worldwide. The graphene thermal field continues its rapid growth, both in fundamental science and engineering aspects.

- **Impact:** Graphene thermal technologies have become the large-scale practical applications of graphene – one can now buy commercial thermal paste or epoxies with graphene and few-layer graphene fillers, or even sports jackets with graphene-enhanced textiles for better heat spreading.
- **Recognition:** The MRS Medal from the Materials Research Society (2013); MRS Fellow; The Brillouin Medal (2019); numerous plenary, keynote, and invited talks at the top conferences such as Graphene Week, MRS Fall and Spring Meetings, Nature Conference; invited reviews in Nature Mat. (2011), Reports on Progress in Physics (2018); and ACS Nano (2020); a feature article in IEEE Spectrum (2010) and other magazines; several US patents granted in this field.

ELECTRONIC NOISE: In 1998, I entered the field of electronic noise with the goal to reduce the low-frequency $1/f$ noise in GaN field-effect transistors allowing for their applications in high-frequency high-power communications (f is the frequency). The $1/f$ noise contributes to the phase noise of high-frequency communication systems *via* up-conversion due to the device's non-linearities. In 2009, I started to investigate the noise in graphene and other 2D materials to remove the barrier for their applications in sensors, detectors, and communication devices. In Nano Letter (2012), we demonstrated an innovative graphene sensor, where the noise was used as a signal – allowing us to distinguish different gases by characteristic peaks in the noise spectra. We were the first to point out that the noise mechanism in graphene is not the same as in semiconductors, and to use few-layer graphene for addressing the century-old problem – of distinguishing if $1/f$ noise is a volume or a surface phenomenon. In recent years, we further developed approaches for the use of noise measurements as a characterization technique, *e.g.* for high-current diamond diodes. We monitored the phase transitions quantum materials using noise spectroscopy – current fluctuations are more sensitive to phase changes than the current-voltage characteristics.

- **Impact:** Several methods of noise reduction, *e.g.* encasing with boron nitride layers, increasing the thickness of few-layer graphene near the metal contacts, are used in graphene devices. Noise spectroscopy has become an established technique, which gives a unique perspective on phase transitions and transport phenomena in low-dimensional materials.
- **Recognition:** Fellow of SPIE; plenary talks at the top noise conference, *e.g.* International Conference on Noise and Fluctuations (ICNF), Gainesville, USA (2001), and in Neuchâtel, Switzerland (2019); serving as a General Chair of the SPIE Noise Conference (2005) and member of the international committee for Unsolved Problems of Noise (UPON), Hungary (2024); 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.

QUANTUM MATERIALS: In 2012, I became interested in strongly-correlated phenomena in 2D materials. When researchers were trying to come up with a 2D material that has a bandgap and can complement the gap-less graphene, we focused on charge-density-wave (CDW) quantum phenomena in 2D materials to achieve new device functionalities. In Nature Nano (2016), we

reported the first CDW quantum device – a voltage-controlled oscillator based on 1T-TaS₂ CDW material – operational at room temperature (RT). In a series of publications, we demonstrated the radiation hardness of quasi-2D CDW quantum devices and their possible use for information processing. Our work helped in the renewal of interest in CDW materials and moved this research field in the direction of practical applications. In 2015, I started to work on one-dimensional (1D) van der Waals materials such as TaSe₃. In *Nanoscale* (2016), we reported the record-high current density in quasi-1D bundles of TaSe₃ while in *Advanced Materials* (2021), we described the exceptional EMI shielding properties of the first composite with quasi-1D fillers. In 2023, we achieved a breakthrough result demonstrating the first quantum composite with the unique functionality achieved *via* quantum condensate transitions above RT – reported in *Advanced Materials* (2023).

- **Impact:** The quasi-1D van der Waals materials are now considered for possible applications as interconnects, as fillers in multi-functional composites, and as constituent materials in the new type of quantum composites.
- **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 to investigate 1D quantum materials.

ELECTROMAGNETICS: I started my research career with electromagnetics and antenna theory. While working on my Diploma at the Moscow Institute of Physics and Technology (MIPT), I designed ultra-low-frequency antennas, measured antenna radiation patterns, and simulated antenna coverage areas. As a Ph.D. student at Notre Dame, I changed my research focus to solid-state electronics. At UCR, I have taught Engineering Electromagnetics courses for many years. In the last five years, I turned to electromagnetics as a research field, again. There is a need for a new generation of materials that can perform well as electromagnetic interference (EMI) shielding materials. We have developed unique EMI shielding composites with graphene and quasi-1D van der Waals materials (*Advanced Mat.* (2021)). We achieved efficient EMI shielding even with *electrically insulating* materials, and attain a regime where the shielding is mostly *via* EM wave absorption rather than reflection. We have created the EM polarization selective composites by imitating the functionality of the grid antenna at the nanometer scale (*Advanced Funct. Mat* (2022)).

- **Recognition:** The Vannevar Bush Faculty Fellowship incorporates some of the results obtained for composites with quasi-1D van der Waals materials for developing an entirely new class of materials.

NANOPHOTONICS: Since 1997, I have been interested in inelastic light scattering spectroscopy as means of understanding phonon properties in nanostructures. In 2007, I came up with an unconventional use of the Raman spectrometer by turning it into an optical micro-heater and thermometer in my studies of the thermal properties of graphene. In 2016, using an “in-house” built Brillouin spectrometer, we demonstrated directly the spatial confinement of acoustic phonons in nanowires (*Nature Com* (2016)). Presently, we work with *phoxonic* (photonic-phononic) nanostructures to achieve new functionalities in light-matter interactions (*Nanotechnology* (2020)). With the funds provided by a major NSF MRI project, we built an

advanced Brillouin – Mandelstam spectrometer, which allows us to investigate acoustic phonons, magnons, and other elemental excitations in small samples of various materials.

- **Impact:** The Raman optothermal technique, which I invented for measurements of the thermal conductivity of graphene, became the standard technique for 2D materials, and it is adopted in many laboratories worldwide.
- **Recognition:** OSA Fellow from the Optical Society of America; The MRS Medal from the Materials Research Society (2013); The Brillouin Medal (2019); numerous plenary, keynote, and invited talks at the top conferences; invited review in Nature Photonics (2021).

QUANTUM ENGINEERING: Two decades ago, I was an active participant in the “first wave” of research interest in quantum computing and alternative computational paradigms. I studied several implementations of a quantum computer. Since 2010, I have been investigating non-Boolean computational paradigms using graphene field-effect transistors (Phys. Rev. B (2013)), and alternative computational paradigms with 2D charge-density-wave quantum devices (EDL (2018)). These days, I use my expertise in phonons and electronic noise to address critical problems of the solid-state implementation of a quantum computer: coherence of the state variables and addressability of the qubits. Phonons are detrimental to the coherence of the electron and spin state variables while $1/f$ noise is an obstacle in any implementation, including those based on superconducting qubits.

- **Recognition:** My research on the graphene non-Boolean architecture – that does not require the energy band gap in graphene – received the Inventor Recognition Award from the Semiconductor Research Corporation (2013).

Biographical Sketch



Alexander A. Balandin received his MS degree *Summa Cum Laude* in Applied Physics from the Moscow Institute of Physics and Technology (MIPT), Russia. He received his second MS degree and a Ph.D. degree in Electrical Engineering from the University of Notre Dame, USA. From 1997 to 1999, he worked as a Research Engineer at the University of California at Los Angeles (UCLA). From 1999 to 2023, he was a Professor at the Department of Electrical and Computer Engineering at the University of California at Riverside (UCR) where he also served as the Founding Chair of the Materials Science and Engineering Program and directed the UCR Nanofabrication Facility. In 2023, he joined UCLA as a Distinguished Professor at the Department of Materials Science and Engineering at the Henry Samueli School of Engineering and Applied Science.

Professor Balandin's expertise covers a wide range of areas – from material science and solid-state physics to electronics and nanotechnology. He is recognized as a pioneer of the graphene thermal field who discovered experimentally and explained theoretically unique heat conduction properties of graphene, and introduced the first graphene-based thermal management technologies. His other achievements include the development of the phonon engineering approaches for nanoscale devices, demonstration of the room-temperature charge-density-wave quantum devices, electronic noise reduction in wide-band-gap-semiconductor transistors, and development of the electronic noise spectroscopy methods. His current research interests include 1D and 2D van der Waals quantum materials, charge-density-waves and their device applications, electronic noise, Brillouin – Mandelstam – Raman spectroscopy, nanophononics, electromagnetic interference shielding, thermal applications of graphene, emerging quantum devices.

Professor Balandin is a recipient of The MRS Medal from the Materials Research Society, The Brillouin Medal from the International Phononics Society, and the Pioneer of Nanotechnology Award from the IEEE Society for his graphene, phononics, and nanotechnology research. He is an elected Fellow of eight professional societies: MRS, APS, IEEE, OSA, SPIE, IOP, IOM3, and AAAS. Since 2015, he is among the Clarivate Analytics and Thomson Reuters Highly Cited Researchers. In 2021, he was elevated to the Vannevar Bush Faculty Fellow, the highest recognition from DOD for a US Professor. He serves as a Deputy Editor-in-Chief of the Applied Physics Letters, and a Member of the IEEE Nanotechnology Council and IEEE Fellow Committee.

Professor Balandin's research has been funded by NSF, SRC, DOE, ONR, AFOSR, DARPA, and other federal and state government agencies as well as industry. He presently serves as a Thermal Thrust Co-Leader for the DOE EFRC Ultra Materials for a Resilient, Smart Electricity Grid (ULTRA). He led several multi-PI NSF projects such as Nano 2020 and Beyond, EFRI 2DARE, DMREF, and others. He directed dissertation research of 40 Ph.D. students who enjoy successful careers at Apple, Intel, Micron, IBM, Raytheon, Lam Research, Keysight, Northrop Grumman, and General Atomics, as well as in academia and government labs.

