

Rama K. Vasudevan

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[Publications](#)

Education

The University of New South Wales, Australia Nanotechnology B.Sc. Hons, 2010
The University of New South Wales, Australia Materials Science Ph.D., 2013

Professional and Synergistic Activities

2012-Present Reviewer for *J. Mat. Chem. C*, *J. Appl. Phys.*,
App. Phys. Lett., *Nanoscale*, and others.

Honors and Awards

2015 ORNL Postdoctoral Researcher award
2014 Faculty of Science Award for Excellence in PhD Research, UNSW
2010 - 2012 Recipient of Australian Postgraduate Award (APA) for study toward a
PhD in the Faculty of Science at University of New South Wales
2011 – 2012 Recipient of Faculty Top-Up Scholarship at UNSW
2012 Winner of 2012 Materials Science and Engineering Postgraduate
Student Presentation Competition

Publications (31 publications). Full publication list follows CV.

Research Synopsis

1. *Polarization and Transport in Ferroic and Ionic Materials*
Scanning probe microscopy (SPM) techniques have been applied to determine fundamental mechanisms of domain wall motion, conduction and electromechanical response in ferroic materials. These studies allow unravelling of the sources of conductivity, domain-wall –defect interactions, and test the applicability of macroscale theories on nanoscale systems. Techniques involving multi-frequency excitations are applied to ferroelectric thin films, ceramics and relaxor systems as well as battery materials.
2. *Local structure-property relations in manganites*
In-situ scanning probe microscopy is used following growth of epitaxial manganite thin films by pulsed laser deposition, to provide atomic-level insight into growth mechanisms and transport phenomena, and allowing structure-property relations to be mapped at the unit cell level.
3. *Big and Deep data analytics for extracting physics*
SPM measurements in combination with diffraction and other modalities offer tremendous opportunities for learning physics, but also present challenges in analysis. We implement methods, taken from existing computational science literature, to problems in materials science to extract meaningful information from large datasets, bridging divide between theory and measurements.

PUBLICATIONS

Dr. Rama Vasudevan

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Oak Ridge, Tennessee

Publications ([Google Scholar](#), 400+ citations, h-index: 12)

Journals with impact factor >6 are highlighted in red.

Refereed Reviews

1. R. K. Vasudevan, D. Marincel, S. Jesse, Y. Kim, A. Kumar, S. V. Kalinin and S. Trolrier-McKinstry, “Polarization Dynamics in Ferroelectric Capacitors: Local Perspective on Emergent Collective Behavior and Memory Effects,” **Advanced Functional Materials** **23**, 2490 (2013).
2. R. K. Vasudevan, S. Jesse, Y. Kim, A. Kumar and S. V. Kalinin, “Spectroscopic imaging in piezoresponse force microscopy: New opportunities for studying polarization dynamics in ferroelectrics and multiferroics,” MRS Communications **2**, 61 (2012).
3. S. Jesse, R. K. Vasudevan, L. Collins, E. Strelcov, M. B. Okatan, A. Belianinov, A. P. Baddorf, R. Proksch and S. V. Kalinin, “Band Excitation in Scanning Probe Microscopy: Recognition and Functional Imaging,” **Annual Review of Physical Chemistry** **65**, 519 (2014).
4. R. K. Vasudevan, W. D. Wu, J. R. Guest, A. P. Baddorf, A. N. Morozovska, E. A. Eliseev, N. Balke, V. Nagarajan, P. Maksymovych and S. V. Kalinin, “Domain Wall Conduction and Polarization-Mediated Transport in Ferroelectrics,” **Advanced Functional Materials** **23**, 2592 (2013).
5. J. Siedel, R. K. Vasudevan and V. Nagarajan, “Topological Structures in Multiferrroics-Domain Walls, Skyrmions and Vortices,” *Advanced Electronic Materials*, doi: 10.1002/aelm.201500292 (2015).
6. B. G. Sumpter, R. K. Vasudevan, T. Potok and S. V. Kalinin, “A bridge for acceleration materials by design,” *npj Comp. Mater.* **1**, 15008 (2015).

Refereed Journal Papers (Thematically Grouped)

POLARIZATION DYNAMICS IN FERROIC AND IONIC MATERIALS

4. R. K. Vasudevan, M. B. Okatan, Y. Liu, S. Jesse, J.-C. Yang, W.-I. Liang, Y.-H. Chu, J. Li, S. V. Kalinin, and V. Nagarajan, “Unraveling the origins of enhanced electromechanical response in mixed-phase BiFeO_3 ” *Physical Review B* **88**, 020402 (2013).
5. R. K. Vasudevan, M. B. Okatan, C. Duan, Y. Ehara, H. Funakubo, A. Kumar, S. Jesse, L.-Q. Chen, S. V. Kalinin, and V. Nagarajan, “Nanoscale Origins of Nonlinear Behavior in Ferroic Thin Films,” **Advanced Functional Materials** **23**, 81 (2013).
6. R. K. Vasudevan, M. B. Okatan, I. Rajapaksa, Y. Kim, D. Marincel, S. Trolrier-McKinstry, S. Jesse, V. Nagarajan, and S. V. Kalinin, “Higher order

- harmonic detection for exploring nonlinear interactions with nanoscale resolution*,” Scientific Reports **3**, 2677 (2013).
7. A. Belianinov, R. K. Vasudevan, E. Strelcov, C. Steed, S.-M. Yang, A. Tselev, S. Jesse, M. D. Biegalski, G. Shipman, C. Symons, A. Borisevich, R. Archibald and S. V. Kalinin, “*Big data and deep data in scanning and electron microscopies: deriving functionality from multidimensional datasets*,” Advanced Structural and Chemical Imaging **1**,1 (2015).
 8. R. K. Vasudevan, S. Zhang, M. B. Okatan, S. Jesse, S. V. Kalinin and N. Bassiri-Gharb, “*Mesoscopic Harmonic Mapping of Electromechanical Response in a Relaxor Ferroelectric*,” Applied Physics Letters **106**, 22901 (2015).
 9. R. K. Vasudevan, Y. Liu, J. Li, W.-I. Liang, A. Kumar, S. Jesse, Y.-C. Chen, Y.-H. Chu, V. Nagarajan, and S. V. Kalinin “*Nanoscale control of phase variants in strain-engineered BiFeO₃*,” **Nano Letters** **11**, 3346 (2011).
 10. Y. Y. Liu, R. K. Vasudevan, K. Pan, S. H. Xie, W. I. Liang, A. Kumar, S. Jesse, Y. C. Chen, Y. H. Chu, V. Nagarajan, S. V. Kalinin, and J. Y. Li, “*Controlling magnetoelectric coupling by nanoscale phase transformation in strain engineered bismuth ferrite*” **Nanoscale** **4**, 3175 (2012).
 11. R. K. Vasudevan, Y. Matsumoto, X. Cheng, A. Imai, S. Maruyama, H. L. Xin, M. B. Okatan, S. Jesse, S. V. Kalinin, V. Nagarajan, “*Deterministic arbitrary switching of polarization in a ferroelectric thin film*,” **Nature Communications** **5**, 4971 (2014).
 12. R. K. Vasudevan, Y.-C. Chen, H.-H. Tai, N. Balke, P. Wu, S. Bhattacharya, L. Q. Chen, Y.-H. Chu, I. N. Lin, S. V. Kalinin, and V. Nagarajan, “*Exploring topological defects in epitaxial BiFeO₃ thin films*,” **ACS Nano** **5**, 879 (2011).
 13. R. K. Vasudevan, K. A. Bogle, A. Kumar, S. Jesse, R. Magaraggia, R. Stamps, S. B. Ogale, H. S. Potdar, and V. Nagarajan, “*Ferroelectric and electrical characterization of multiferroic BiFeO₃ at the single nanoparticle level*,” Applied Physics Letters **99**, 252905 (2011).
 14. Y.-C. Chen, Q. He, F.-N. Chu, Y.-C. Huang, J.-W. Chen, W.-I. Liang, R. K. Vasudevan, V. Nagarajan, E. Arenholz, S. V. Kalinin, and Y.-H. Chu, “*Electrical Control of Multiferroic Orderings in Mixed-Phase BiFeO₃ Films*” **Advanced Materials** **24**, 3070 (2012).
 15. R. K. Vasudevan, A. N. Morozovska, E. A. Eliseev, J. Britson, J. C. Yang, Y. H. Chu, P. Maksymovych, L. Q. Chen, V. Nagarajan, and S. V. Kalinin, “*Domain Wall Geometry Controls Conduction in Ferroelectrics*,” **Nano Letters** **12**, 5524 (2012).
 16. A. N. Morozovska, R. K. Vasudevan, P. Maksymovych, S. V. Kalinin, and E. A. Eliseev, “*Anisotropic conductivity of uncharged domain walls in BiFeO₃*,” Physical Review B **86**, 085315 (2012).
 17. N. Balke, B. Winchester, W. Ren, Y. H. Chu, A. N. Morozovska, E. A. Eliseev, M. Huijben, R. K. Vasudevan, P. Maksymovych, J. Britson, S. Jesse, I. Kornev, R. Ramesh, L. Bellaiche, L. Q. Chen, and S. V. Kalinin, “*Enhanced*

- electric conductivity at ferroelectric vortex cores in BiFeO₃*,” **Nature Physics** **8**, 81 (2012).
18. A. Rana, H. Lu, K. Bogle, Q. Zhang, R.K. Vasudevan, V. Thakare, A. Gruverman, S. Ogale, and N. Valanoor, “*Scaling Behaviour of Resistive Switching in Epitaxial Bismuth Ferrite Heterostructures*,” **Advanced Functional Materials** **24**, 3962 (2014).
 19. P. Ponath, K. Fredrickson, A. B. Posadas, Y. Ren, X. Wu, R. K. Vasudevan, M. B. Okatan, S. Jesse, T. Aoki, M. R. McCartney, D. J. Smith, S. V. Kalinin, K. Lai, and A. A. Demkov, “*Carrier density modulation in a germanium heterostructure by ferroelectric switching*,” **Nature Communications** **6**, 6067 (2015).
 20. F. Lavini, N. Yang, R. K. Vasudevan, E. Strelcov, S. Jesse, M. B. Okatan, I. Kravchenko, D. Di Castro, S. V. Kalinin, G. Balestrino, C. Aruta and V. Foglietti, “*Bias assisted SPM direct write lithography enables local oxygen enrichment of Lanthanum Cuprates thin films*,” **Nanotechnology** **26**, 325302 (2015).
 21. A. B. Papandrew, C. Hartnett, M. B. Okatan, S. Jesse, S. V. Kalinin and R. K. Vasudevan, “*Catalysis Induced Elasticity Modulation in a superionic proton conductor probed by Band Excitation Atomic Force Microscopy*,” **Nanoscale** **7**, 20089 (2015).
 22. Q. Li, Y. Cao, P. Yu, R.K. Vasudevan, N. Laanait, A. Tselev, F. Xue, L.Q. Chen, P. Maksymovych, S.V. Kalinin and N. Balke, “*Giant elastic tenability in strained BiFeO₃ near an electrically induced phase transition*,” **Nature Communications** **6**, 8985 (2015).

LOCAL STRUCTURE-PROPERTY RELATIONS IN MANGANITES

23. R. K. Vasudevan, A. Tselev, A. P. Baddorf and S. V. Kalinin, “*Atomic scale Electrochemistry on the surface of a manganite by scanning tunneling microscopy*,” **Applied Physics Letters** **106**, 143107 (2015).
24. A. Tselev, R. K. Vasudevan, A. G. Gianfrancesco, L. Qiao, P. Ganesh, T. L. Meyer, H.-N. Lee, M. D. Biegalski, A. P. Baddorf and S. V. Kalinin, “*Surface control of epitaxial manganite films via oxygen pressure*”, **ACS Nano** **9**, 4316 (2015).
25. A. Tselev, R. K. Vasudevan, S. V. Kalinin and A. P. Baddorf, “*Effect of silver doping on the surface of La_{5/8}Ca_{3/8}MnO₃ epitaxial films*,” **Applied Physics Letters** **105**, 101602 (2014).
26. A. G. Gianfrancesco, A. Tselev, A. P. Baddorf, S. V. Kalinin and R. K. Vasudevan, “*Imaging the Ehrlich-Schwoebel Barrier: A combined Monte-Carlo and in-situ Scanning Tunneling Microscopy Approach*,” **Nanotechnology** **26**, 455705 (2015).
27. R. K. Vasudevan, Y. Cao, A. N. Morozovska, S. Zhang, M. B. Okatan, S. Jesse, L.-Q. Chen, P. Alpay, S. V. Kalinin and N. Bassiri-Gharb, “*Acoustic Detection of Phase Transitions on the Nanoscale*,” **Advanced Functional Materials** **26**, 478 (2016).

28. L. Qiao, J. H. Jang, D. J. Singh, Z. Gai, H. Xiao, A. Mehta, R. K. Vasudevan, A. Tselev, Z. Feng, H. Zhou, S. Li, W. Prellier, X. Zu, Z. Liu, A. Borisevich, A. P. Baddorf, M. D. Biegalski, *Dimensionality Controlled Octahedral Symmetry-Mismatch and Functionalities in Epitaxial LaCoO₃/SrTiO₃ Heterostructures*, **Nano Letters** **15**, 4677 (2015).

BIG AND DEEP DATA ANALYTICS FOR EXTRACTING PHYSICS

29. R. K. Vasudevan, A. Tselev, A. P. Baddorf and S. V. Kalinin, “*Big-Data Reflection High Energy Electron Diffraction Analysis for Understanding Epitaxial Film Growth Processes*,” **ACS Nano** **8**, 10899 (2014).
30. R. K. Vasudevan, A. Belianinov, A. G. Gianfrancesco, A. P. Baddorf, A. Tselev, S. V. Kalinin and S. Jesse, “*Big data in reciprocal space: Sliding fast Fourier transforms for determining periodicity*,” *Applied Physics Letters* **106**, 091601 (2015).
31. R. K. Vasudevan, S. Zhang, M. B. Okatan, S. Jesse, S. V. Kalinin and N. Bassiri-Gharb, “*Multidimensional Dynamic Piezoresponse Measurements: Unraveling Local Relaxation Behavior in Relaxor-Ferroelectrics via Big Data*,” *Journal of Applied Physics* **118**, 072003 (2015).