

Jayakanth Ravichandran

Assistant Professor

Mork Family Department of Chemical Engineering and Materials Science

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RESEARCH INTERESTS

Synthesis of Thin film and Bulk materials, Transport properties (Electrical, Thermal, Optical and Electro-chemical) of Complex materials particularly Oxides and Chalcogenides, Materials Design, Quantum mechanical effects and effects of electron correlation in materials.

EDUCATION

University of California, Berkeley, Applied Science & Technology Graduate Group (2007-11)

- *Ph.D.* in Applied Science and Technology (Major: Quantum Physics, Minor: Heat Transfer)
- *Dissertation:* Thermal and electrical transport in oxide heterostructures
- *Advisors:* Prof. R. Ramesh (UC Berkeley) & Prof. Arun Majumdar (Stanford)

Indian Institute of Technology, Kharagpur, India (2002-07)

- *B.Tech.* (Hons.) and *M.Tech.* in Metallurgical and Materials Engineering & Minor in Physics.
- *Thesis:* Synthesis and Characterization of tin oxide nanowires for hydrogen sensing applications

PROFESSIONAL PREPARATION

Assistant Professor – Department of Chemical Engineering and Materials Science (01/'15 – present)
University of Southern California, Los Angeles, CA

Post-doctoral Fellow – Department of Physics, Harvard University, Cambridge, MA (06/'14 – 12/'14)
• Sponsor: Prof. Philip Kim (Physics)

Post-doctoral Fellow – Department of Physics, Columbia University, New York, NY (01/'12 – 05/'14)
• Sponsor: Prof. Philip Kim (Physics)

Research Assistant - Applied Science and Technology, University of California, Berkeley (07/'07 – 12/'11)
• Advisors: Prof. R Ramesh (Materials Science) and Prof. Arun Majumdar (Mechanical Engineering)

FELLOWSHIPS AND AWARDS

- Early Career Scholar in Materials Science – Journal of Materials Research (2017)
- Link Foundation Energy Fellowship (2010-2012)
- Anselmo J. Macchi Fellowship (2008)
- Institute Silver Medal (IIT) (2007)
- J C Ghosh Memorial Prize (2005)
- P K Chakraborty Award (2005)

PEER REVIEWED JOURNAL PUBLICATIONS (Citations ~ 993, h-index = 17)

Note: My name is highlighted in bold and mentored graduate students' names have * after them, mentored undergraduate students have ** after them, corresponding authors are underlined.

Preprints:

1. S. Niu*, Y. Zhou*, D. Sarkar, K. Williams, R. Jaramillo, D. J. Singh, W. A. Tisdale, R. Kapadia, **J. Ravichandran**, "Solar optimal band-gap in a Ruddlesden Popper Chalcogenide", *to be submitted*.
2. T. Orvis*, A. Clough, K. Ye**, **J. Ravichandran**, "Electron doping of BaZrO₃", *to be submitted*.
3. B. Zhao*, **J. Ravichandran**, "Bilayer oscillators based on phase change oxides and their synchronization characteristics", *to be submitted*.
4. Guneeta Singh-Bhalla, P. B. Rossen*, G. K. Palsson, S. J. Suresha, D. Yi, A. Dasgupta, V. G. Ruiz, A. K. Yadav*, M. Trassin, J. T. Heron, C. S. Fadley, R. Pentcheva, **J. Ravichandran**, **R. Ramesh**, "Unexpected Termination Switching and Polarity Compensation in the LaAlO₃/SrTiO₃ Heterostructures", *under review*.
5. S. Niu*, G. Joe, H. Zhao, Y. Zhou*, T. Orvis*, H. Huyan*, J. Salman, K. Mahalingam, B. Urwin, J. Wu, Y. Liu*, T. Tiwald, S. B. Cronin, B. M. Howe, M. Mecklenburg, R. Haiges, D. J. Singh, **H. Wang**, **M. Kats**, **J. Ravichandran**, "Giant optical anisotropy in a quasi-1D crystal", *under review*.

- D. Sarkar, W. Wang, M. Mecklenburg, A. Clough, M. Yeung, C. Ren, Q. Lin, L. Blankemeier, S. Niu*, H. Zhao, H. Shi, H. Wang, S. B. Cronin, **J. Ravichandran**, M. Luhar, R. Kapadia, “Confined Liquid Phase Growth of Crystalline Compound Semiconductors on Any Substrate”, *under review*.

Peer Reviewed Journal Publications:

- S. Ghosh, S. Niu*, M. Yankova, M. Mecklenburg, S. M. King, **J. Ravichandran**, R. K. Kalia, A. Nakano, P. Vashishta, and P. Setlow, “Analysis of killing of growing cells and dormant and germinated spores of *Bacillus* species by black silicon nanopillars”, *Scientific Reports*, **7**, 17768 (2018).
- K. Luo*, S. Niu*, D. Shah**, A. Lonkar**, Y. Liu*, and **J. Ravichandran**, “Perovskite Oxide Multilayers as Soft X-ray Mirrors”, *Materials Research Bulletin*, **98**, 206 (2018).
- S.Y.F. Zhao, G.A. Elbaz, D. K. Bediako, C. Yu, D.K. Efetov, Y. Guo, **J. Ravichandran**, K.-A. Min, S. Hong, T. Taniguchi, K. Watanabe, L.E. Brus, X. Roy, and P. Kim, “Controlled Electrochemical Intercalation of graphene/hBN van der Waals Heterostructures”, *Nano Letters*, **18** (1), 460 (2018).
- Q. Lin, D. Sarkar, Y. Lin, M. Yeung, L. Blankemeier, J. Hazra, W. Wang, S. Niu*, **J. Ravichandran**, Z. Fan, R. Kapadia, “A Scalable Indium Phosphide Thin-Film Nanophotonics Platform for Photovoltaic and Photoelectrochemical Devices”, *ACS Nano* **11** (5), 5113 (2017).
- S. Niu*, H. Huyan*, Y. Liu*, M. Yeung, K. Ye**, L. Blankemeier, T. Orvis*, D. Sarkar, D. J. Singh, R. Kapadia, and **J. Ravichandran**, “Band-Gap Control via Structural and Chemical Tuning of Transition Metal Perovskite Chalcogenides”, *Advanced Materials* **29**, 1604733 (2017) [Featured in **Advanced Science News, Nanowerk, Sciencenewline, Phys.org, ECN Magazine, EurekAlert!, Health Medicine Network, Controlled Environments Magazine, AZO Materials, Chemeurope.com**].
- J. Ravichandran**, “Thermoelectric and Thermal Transport Properties of Complex Oxide Thin Films, Heterostructures and Superlattices”, *Journal of Materials Research* **32** (1), 183 (2017). (Invited Review: Focus issue on Early Career Scholars in Materials Science)
- J. Ravichandran**, C. R. Serrao, D. K. Efetov, D. Yi, Y. S. Oh, S-W. Cheong, R. Ramesh and P. Kim, “Ambipolar Transport and Magnetoresistance Crossover in a Mott Insulator, Sr_2IrO_4 ”, *Journal of Physics: Condensed Matter* **28**, 505304 (2016). [IOPSelect - Articles from the last 12 months that have been chosen by our editors for their novelty, significance and potential impact on future research].
- M. Huang, G. Jnawali, J.-F. Hsu, S. Dhingra, H. Lee, S. Ryu, F. Bi, F. Ghahari, **J. Ravichandran**, L. Chen, P. Kim, C.-B. Eom, B. D’Urso, P. Irvin, and J. Levy, *APL Materials* **3**, 062502 (2015).
- W. Gao, A. I. Khan, X. Marti, C. Nelson, C. R. Serrao, **J. Ravichandran**, R. Ramesh and S. Salahuddin, “Room Temperature Ferroelectric Negative Capacitance in a ferroelectric-dielectric superlattice heterostructure”, *Nano Letters* **14**, 5814 (2014).
- J. Ravichandran**, A. K. Yadav*, R. Cheaito, P. B. Rossen*, A. Soukiassian, S. J. Suresha, J. C. Duda, B. M. Foley, C-H. Lee, Y. Zhu, A. W. Lichtenberger, J. E. Moore, D. A. Muller, D. G. Schlom, P. E. Hopkins, A. Majumdar, R. Ramesh and M. A. Zurbuchen, “Crossover from incoherent to coherent phonon scattering in epitaxial oxide superlattices”, *Nature Materials* **13**, 168-172 (2014).
- A. Biswas, P. B. Rossen*, **J. Ravichandran**, Y-H. Chu, Y-W. Lee, C-H. Yang, R. Ramesh, Y. H. Jeong, “Creating both A-site and B-site terminated surfaces on oxide substrates”, *Applied Physics Letters*, **102**, 051603 (2013).
- E. Ertekin, V. Srinivasan, **J. Ravichandran**, P. B. Rossen*, W. Siemons, A. Majumdar, R. Ramesh and J. Grossman, “Interplay between intrinsic defects, doping and free carriers in perovskite thin films”, *Physical Review B*, **85**, 195460 (2012).
- J. E. Kleibeuker, B. Kuiper, S. Harkema, D. H. A. Blank, G. Koster, G. Rijnders, P. Tinnemans, E. Vlieg, P. B. Rossen*, **J. Ravichandran**, R. Ramesh, G. Portale, W. Siemons and J. M. Szepieniec, “Surface analysis of polar DyScO_3 (110)”, *Physical Review B*, **85**, 165413 (2012).
- J. Ravichandran**, A. K. Yadav*, W. Siemons, M. A. McGuire, V. M. Wu**, A. Majumdar and R. Ramesh, “Size effects on thermoelectricity in a strong correlated electron system”, *Physical Review B*, **85**, 085112 (2012).
- K. R. Balasubramanian, V. M. Kao, **J. Ravichandran**, P. B. Rossen*, W. Siemons and J. W. Ager III, “Semiconductor thin films directly from mineral – Study of structural, optical and transport characteristics of Cu_2O thin films from malachite mineral and synthetic copper oxide”, *Thin solid films*, **520**, 3914 (2012).
- D-W. Oh, **J. Ravichandran**, C-W. Liang, W. Siemons, B. Jalan, C. M. Brooks, M. Huijben, D. G. Schlom, S. Stemmer, L. W. Martin, A. Majumdar, R. Ramesh and D. G. Cahill, “Thermal conductivity as a metric for the crystalline quality of SrTiO_3 epitaxial layers”, *Applied Physics Letters*, **98**, 221904 (2011).
- J. Ravichandran**, J. T. Kardel**, M. L. Scullin, J.-H. Bahk, H. Heijmerikx**, J. E. Bowers and A. Majumdar, “An apparatus for simultaneous measurement of electrical conductivity and thermopower of thin films in the temperature range of 300-750 K”, *Review of Scientific Instruments*, **82**, 015018 (2011).
- J. Ravichandran**, W. Siemons, M. L. Scullin, S. Mukerjee, M. Huijben, J. E. Moore, A. Majumdar and R. Ramesh, “Tuning the electronic effective mass in double-doped SrTiO_3 ”, *Physical Review B*, **83**, 035101 (2011).
- G. Singh-Bhalla, C. Bell, **J. Ravichandran**, W. Siemons, Y. Hikita, S. Salahuddin, A. F. Hebard, H. Y. Hwang and R. Ramesh, “Built-in and induced polarization across $\text{LaAlO}_3/\text{SrTiO}_3$ heterojunctions”, *Nature Physics*, **7**, 80 (2011).
- J. Ravichandran**, W. Siemons, D-W. Oh, J. T. Kardel**, A. Chari**, H. Heijmerikx**, M. L. Scullin, A. Majumdar, R. Ramesh and D. G. Cahill, “High temperature thermoelectric response of double-doped SrTiO_3 epitaxial films”, *Physical Review B*, **82**, 165126 (2010).
- J. Kleibeuker, G. Koster, W. Siemons, D. Dubbink, B. Kuiper, J. L. Blok, C-H. Yang, **J. Ravichandran**, R. Ramesh, J. E. ten Elshof, D. H. A. Blank and G. Rijnders, “Atomically defined rare-earth scandate crystal surfaces”, *Advanced Functional Materials*, **20**, 3490 (2010).

22. **J. Ravichandran**, W. Siemons, H. Heijmerikx**, M. Huijben, A. Majumdar and R. Ramesh, "An epitaxial transparent conducting perovskite oxide: double-doped SrTiO₃", *Chemistry of Materials*, **22**, 3983 (2010).
23. **M. L. Scullin, J. Ravichandran**, C. Yu, M. Huijben, J. Seidel, A. Majumdar and R. Ramesh, "Pulsed-laser deposition-induced reduction of SrTiO₃ crystals", *Acta Materialia*, **58**, 457 (2010).
24. S. P. Mondal, **S. K. Ray, J. Ravichandran** and I. Manna, "Temperature dependent growth and optical properties of SnO₂ nanowires and nanobelts", *Bulletin of Materials Science*, **33 (4)**, 357 (2010).
25. S. Maiti, M. Pastor, R. S. Sundaram, **J. Ravichandran**, K. Biswas and **I. Manna**, "Synthesis and characterization of nanocrystalline dysprosia stabilized zirconia based electrolyte for intermediate-temperature solid oxide fuel cell", *Journal of alloys and compounds*, **475**, 587 (2009).
26. **N. Chakraborti**, R. Sreevathsan, **R. Jayakanth** and B. Bhattacharya, "Tailor-made material design: An evolutionary approach using multi-objective genetic algorithms", *Computational Materials Science*, **45 (1)**, 1 (2009).
27. **J. Ravichandran**, A. G. Manoj, J. Liu, I. Manna and **D. L. Carroll**, "A novel polymer nanotube composite for photovoltaic packaging applications", *Nanotechnology*, **19**, 085712 (2008).
28. **N. Chakraborti, R. Jayakanth**, S. Das, E.D. Çalisir, and Ş. Erkoç, "Evolutionary and genetic algorithms applied to Li⁺-C system: calculations using differential evolution and particle swarm algorithm", *Journal of Phase Equilibria and Diffusion*, **28 (2)**, 140-149 (2007).
29. **N. Chakraborti**, S. Das, **R. Jayakanth**, R. Pekoz and Ş. Erkoç, "Genetic algorithms applied to Li⁺ ions contained in carbon nanotubes: an investigation using particle swarm optimization and differential evolution along with molecular dynamics", *Materials and Manufacturing Processes*, **22 (5)**, 562-569 (2007).
30. S. R. C. Vivekchand, **R. Jayakanth**, A. Govindaraj and **C. N. R. Rao**, "The problem of purification of single-walled carbon nanotubes", *Small*, **1 (10)**, 920-923 (2005).
31. R. Nandan, R. Rai, **R. Jayakanth**, S. Moitra, **N. Chakraborti** and A. Mukhopadhyay, "Regulating crown and flatness during hot rolling: a multi-objective optimization study using genetic algorithms", *Materials and Manufacturing Processes*, **20 (3)**, 459-478 (2005).

INVITED TALKS AND SEMINARS

- **Colloquium**, Department of Physics, California State University, Los Angeles – April 19, 2018 (upcoming)
- Ming Hsieh Institute Nano Materials and Devices seminar series, University of Southern California – January 11, 2018
- **Colloquium**, Materials Science and Engineering, Boston University – November 29, 2017
- **Colloquium**, Institute of Quantum Computing, University of Waterloo – November 13, 2017
- 26th International Materials Research Congress – 2017 (IMRC 2017), Cancun, Mexico (Organized by Materials Research Society, USA and Sociedad Mexicana de Materiales, Mexico) – August 22, 2017
- Nanoelectronic Materials Branch, Air Force Research Laboratory, Dayton, OH – August 17, 2017
- Jet Propulsion Laboratory, Pasadena, CA – July 25, 2017
- 9th International Conference on Materials for Advanced Technologies (ICMAT 2017), Singapore (organized by Materials Research Society, Singapore) – June 22, 2017
- Condensed Matter Seminar Series, Department of Physics and Astronomy, University of Utah, Salt Lake City – March 28, 2017
- Energy Materials Nanotechnology Meeting on Thermoelectric Materials 2016 (EMN 2016), Orlando, FL – February 22, 2016
- Conference on Electronic Materials and Applications 2016 (EMA 2016), Orlando, FL (Organized by American Ceramics Society) – January 22, 2016
- Chemical Engineering and Materials Science seminar, University of California, Irvine – May 8, 2015
- Mechanics and Materials Seminar, University of California, San Diego – February 23, 2015
- BBN Raytheon, Cambridge, MA, Special Seminar – November 25, 2014
- TRIUMF, Vancouver, BC, Canada – Special Seminar – August 28, 2014
- Department of Mechanical and Aerospace Engineering, The Ohio State University, Columbus, OH – April 16, 2014
- Mork Family Department of Chemical Engineering and Materials Science, University of Southern California, Los Angeles, CA – April 4, 2014
- Department of Metallurgical and Materials Engineering, Indian Institute of Technology, Kharagpur, India – April 4, 2013
- Department of Physics, Rutgers University, Piscataway, NJ – April 6, 2012
- Materials Science and Engineering and Mechanical and Aerospace Engineering Joint Seminar, University of Virginia, Charlottesville – January 10, 2012
- Department of Physics seminar, Indian Institute of Science, Bangalore, India – October 18, 2011
- MRSEC special seminar, Columbia university, NY – August 19, 2011
- Materials Research Society Spring meeting 2011 (MRS Spring 2011), San Francisco, CA – April 28, 2011

STUDENT SUPERVISIONS & ADVISING

Ph.D. Students:

Current:

1. Shanyuan Niu – *Link Foundation Energy Fellow* (Expected Summer 2019)

2. Thomas Orvis – *Provost's Fellow* (Expected Summer 2020)
3. Yang Liu (Expected Summer 2021)

M.S Students:

Current:

1. Yucheng Zhou (Expected Spring 2018)
2. Boyang Zhao (Expected Spring 2018)
3. Mythili Surendran (Expected Spring 2018)

Past:

- | | |
|---|---|
| 1. Shiyang Zhang (2015) | Now: Baidu (China) |
| 2. Kaihang Luo (2016) | Now: Industry in China |
| 3. Yang Liu (2016) | Now: PhD student, USC Ravichandran Lab |
| 4. Huaxiun Huyan (2017) | Now: PhD student, UC Irvine |
| 5. Shengyuan Bai (2017) | Now: PhD student, Michigan State University |
| 6. Fausto Isreal Mares-Davila (2017). | Now: Industry |
| 7. Ramanamurali Srinivasan (Expected Spring 2018) | Now: MS at USC |

Undergraduate Students:

Current:

1. Kevin Ye – *Barry Goldwater Fellow, Provost's Fellow (x5), Rose Hills Foundation Fellow* (Chemical Engineering - Junior)
2. Lisa Luciano (Chemical Engineering – Senior)
3. Dhyey Shah (Electrical Engineering – Sophomore)

Past:

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| 1. Hannah Cyr (USC - 2016) | Now: Industry in Australia |
| 2. William (Yu Ren) Zhou (UPenn - SURE Summer Fellow 2016) | Now: PhD student at MIT |
| 3. Kunjesh Agashiwala (BITS Pilani - Viterbi India Fellow 2016) | Now: PhD student at UCSB |
| 4. Amogh Lonkar (Electrical Engineering) | Now: BS at USC |
| 5. Kangmin Lee – <i>Provost's Fellow</i> (Chemical Engineering) | Now: BS at USC |
| 6. Yihong Fan – (Summer Intern 2017) | Now: BS at Tsinghua |

High School Students:

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|------------------------------------|---|
| 1. Malcolm Pithwala (Summer 2015) | Now: Undergraduate student at Univ of Minnesota, Twin Cities |
| 2. Matthew Kuner (Summer 2016) | Now: Undergraduate student at Georgia Institute of Technology |
| 3. Adrian Ballard (Summer 2016) | Now: Undergraduate student at Haverford College |
| 4. Yizhi Huang (Summer 2017) | |
| 5. Shravan Hariharan (Summer 2017) | |
| 6. Samantha Noriega (Summer 2017) | |

TEACHING

- MASC 504 – Diffusion and Phase Equilibria (Spring 2015-18)
- MASC 512 – Thin Film Science and Technology (Fall 2016-17)
- CHE 450 – Sustainable Energy (Fall 2016-17): Co-taught with Dr. Ted Lee (ChemE)

SERVICE

- Chair, Departmental Seminar Committee (2017-18)
- Faculty Coordinator, Departmental Seminar Series Organization Committee (2015-17)
- Member, Graduate Student Symposium Organization Committee (2015-16)
- Member, Graduate Recruitment Committee (2015-18)
- USC Chemical Safety Committee (2015-18)
- Screening Exam
 - Materials Science (2015-17)
 - Fall 2015: Andrew Clough (Che), Abbey Neer (Che)
 - Spring 2016: Dmitri Svetlov (Che), Joel Patrow (Che), Laura Estergreen (Che)
 - Fall 2017: Savannah Kapper (Che), JoAnna Milam-Guerrero (Che)
- Qualifying Exam
 - Spring 2015: Shima Haghghat (MASC), Michele Lee (MASC)
 - Fall 2015: Lee Hamill (MASC), Theresa Juarez (MASC), Andrew Clough (Che)
 - Spring 2016: Alireza Divsalar (ChemE), Abbey Neer (Che), Nathan Heckman (AME)
 - Fall 2016: Nirakar Poudel (EE-EP), Laura Estergreen (Che), Joel Patrow (Che)
 - Spring 2017: Vinh Diep (MASC), Hyungwoo Choi (ChemE), Rebecca Wilson (ChemE), Fatemeh Rezaeifar (EE-EP), Niki Bayat (ChemE)
 - Fall 2017: Prathamesh Karandikar (ChemE), Chunyang Sheng (MASC), Shiyu Su (EE-EP), Thomas Saal (Che)

- Spring 2018: Savannah Kapper (Che), Mark De Luna (ChemE), JoAnna Milam-Guerrero (Che), Debarghya Sarkar (EE-EP), Andre Kovach (ChemE)
- Thesis Defense
 - Spring 2015: Mikhail Polyakov (AME)
 - Spring 2016: Rohan Dhall (EE-EP) and Leonardo Velasco Estrada (AME)
 - Fall 2016: Kunal Dutta (EE-EP), Yoshitake Nakajima (EE-EP), Alireza Imani (EE-EP)
 - Spring 2017: Michele Lee (MASC), Shima Haghghat (MASC)
 - Fall 2017: Lee Hamill (MASC)
 - Spring 2018: Vinh Diep (MASC)

SYNERGISTIC ACTIVITIES

- Grant Reviewer for US National Science Foundation (NSF) (2015-17), US Air Force Office of Scientific Research (AFOSR) (2016-17), American Chemical Society Petroleum Research Fund (ACS PRF) (2017), Israel PAZY Foundation (2017).
- Journal Reviewer for ACS Nano, Advanced Functional Materials, Advanced Energy Materials, Advanced Materials Interfaces, APL Materials, Applied Physics Letters, Chemistry of Materials, Journal of Applied Physics, Materials and Manufacturing Processes, Materials Research Bulletin, Nano Letters, Nanoscale and Microscale Thermophysical Engineering, Physical Review Applied, Physica Status Solidi, Scientific Reports, and Solid State Communications.
- Symposium Organization: Lead organizer for a symposium each at ACerS Electronic Materials and Applications 2017, and ACerS Electronic and Advanced Materials 2018.
- Conference Session Chair at American Physical Society – March meeting 2015, Materials Research Society – Spring Meeting 2015, Materials Research Society – Spring Meeting 2016, International Conference on Materials for Advanced Technologies 2017, ACerS Electronic Materials and Applications 2017, and ACerS Electronic and Advanced Materials 2018.