

ALEXANDER A. BALANDIN

Distinguished Professor and Vice Chair
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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 and thermal management; electronic noise in materials and devices; nanoscale phonon engineering and phonon transport; electromagnetics and materials for electromagnetic interference shielding; emerging electronic devices; quantum science and technologies

EMPLOYMENT HISTORY

- Distinguished Professor (2023 – present), Department of Materials Science and Engineering, University of California, Los Angeles, California, USA
- Vice Chair for Graduate Education (2023 – present), Department of Materials Science and Engineering, University of California, Los Angeles, California, USA
- Director of the Brillouin – Mandelstam Spectroscopy Facility (2023 – present), California NanoSystems Institute (CNSI), University of California, Los Angeles, California, USA
- Faculty Member (2023 – present), California NanoSystems Institute (CNSI), University of California, Los Angeles, California, USA
- Faculty Member (2023 – present), The Center for Quantum Science and Engineering (CQSE), 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, USA
- Associate Director (2014 – 2018), Spin and Heat in Nanoscale Electronic Systems (SHINES) Center – Department of Energy (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 (MSE) 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
- Graduate Student Research and Teaching Assistant (1993 – 1996), Department of Electrical Engineering, University of Notre Dame, Indiana, USA
- Graduate Research Associate (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), 2021 – 2026
For research on “One-dimensional quantum materials”
- 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 – 2023
 - Thomson Reuters Highly Cited Researcher, 2015 – 2016
 - 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 MRS – The Materials Research Society, 2014
“For pioneering contributions on the thermal properties of graphene and low-dimensional materials; seminal contributions to the study of quantum confinement effects in nanostructures; and leadership in materials education.”
 - Fellow of IEEE – The Institute of Electrical and Electronics Engineering, 2013
“For contributions to the characterization of thermo-electric properties of semiconductor nanostructures and graphene.”
 - University of California Presidential Chair Professor, University of California, USA, 2013
The University of California (UC) system-wide recognition for research achievements and academic excellence.
 - Fellow of APS – The American Physical Society, 2012
“For pioneering studies of phonon transport in graphene and outstanding contributions to the investigation of confined phonons and excitons in semiconductor nanostructures.”
 - Fellow of IOM3 – The Institute of Materials, Minerals, and Mining, U.K., 2012
“For pioneering contributions to the investigation of thermal properties of carbon materials such as graphene and its derivatives as well as his development of the phonon engineering concept for nanoscale materials.”
 - Fellow of IOP – The Institute of Physics, U.K., 2012
“For studies of physical properties of semiconductor nanostructures and graphene.”
 - 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
“For distinguished contributions to the investigation of optical and phonon properties of semiconductor nanostructures.”
 - Fellow of OSA - The Optical Society of America, 2011
“For outstanding contributions to understanding optical properties of semiconductor nanostructures and pioneering work on opto-thermal metrology of graphene.”
 - 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

“For distinguished contributions to understanding phonon confinement in nanostructures and investigation of thermal phenomena in semiconductors and devices.”

- 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 Award, Arlington, USA, 1999
- Merrill Lynch Innovative Engineering Research Award, New York, USA, 1998
“For commercially valuable doctoral dissertation research.”
- 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

- **Citation Record**
 - **Google Scholar:** The h-index is ≥ 108 , i10-index ≥ 304 , with a total number of citations above 73,000 (January 2025);
 - **Web of Science:** Web of Science Researcher ID: F-9230-2011; ORCID: 0000-0002-9944-7894. The Web of Science tracks >368 publications in the Web of Science Core Collection and >439 Publications indexed in Web of Science
- **Selected Invited Review Articles – Chronological**
 - A. A. Balandin, “Thermal properties of graphene and nanostructured carbon materials,” *Nature Materials*, 10, 569 (2011);
 - A. A. Balandin and D. L. Nika, “Phononics in low-dimensional materials,” *Mater. Today*, 15, 266 (2012);
 - A. A. Balandin, “Low-frequency $1/f$ noise in graphene devices,” *Nature Nanotechnology*, 8, 549 (2013);
 - A. A. Balandin, “Phonon engineering in graphene and van der Waals materials,” *MRS Bull.*, 39, 817 (2014) – The MRS Medal publication;
 - D. L. Nika and A. A. Balandin, “Phonons and thermal transport in graphene and graphene-based materials,” *Reports Prog. Phys.*, 80, 36502 (2017);
 - 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, F. Kargar, T. T. Salguero, R. Lake, “One-dimensional van der Waals quantum materials,” *Materials Today*, 55, 74 (2022).

- **Selected Impactful Journal Publications – Chronological**

- Balandin and K. L. Wang, "Significant decrease of the lattice thermal conductivity due to phonon confinement in a free-standing semiconductor quantum well," *Phys. Rev. B*, **58**, 1544 (1998);
- R. Vrijen, E. Yablonovitch, K. Wang, H. W. Jiang, A. Balandin, V. Roychowdhury, T. Mor, and D. DiVincenzo, "Electron-spin-resonance transistors for quantum computing in silicon-germanium heterostructures," *Phys. Rev. A*, **62**, 12306 (2000);
- A. Balandin, S. Ghosh, W. Bao, I. Calizo, D. Teweldebrhan, F. Miao, and C. N. Lau, "Superior thermal conductivity of single-layer graphene," *Nano Lett.*, **8**, 902 (2008);
- S. Ghosh, W. Bao, D. L. Nika, S. Subrina, E. P. Pokatilov, C. N. Lau, and A. A. Balandin, "Dimensional crossover of thermal transport in few-layer graphene," *Nature Mater.*, **9**, 555 (2010);
- K. M. F. Shahil and A. A. Balandin, "Graphene-multilayer graphene nanocomposites as highly efficient thermal interface materials," *Nano Lett.*, **12**, 861 (2012);
- Z. Yan, G. Liu, J. M. Khan, and A. A. Balandin, "Graphene quilts for thermal management of high-power GaN transistors," *Nature Com.*, **3**, 827 (2012);
- S. Romyantsev, G. Liu, M. S. Shur, R. A. Potyrailo, and A. A. Balandin, "Selective gas sensing with a single pristine graphene transistor," *Nano Lett.*, **12**, 2294 (2012);
- M. Zahid Hossain, S. Romyantsev, M. S. Shur, and A. A. Balandin, "Reduction of $1/f$ noise in graphene after electron-beam irradiation," *Appl. Phys. Lett.*, **102**, 153512 (2013);
- H. Malekpour, K.-H. Chang, J.-C. Chen, D. L. Nika, K. S. Novoselov, and A. A. Balandin, "Thermal conductivity of graphene laminate," *Nano Lett.*, **14**, 5155 (2014);
- G. Liu, B. Debnath, T. R. Pope, T. T. Salguero, R. K. Lake, and A. A. Balandin, "A charge-density-wave oscillator based on an integrated tantalum disulfide–boron nitride–graphene device operating at room temperature," *Nature Nano*, **11**, 845 (2016);
- F. Kargar, B. Debnath, J.-P. Kakko, A. Säynätjoki, H. Lipsanen, D. L. Nika, R. K. Lake, and A. A. Balandin, "Direct observation of confined acoustic phonon polarization branches in free-standing semiconductor nanowires," *Nature Com.*, **7**, 13400 (2016);
- S. Romyantsev, M. Balinskiy, F. Kargar, A. Khitun, and A. A. Balandin, "The discrete noise of magnons," *Appl. Phys. Lett.*, **114**, 090601 (2019);
- M. Taheri, J. Brown, A. Rehman, N. Sesing, F. Kargar, T. T. Salguero, S. Romyantsev, and A. A. Balandin, "Electrical gating of the charge-density-wave phases in two-dimensional h-BN/1T-TaS₂ devices", *ACS Nano*, **16**, 18968 (2022);
- S. Ghosh, H. Surdi, F. Kargar, F. Koeck, S. Romyantsev, S. Goodnick, R. J. Nemanich, and A. A. Balandin, "Excess noise in high-current diamond diodes", *Appl. Phys. Lett.*, **120**, 062103 (2022);
- E. Guzman, F. Kargar, F. Angeles, R. V. Meidanshahi, T. Grotjohn, A. Hardy, M. Muehle, R. B. Wilson, S. M. Goodnick, and A. A. Balandin "Effects of boron doping on the bulk and surface acoustic phonons in single-crystal diamond", *ACS Appl. Mater. Interfaces*, **14**, 37, 42223 (2022);

- Z. Barani, T. Geremew, M. Stokey, N. Sesing, M. Taheri, M. J. Hilfiker, F. Kargar, M. Schubert, T. T. Salguero, and A. A. Balandin, "Quantum composites with charge-density-wave fillers", *Adv. Mater.*, 2209708 (2023);
- Z. Ebrahim Nataj, Y. Xu, D. Wright, J. O. Brown, J. Garg, X. Chen, F. Kargar, and A. A. Balandin "Cryogenic characteristics of graphene composites—evolution from thermal conductors to thermal insulators", *Nature Com.*, 14, 3190 (2023);
- J. Teeter, N. Y. Kim, T. Debnath, N. Sesing, T. Geremew, D. Wright, M. Chi, A. Z. Stieg, J. Miao, R. K. Lake, T. T. Salguero, and A. A. Balandin "Achieving the 1D atomic chain limit in Van der Waals crystals" *Adv. Mater.*, 2409898 (2024);
- S. Ghosh, S. Romyantsev, and A. A. Balandin. "The noise of the charge density waves in quasi-1D NbSe₃ nanowires — contributions of electrons and quantum condensate," *Appl. Phys. Rev.*, 11, 021405 (2024).
- **Highlights of Edited Books and Invited Book Chapters**
 - "Noise and Fluctuations Control in Electronic Devices," Editor A.A. Balandin (ASP, Los Angeles, USA) – a 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 reference source used for graduate courses;
 - Author of more than 25 book chapters, and several edited books.
- **Selected Conference Proceedings**
 - A. A. Balandin (University of California), 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.) – edited proceedings volume for the Materials Research Society (MRS) Spring Meeting;
 - Authored ~400+ conference abstracts and proceedings.
- **Highlights of Patents in Graphene and Phononics Fields**
 - "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;
 - "Electromagnetic and thermal shields with low-dimensional material," US Patent 12,137,546.
- **Invited Editorials for Applied Physics Letters – Chronological**
 - A.A. Balandin, S.V. Zaitsev-Zotov, and G. Grüner, "Charge-density-wave quantum materials and devices—New developments and prospects," *Appl. Phys. Lett.*, 119, 170401 (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.*, **121**, 040401 (2022);
 - A.C. Ferrari and A. A. Balandin, "Phononics of graphene, layered materials, and heterostructures," *Appl. Phys. Lett.*, **122**, 070401 (2023);
 - A. A. Balandin, S. Iwamoto, M. A. Loi, J. Stein, and L. F. Cohen, "Last 60th salute to the journal", *Appl. Phys. Lett.*, **122**, 020401 (2023);
 - A. A. Balandin, E. Paladino, and P. J. Hakonen, "Electronic noise—From advanced materials to quantum technologies" *Appl. Phys. Lett.*, **124**, 050401 (2024);
 - M. G. Vergniory, T. Kondo, N. A. Kotov, and A. A. Balandin, "Topological and chiral matter—Physics and applications," *Appl. Phys. Lett.*, **125**, 160401 (2024).
- **Selected Educational and Popular Science Articles**
 - A. A. Balandin, "Nanoscale thermal management," *IEEE Potentials*, **21**, 11 (2002) – the explanation of the acoustic phonon confinement, *i.e.* phonon wave interference, effects for non-experts;
 - A. A. Balandin, "Chill out," *IEEE Spectrum*, **46**, 34 (2009) – the story of the discovery of graphene's 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) – the history of creating the MSE program at UCR.

PLENARY, KEYNOTE, AND INVITED CONFERENCE TALKS

- Invited Talk, "2D charge-density-wave materials and devices," 7th Annual U.S. Government Workshop on 2D Materials, National Institute of Standards and Technology, USA, 2024
- Keynote Talk, "Noise of charge density waves in low-dimensional materials," The 9th International Conference on Unsolved Problems of Noise (UPON 2024), Budapest, Hungary, 2024
- Plenary Talk, "A Journey from 2D to 1D van der Waals materials and back," FUSENANO 2024: Molecules to Systems: The Future of Semiconductors with 1D and 2D Nanomaterials, Tucson, USA, 2024
- Plenary Talk, "Phonons and thermal transport in graphene," International Conference on Phonon Scattering in Condensed Matter (PHONONS 2023), Paris, France, 2023
- 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
- 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
- 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 – Symposium on Macromaterials, Sungkyunkwan University, Suwon, Republic of Korea, 2022 (pre-recorded talk)

- 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
- 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
- Plenary Lecture, “Two-dimensional charge-density-wave quantum materials and devices,” Global Summit and Expo on Graphene and 2D Materials (2DMAT), Paris, France, 2021
- Invited Talk, “One-dimensional van der Waals materials,” Symposium – Heterostructures of Various Dimensional Materials, Materials Research Society (MRS) Fall Meeting, Boston, USA, 2021
- Keynote Talk, “Quasi 2D and 1D van der Waals quantum materials,” Low-Dimensional Materials and Devices Conference, SPIE Optics + Photonics, San Diego, USA, 2021
- Plenary Lecture, “Unique heat conduction properties of graphene – applications in thermal management,” The Israeli Graphene Consortium Conference – International Online Conference, Israel, 2021
- Keynote Lecture, “Two-dimensional charge-density-wave quantum materials,” Graphene and 2DM Online Conference: Fundamental Research Insights, Madrid, Spain, 2021
- 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
- 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
- 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
- Invited Talk “Monitoring and controlling charge-density-waves in 2D materials,” American Physical Society (APS) March Meeting, Denver, Colorado, USA, 2020 (pre-recorded talk)
- 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 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, "Phonons and magnons in NiO," Spins and Heat in Nanoscale Electronic Systems 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," International Conference on Phonon Scattering in Condensed Matter (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, "Phononic 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, "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 Bi_2Te_3 and related materials: Applications in thermoelectrics and topological insulators," Symposium on Compound Semiconductors, Electrochemical Society (ECS), Las Vegas, USA, 2010
- Invited Talk, "New carbon materials for thermal management," SRC Carbon Based Electronics Workshop, University of Albany – SUNY, Albany, New York, USA, 2010
- Keynote Lecture, "Thermal conductivity of graphene and carbon materials," International Workshop on Nanocarbon Photonics and Optoelectronics, North Karelia, Finland, 2010

- Invited Talk, "Extraordinary thermal conductivity of graphene: Applications in thermal management," 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 and The Russian Foundation for Basic Research, 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: The above list includes only selected invited, keynote, and plenary talks. A comprehensive list of talks, including the contributing is available upon request.

INVITED UNIVERSITY SEMINARS

- Invited Seminar Speaker, "Physics of quasi-2D/1D charge-density-wave materials," Mork Family Department of Chemical Engineering and Materials Science, University of Southern California, Los Angeles, USA, 2024
- Invited Seminar Speaker, "2D charge density wave devices," Department of Physics and Astronomy, University of California, Las Angeles, USA, 2024
- Invited Seminar Speaker, "One-dimensional quantum materials," Center for Quantum Science and Engineering (CQSE), University of California, Las Angeles, USA, 2024
- Invited Seminar Speaker, "Van der Waals materials – A journey from 2D to 1D material systems and back," Department of Chemistry and Biochemistry, University of California, Las Angeles, USA, 2024
- 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, 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, 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, USA, 2014
- Invited Colloquium Speaker, "Two-dimensional materials: Physical properties and practical applications," Department of Electrical Engineering, University of Houston, USA, 2013
- Invited Colloquium Speaker, "Graphene devices: Heat and noise," Materials Science Colloquium, California Institute of Technology, Pasadena, USA, 2012
- Invited Colloquium Speaker, "Thermal effects in graphene," Mechanical Engineering Colloquium, University of California, Berkeley, USA, 2012
- Invited Colloquium Speaker, "Noise and heat in graphene devices," Electrical Engineering Colloquium, University of Notre Dame, Notre Dame, 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, 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, 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, USA, 2007
- Distinguished Lecturer, "Nanoscale phonon engineering: From concepts to devices applications," University of Texas, Arlington, USA, 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, USA, 2005
- Invited Colloquium Speaker, "Phonon engineering in nanoscale devices," Department of Electrical Engineering, University of California, San Diego, USA, 2004
- Invited Colloquium Speaker, "Phonon engineering: Physics and applications," Department of Physics, University of California, Irvine, USA, 2004
- Invited Colloquium Speaker, "Low-frequency noise in GaN HFETs," Department of Electrical Engineering, University of Texas, Austin, USA, 1999
- Invited Colloquium Speaker, "Noise in GaN transistors," Department of Electrical Engineering, University of South Carolina, Columbia, USA, 1998

Note: The above list includes only selected invited talks. A comprehensive list of talks is available upon request.

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, USA, 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, 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 Workshop, Semiconductor Research Corporation (SRC), Austin, USA, 2019
- Invited Speaker, "The noise of magnons," Center on Spins and Heat in Nanoscale Electronic Systems (SHINES) Workshop, Riverside, USA 2019
- Invited Colloquium Speaker, "Thermal interface materials with graphene," Samsung, Irvine, USA, 2019

- Invited Speaker, "Charge-density-wave effects in van der Waals materials," Project Review and Workshop, Center for Integrated Nanotechnologies, Sandia National Laboratories – Los Alamos National Laboratory, Albuquerque, 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, San Diego, 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), San Diego, 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, 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, USA, 2015
- Invited Colloquium Speaker, "Graphene enhanced thermal interface materials," Henkel Corporation, Irvine, USA, 2015
- Invited Speaker, "Heat and noise in 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, USA, 2014
- Invited Speaker, "Low-noise topological insulator and graphene devices," DARPA – SRC FCRP Program Review and Workshop, Massachusetts Institute of Technology, Boston, USA, 2011
- Invited Speaker, "Graphene-like" exfoliated topological insulators: Optical, electrical and thermal characterization," DARPA Workshop on Topological Insulators, University of California, Los Angeles, 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, 2010
- Invited Speaker, "Phonon and thermal nano-engineering," SRC – DARPA Functional Engineered Nano Architectonics Workshop, Los Angeles, USA, 2010
- Invited Colloquium Speaker, "Overview of solar power research," 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, Arlington, USA, 2009
- Invited Colloquium Speaker, "Highlights of graphene electronics research," Intel – SRC – DARPA Advanced Electronics Workshop, Intel Corporation, Portland, 2008

- Invited Speaker, "Carbon materials for thermal management," SRC – DARPA Functional Engineered Nano Architectonics Workshop, San Diego, USA, 2008
- Invited Speaker, "Acoustic phonon engineering in semiconductor nanostructures," DARPA Workshop on Nanoscale Phonon Engineering, Arlington, USA 2005
- Invited Speaker, "Phonon engineering: From concept to device applications," NSF Workshop on Silicon Nanoelectronics and Beyond, Arlington, USA 2005
- Invited Colloquium Speaker, "Micro-Raman characterization of stress/strain in semiconductors," Raytheon Vision Systems, Goleta, USA, 2005
- Invited Speaker, "Nanoscale phonon engineering," Superconducting Electronics Workshop and ONR Program Review, Red Bank, USA, 2005
- Invited Colloquium Speaker, "Nanophononics: Concept and device applications," California NanoSystems Institute (CNSI), University of California, Los Angeles, USA, 2005
- Invited Colloquium Speaker, "Thermal conductivity of AlGaN materials: Implications for high-power electronics," NASA Jet Propulsion Laboratory (JPL), Pasadena, USA, 2004
- Invited Speaker, "Thermal properties of GaN films and AlGaN alloys," Office of Naval Research (ONR) Workshop on Advanced Materials, Tampa, USA, 2004
- Invited Colloquium Speaker, "Phonon engineering for enhancement of device operation," Workshop on Novel Device Concepts, Naval Postgraduate School, Monterey, USA, 2003
- Invited Colloquium Speaker, "Phonon confinement effects in nanowires," Ames Research Center, National Aeronautics and Space Administration (NASA), Moffett Field, USA, 2002

TEACHING AND CURRICULUM DEVELOPMENT

- Developed and/or taught the following graduate courses at the Department of Materials Science and Engineering, Henry Samueli School of Engineering and Applied Science (SEAS), University of California, Los Angeles (UCLA), 2023 – present
 - MSE 226 Si-CMOS Technology: Selected Topics in Materials Science (revised course content to reflect developments in Si-CMOS technology and beyond, and taught it since Spring 2024)
 - MAT SCI 296 Seminar: Advanced Topics in Materials Science and Engineering
 - MAT SCI 597B Preparation for PhD Preliminary Examinations
 - MAT SCI 598 Research for and Preparation of MS Thesis
- Served as a Founding Chair of the Interdepartmental Materials Science and Engineering (MSE) Program, University of California, Riverside (UCR), 2006 – 2011
 - Wrote the proposals for the creation of the campus-wide undergraduate and graduate Materials Science and Engineering (MSE) majors
 - Developed MSE curriculum, introduced the first courses and study plans
 - Supervised MSE educational laboratory development
 - Coordinated MSE curriculum among five departments of the College of Engineering and two outside departments: The Department of Chemistry, and the Department of Physics and Astronomy

- Developed curriculum, courses and study plans for undergraduate and graduate students in the focus area of Nanoscale Materials, Devices, and Circuits (NMDC) at the Department of Electrical and Computer Engineering (ECE) at UCR, 2000 – 2003
- Taught the following undergraduate courses at the Department of Electrical and Computer Engineering, and Materials Science and Engineering Program, UCR
 - EE116 Engineering Electromagnetics – I (required course for EE majors)
 - EE117 Engineering Electromagnetics – II (taught the course and developed experimental laboratory)
 - EE107 Solid-State Electronics (revised the course content)
 - 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)
- Developed and/or taught the following graduate courses at the Department of Electrical and Computer Engineering, and Materials Science and Engineering Program, UCR
 - 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

I directed doctoral dissertation research of more than 40 Ph.D. students majoring in MSE, EE, and CEE. The graduated Ph.D. students are employed by leading US companies, including Intel, Apple, IBM, Raytheon, Northrop Grumman, General Atomics, Keysight Technologies, Lam Research, AMD, Micron Technologies; government laboratories, including LLNL, ANL, and NIST; and universities. Approximately half of all Ph.D. students, I supervised, are from underrepresented groups in science, technology, engineering, and mathematics (STEM). The list of M.S. student (thesis) supervision is available upon request. The graduated Ph.D. students are listed below in reverse chronological order.

Dr. Erick Guzman (Ph.D., 2024); Dr. Tekwam Geremew (Ph.D., 2024); Dr. Sriharsha Sudhindra (Ph.D., 2023); Dr. Zahra Barani (Ph.D., 2022); Dr. Subhajit Ghosh (Ph.D., 2022); Dr. Jacob Lewis (Ph.D., 2021); Dr. Saba Baraghani (Ph.D., 2021); Dr. Amir Mohammadzadeh (Ph.D., 2021); Dr. Chun-Yu Huang (Ph.D., 2020); Dr. Sahar Naghibi (Ph.D., 2020); Dr. Adane Geremew (Ph.D., 2019); Dr. Ruben Salgado (Ph.D., 2019); Dr. Ece Aytan Coleman (Ph.D., 2019); Dr. Howard Chiang (Ph.D., 2018); Dr. Mohammad Saadah (PhD, 2018); Dr. Fariborz Kargar (Ph.D., 2017); Dr. Chenglong Jiang (Ph.D., 2017); Dr. Hoda Malekpour (Ph.D., 2016); Dr. Sylvester Ramirez (Ph.D., 2016); Dr. Rameez Samnakay (Ph.D., 2016); Dr. Richard Gulotty (Ph.D., 2015); Dr. Jackie Renteria (Ph.D., EE, 2014); Dr. Pradyumna Goli (Ph.D., 2014); Dr. Zhong Yan (Ph.D.,

2013); Dr. Farhan Shahil (Ph.D., 2013); Dr. Craig Nolen (Ph.D., 2012); Dr. Zahid Hossain (Ph.D., 2012); Dr. Guanxiong Liu (Ph.D., 2012); Dr. Javed Khan (Ph.D., 2012); Dr. Jie Yu (Ph.D., 2012); Dr. Vivek Goyal (Ph.D., 2011); Dr. Desalegne Teweldebrhan (Ph.D., 2011); Dr. Suchismita Ghosh (Ph.D., 2010); Dr. Muhammad Rahman (Ph.D., 2010); Dr. Samia Sabrina (Ph.D., 2010); Dr. Irene Calizo (Ph.D., 2009); Dr. Qinghui Shao (Ph.D., 2009); Dr. Manu Shamsa (Ph.D., 2007); Dr. Khan Alim (Ph.D., 2006); Dr. Young Bao (Ph.D., 2005); Dr. Jie Zou (Ph.D., 2002)

CURRENT UCLA DOCTORAL STUDENTS

Dylan Wright (Ph.D., UCLA); Jonas Brown (Ph.D., UCLA); Maedeh Taheri (Ph.D., UCLA); Zahra Ebrahim Nataj (Ph.D., UCLA); Jordan Teeter (Ph.D., UCLA).

SUPERVISED POSTDOCTORAL AND VISITING RESEARCHERS

Dr. S. Ghosh (2023 – present); Dr. Klaudia Zeranska (2022 – 2023); Dr. M. Wurch (2021 – 2022); Dr. F. Kargar (2017 – 2019); Dr. G. Liu (2016 – 2018); Dr. J. Renteria (2014 – 2015); Dr. A. I. Cocemasov (2011 – 2012); Dr. D.L. Nika (2006 – 2010); Dr. I. Bejenari (2008 – 2009); Dr. W.L. Liu (2003 – 2006); Dr. V. Fonoberov (2002 – 2006); Dr. V.O. Turin (2003 – 2005); Dr. S. Dmitriev (2003 – 2003); Dr. O. Lazarenkova (2001 – 2003).

HIGHLIGHTS OF PROFESSIONAL SERVICE

- Guest Editor for the Special Issue of Applied Physics Letters on Topological and Chiral Matter – Physics and Applications (with M. Vergniory, Max Planck Institute, Germany, T. Kondo, The University of Tokyo, Japan, and N.A. Kotov, University of Michigan, USA), 2023 – 2024
- The US Co-Chair for the Workshop on Innovative Nanoscale Devices and Systems (WINDS), Kona, Big Island, Hawaii, USA, 2023 – present
- 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, USA, 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, USA, 2022
- Chair of the Committee for Graduate External Program Review for Engineering Programs, University of South Carolina, Columbia, USA, 2022
- 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, 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 – 2023
- 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 – 2022
- 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

- Vice Chair for Graduate Education, Department of Materials Science and Engineering, UCLA, 2023 – present
- Member, Executive Committee, Department of Materials Science and Engineering, UCLA, 2023 – present
- Member, Advisory Committee to the Chair, Department of Electrical and Computer Engineering, 2021 – 2023
- Chair, Bourns College of Engineering (BCOE) Strategic Planning Committee, University of California, Riverside, 2019 – 2021
 - Led the BCOE Strategic Planning Committee consisting of 15 faculty members;
 - Carried out a systematic review of the college's strengths and weaknesses;
 - Produced a report with specific recommendations;
 - Presented the recommendations to the BCOE Council of Advisors.
- Area Lead for Advanced Materials and Electronics, Department of Electrical and Computer Engineering, University of California, Riverside, 2017 – 2022
- Director (2017 – 2020), Interim Director (2016 – 2017), Nanofabrication Facility, University of California, Riverside
- Member of the Campus Search Committees for the Dean of Engineering, Vice-Chancellor for Research and Economic Development, 2016 - 2019
- Chair of the Faculty Search Committees in Spintronics, Magnonics, Phononics, University of California, Riverside, 2015 – 2019
- Founding Faculty Supervisor, UCR Student Chapter of ECS, 2011 – 2014
- Founding Faculty Supervisor, UCR Student Chapter of OSA, 2010 – 2014
- Member, UCR Academic Excellence Subcommittee, 2009 – 2010
 - UCR Strategic Planning Subcommittee on Academic Excellence – development of the strategies for membership in the Association of American Universities (AAU) – *** Note: UCR received the AAU status in 2023
 - UCR 2020: The Path to Preeminence – A Living Document to Guide Our Future
- Founding Chair, Materials Science and Engineering (MSE) Program, 2006 – 2011
 - 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, and 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;

- Led the MSE program development for the first six formative years, firing the first staff members and graduating the first students;
- Represented the MSE program in the Materials Science and Engineering (MSE) Building Committee; the new MSE building entered operation in 2011;
- In 2012, the UCR MSE program had ~45 Ph.D. students and enjoyed a high inaugural US News and World Report ranking.
- Member, Materials Science and Engineering Faculty Search Committee, 2009 – 2010
- Member, UC-Riverside Academic Senate Committee on Research, 2006 – 2009
- Chair, Interdepartmental Faculty Search Committee to hire the core faculty members for the MSE Program, 2007 – 2009
- Chair, Materials Science and Engineering Faculty Search Committee, 2007 – 2009
- Member, Materials Science and Engineering (MSE) Building Committee, 2005 – 2010
- Director and Principal Investigator, Summer Undergraduate Research Institute in Science and Engineering (SUNRISE), National Science Foundation (NSF) Research Experience for Undergraduates (REU) Site, UCR, 2006 – 2009
- Chair, Electrical Engineering Graduate Committee, 2006 – 2008
- Graduate Advisor, *i.e.* Vice Chair for Graduate Education, Department of Electrical Engineering, 2006 – 2008
- Chair, Electrical Engineering Undergraduate Committee, 2003 – 2005
- Undergraduate Advisor, *i.e.* Vice Chair for Undergraduate Education, Computer Engineering, Joint Program offered by the 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

ORIGINAL RESEARCH IDEAS AND THEIR IMPACT

Phonon Engineering and Phononics: In 1997, as a postdoctoral researcher at UCLA, I envisioned that by changing the spectrum of acoustic phonons in nanostructures *via* spatial confinement, one could modify the interaction of phonons with defects and other phonons and, as a result, alter the phonon thermal conductivity. Previously, in the context of thermal transport, the energy dispersion of acoustic phonons was assumed to be the same as in bulk semiconductors, even in free-standing nanostructures. The bulk phonon–boundary scattering was the only nanoscale-related mechanism believed to be affecting the phonon heat conduction in nanostructures. My theoretical paper (Phys. Rev. B (1998)) was the first report that described the acoustic phonon confinement effect on thermal transport and introduced the term nanoscale “phonon engineering”. It took years but eventually, the idea of the phonon wave interference effects, the other term for phonon confinement effects, became conventionally accepted. In 2016, with my research group, I demonstrated experimentally the spatial confinement of acoustic phonons in individual semiconductor nanowires, proving that the acoustic phonon spectrum is strongly modified even in nanowires with relatively large

diameters (Nature Com. (2016)). Later, my group proved that even doping of bulk semiconductors can change the acoustic phonon velocity (APL (2018); ACS Appl. Mater. (2022)). The phonon engineering concepts and approaches are now being incorporated into the design of devices to increase energy conversion efficiency, enhance electron mobility, improve heat removal, and tune the light-matter interactions. Phonon engineering became the mainstream research direction with practical applications. The recognitions for my research included the IEEE Pioneer in Nanotechnology Award (2011), a Fellow of IEEE, numerous plenary, keynote, and invited talks at the top conferences such as the international biannual PHONONICS, flagship IEEE NANO, invited reviews in Materials Today, MRS Bulletin, and several U.S. patents granted in the nanophononics field.

Graphene Thermal Field: After the first exfoliation of graphene and electrical measurements in 2004, the research community has focused on the linear, *i.e.* Dirac, energy dispersion of electrons in graphene and its implications for electronic transport. In 2008, I went in an entirely different direction by conducting pioneering studies of the thermal properties of graphene. My first experimental paper on the subject (Nano Letters (2008)), has been cited more than 17,000 times. Following the experimental discovery that the thermal conductivity of graphene can be exceptionally high, I explained this non-trivial fact theoretically by the specifics of the 2D phonon transport in graphene (Nature Mat. (2010); Phys. Rev. B (2010); and Nature Mat. (2011)). In 2011, expanding this research field to engineering applications, my group developed the first thermal interface materials (TIMs) with graphene and few-layer graphene (FLG). In later years, the group demonstrated the application of graphene–FLG thermal technologies with computers, solar cells, and battery packs. The optothermal method for measuring thermal conductivity, which I developed for graphene, has been extended to other 2D materials and adopted in many laboratories worldwide. The graphene thermal technologies have become the real large-scale practical application of graphene – one can now buy commercial thermal paste or epoxies with graphene fillers, or even sports jackets with graphene-enhanced textiles for better heat spreading. The recognitions for these research achievements included The MRS Medal from the Materials Research Society, a Fellow of MRS, The Brillouin Medal, numerous plenary and keynote talks at the top conferences such as Graphene Week, MRS Fall and Spring Meetings, Nature Conference, invited reviews in Nature Mat., Reports on Progress in Physics, and ACS Nano, a feature article in IEEE Spectrum and other magazines. I also received several U.S. patents in the graphene thermal field that originated from my Nano Letter (2008) and Nature Materials (2011) papers.

Electronic Noise Spectroscopy: In 1998, I entered the field of low-frequency electronic noise as an electrical engineer, trying to reduce the $1/f$ noise in field-effect transistors based on wide-band-gap semiconductors (f is the frequency). The task was accomplished with the noise reduced by several orders of magnitude to the level acceptable for materials' applications in communication systems (Appl. Phys. Lett (1999); IEEE Trans. MTT (1999)). In 2009, I started investigating the noise in graphene and other 2D materials to remove the barrier for their applications in sensors, detectors, and communication devices (Nature Nano (2013)). At about that time, I also looked at noise as a materials scientist and turned things upside down in the graphene electronic field by treating low-frequency noise as a signal. My group demonstrated

an innovative graphene sensor, where the noise was used as a signal – allowing one to distinguish different gases by characteristic peaks in the noise spectra (Nano Letters (2012)). The group also discovered that the noise mechanism in graphene is not the same as in semiconductors and used few-layer graphene to address the century-old problem of distinguishing if $1/f$ noise is a volume or a surface phenomenon (Appl. Phys. Lett (2014)). In 2016, I started to develop approaches for using noise measurements as a materials characterization tool to monitor phase transitions in charge-density-wave (CDW) materials and other strongly correlated quantum materials. Current fluctuations, *i.e.* low-frequency noise, are more sensitive to phase transitions, and CDW depinning than the current-voltage characteristics. The innovative noise spectroscopy approaches were used to monitor CDWs in 2D and 1D van der Waals materials. Noise spectroscopy was also applied to test the reliability of diamond and other ultra-wide-band-gap (UWBG) semiconductor devices. The recognitions for these achievements included the election to Fellow of SPIE, plenary talks at the top noise conference, e.g. International Conference on Noise and Fluctuations (ICNF), Gainesville, USA, and in Neuchâtel, Switzerland; serving as a General Chair of the SPIE Noise Conference and member of the international committee for Unsolved Problems of Noise (UPON); editing a book Noise and Fluctuations Control in Electronic Devices, which became a standard reference source; and invited review in Nature Nano on $1/f$ noise in graphene.

Quantum 1D/2D van der Waals 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, my group focused on charge-density-wave (CDW) phenomena in 2D materials to achieve new device functionalities. My group demonstrated the first CDW quantum device, a voltage-controlled oscillator based on 2D CDW material, operational at room temperature (Nature Nano (2016)). In 2023, my group achieved a breakthrough, demonstrating the first “quantum composite” with the unique functionality achieved via CDW condensate transitions above room temperature (Advanced Materials (2023)). These achievements were recognized with invited talks on 2D and 1D CDWs materials at MRS Spring Meetings, APS March Meetings, SPIE conferences, and other top international conferences. In 2022, I was awarded The Vannevar Bush Faculty Fellowship (VBFF) to investigate 1D quantum materials.

Inelastic Light Scattering Spectroscopies: Since 1997, I have been interested in inelastic light scattering spectroscopy to understand the phonon properties of 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 (Nano Letters (2008)). 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. The 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. The recognitions for these achievements include the 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 paper in Nature Photonics (2021).

BRIEF BIOGRAPHY



Alexander A. Balandin is a distinguished professor and vice chair for graduate education at the Department of Materials Science and Engineering (MSE) of the Henry Samueli School of Engineering and Applied Science (SEAS) at the University of California, Los Angeles (UCLA). He directs the Phonon Optimized Engineered Materials (UCLA POEM) Laboratory at the MSE department and the Brillouin – Mandelstam Spectroscopy (BMS) Laboratory at The California NanoSystems Institute (CNSI). Before rejoining UCLA, he served as a founding chair of the MSE program and director of the NanoFab at a sister UC campus in Riverside. He received his Diploma in Applied Physics from the Moscow Institute of Physics and Technology (MIPT), Russia, and his Ph.D. in Electrical Engineering from the University of Notre Dame, USA.

Professor Balandin's expertise is in the physics of materials. Among his research achievements are the pioneering investigation of the acoustic phonon transport and thermal conductivity of graphene and few-layer graphene; the study of the acoustic phonon confinement effects in semiconductor nanostructure; the development of the concept of phonon engineering; and the use of low-frequency electronic noise measurements for material characterization. He developed the optothermal technique for measuring the thermal conductivity of 2D materials by converting a Raman spectrometer to a heater and a temperature sensor. The technique became a standard method in numerous laboratories worldwide.

Professor Balandin's current research interests include low-dimensional 1D/2D van der Waals materials; charge density waves and strongly correlated phenomena in novel materials and nanostructures; inelastic light scattering spectroscopies; electron and phonon transport in quantum materials; thermal conductivity and thermal management; ultra-wide-band-gap semiconductors; emerging electronic devices and quantum technologies. Professor Balandin received The MRS Medal from the Materials Research Society and The Pioneer of Nanotechnology Award from the IEEE Society for his graphene, phononics, and nanotechnology research. He is an elected fellow of MRS, APS, IEEE, OSA, SPIE, AAAS, and The Institute of Physics professional societies. He was a visiting professor and elected fellow of Pembroke College, University of Cambridge, U.K. He is currently a Vannevar Bush faculty fellow (VBFF). He serves as a Deputy Editor-in-Chief of the Applied Physics Letters (APL). Professor Balandin graduated more than 40 Ph.D. students who enjoy successful careers in the U.S. industry, government laboratories, and academia.

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