

Rama K. Vasudevan

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[Publications](#)

Education

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

Job History

2019-Present Data Science Coordinator, Center for Nanophase Materials Sciences

2016-Present Research and Development Associate, Scanning Probe Microscopy Group,
Center for Nanophase Materials Sciences, Oak Ridge National Laboratory.

2013-2015 Postdoctoral Research Associate in Scanning Probe Microscopy Group, Center
for Nanophase Materials Sciences, Oak Ridge National Laboratory (ORNL).

Professional and Synergistic Activities

2018 Appointed on the Internal Review Committee for SEED Proposals

2017 Appointed Faculty, Bredesen Center for Interdisciplinary Research and Graduate
Education (University of Tennessee)
PFM Workshop organizer (ISAF-PFM 2017); Tutorial Instructor (Materials
Research Society March Meeting, Phoenix AZ 2017), Workshop organizer
(Microscopy and Microanalysis 2018, and CNMS User Workshop).

2012-Present Reviewer for *J. Mat. Chem. C*, *J. Appl. Phys.*, *App. Phys. Lett.*, *Nanoscale*, *2D
Materials*, *npj Computational Materials*, and many more.

Proposals/Grants

2019 ORNL LDRD – *ORNL AI Initiative* (Reinforcement Learning/Materials Lead) –
Co-PI

2018 ORNL LDRD Proposal: “*Deep learning for solving inverse problems in imaging
and multi-spectral data*” - PI

2016-2017 ORNL SEED Proposal: “*Deep Text Learning for Better Materials*” - Co-PI

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)

Skillset

- Well-versed in materials science and condensed matter physics, computational physics, thermodynamics. Specializing in complex oxides (manganites, ferroelectrics, etc.)
- Data analytics, machine learning methods, computer vision, deep learning etc. Contributor to pycroscopy (open source python package with >120k downloads, github.com/pycroscopy) for analysing imaging and spectroscopic datasets.
- Ultra-high vacuum (UHV) synthesis (pulsed laser deposition) and characterization with advanced scanning probe microscopy (SPM) modalities.

PUBLICATIONS LIST

Publications ([Google Scholar](#), 1500+ citations, h-index: 22, >70 papers)

Journals with impact factor >6 are highlighted in red.

Refereed Reviews

1. R. K. Vasudevan, N. Balke, P. Maksymovych, S. Jesse and S. V. Kalinin, “*Ferroelectric or non-ferroelectric: why so many materials exhibit ferroelectricity on the nanoscale*”, **Applied Physics Reviews** **4**, 021302 (2017).
2. R. K. Vasudevan, D. Marincel, S. Jesse, Y. Kim, A. Kumar, S. V. Kalinin and S. Trolier-McKinstry, “*Polarization Dynamics in Ferroelectric Capacitors: Local Perspective on Emergent Collective Behavior and Memory Effects*,” **Advanced Functional Materials** **23**, 2490 (2013).
3. 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).
4. 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).
5. 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).
6. J. Siedel, R. K. Vasudevan and V. Nagarajan, “*Topological Structures in Multiferroics-Domain Walls, Skyrmions and Vortices*,” **Advanced Electronic Materials**, **2**, 1 (2016).
7. B. G. Sumpter, R. K. Vasudevan, T. Potok and S. V. Kalinin, “*A bridge for acceleration materials by design*,” **npj Computational Materials** **1**, 15008 (2015).
8. E. Strelcov, S.M. Yang, S. Jesse, N. Balke, R.K. Vasudevan and S.V. Kalinin, “*Solid-state electrochemistry on the nanometer and atomic scales: the scanning probe microscopy approach*,” **Nanoscale** **8**, 13838 (2016).
9. R. Kannan, A. V. Ievlev, N. Laanait, M. A. Ziatdinov, R. K. Vasudevan, S. Jesse, S. V. Kalinin, “*Deep data analysis via physically constrained linear unmixing: universal framework, domain examples, and a community-wide platform*,” **Advanced Structural and Chemical Imaging**, **4**, 6 (2018).

Refereed Journal Papers (Thematically Grouped)**POLARIZATION AND IONIC DYNAMICS IN FERROIC AND IONIC MATERIALS**

10. 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 BiFeO₃*” *Physical Review B* **88**, 020402 (2013).
11. L. Li, Y. Cao, S. Somnath, Y. Yang, S. Jesse, Y. Ehara, H. Funakubo, L.Q. Chen, S. V. Kalinin and R. K. Vasudevan, “*Direct imaging of the relaxation of individual ferroelectric interfaces in a tensile-strained film*,” *Advanced Electronic Materials* **3**, 1600508 (2017).
12. 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).
13. R. K. Vasudevan, M. B. Okatan, I. Rajapaksa, Y. Kim, D. Marincel, S. Trolier-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).
14. 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).
15. 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).
16. 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).
17. 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).
18. 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).
19. 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).
20. 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).
21. 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).
22. 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).
23. 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 BiFeO_3 ,” *Nature Physics* **8**, 81 (2012).
24. L. Li, Y. Yang, Z. Liu, S. Jesse, S. V. Kalinin and R. K. Vasudevan, “Correlation between piezoresponse nonlinearity and hysteresis in ferroelectric crystals at the nanoscale,” *Applied Physics Letters* **108**, 172905 (2016).
25. 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).
26. 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).
27. 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).
28. 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).
29. F. Kurnia, J. Cheung, X. Cheng, J. Sullaphen, S. V. Kalinin, V. Nagarajan and R. K. Vasudevan, “Nanoscale probing of elastic-electronic response to Vacancy motion in NiO nanocrystals,” *ACS Nano*, **11** 8387 (2017).
30. 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 BiFeO_3 near an electrically induced phase transition,” *Nature Communications* **6**, 8985 (2015).
31. J. C. Agar, A. R. Damodaran, M. B. Okatan, J. Kacher, C. Gammer, R. K. Vasudevan, S. Pandya, L. R. Dedon, R. V. K Mangalam, G. A. Velarde, S. Jesse, N. Balke, A. M. Minor, S. V. Kalinin and L. W. Martin, “Highly mobile ferroelastic domain walls in compositionally graded ferroelectric thin films,” *Nature Materials* **15**, 549 (2016).
32. C.-Y. Kuo, Z. Hu, J. C. Yang, S.-C. Liao, Y. L. Huang, R. K. Vasudevan, M. B. Okatan, S. Jesse, S. V. Kalinin, L. Li, H. J. Liu, C.-H. Lai, T. W. Pi, S. Agrestini, K. Chen, P. Ohresser, A. Tanaka, L. H. Tjeng and Y. H. Chu, “Single domain multiferroic BiFeO_3 thin films,” *Nature Communications* **7**, 12712 (2016).
33. S. Brewer, C. Deng, C. Callaway, S. V. Kalinin, R. K. Vasudevan and N. Bassiri-Gharb, “Piezoelectric response enhancement in the proximity of grain boundaries of relaxor-ferroelectric thin films,” *Applied Physics Letters* **108**, 242908 (2016).
34. D. Pradhan, S. Kumari, L. Li, R. K. Vasudevan, P. T. Das, V. S. Puli, D. K. Pradhan, A. Kumar, P. Misra, A. K. Pradhan, S. V. Kalinin and R. S. Katiyar, “Studies on Dielectric, Optical, Magnetic, Magnetic Domain Structure and Resistance Switching Characteristics of Highly c-axis Oriented NZFO Thin Films,” *Journal of Applied Physics* **122**, 033902 (2017).
35. S. M. Yang, A. N. Morozovska, R. Kumar, E. A. Eliseev, Y. Cao, L. Mazet, N. Balke, S. Jesse, R. K. Vasudevan, C. Dubourdieu, and S. V Kalinin, “Mixed electrochemical-ferroelectric states in nanoscale ferroelectrics,” *Nature Physics* **13**, 812 (2017).
36. R. K. Vasudevan, Y. Cao, N. Laanait, A. Ievlev, L. Li, J.-C. Yang, Y.-H. Chu, L. Q. Chen, S. V. Kalinin and P. Maksymovych, “Field enhancement of electronic conductance at ferroelectric domain walls,” *Nature Communications* **8**, 1318 (2017).

37. A. R Damodaran, S. Pandya, J. C. Agar, Y. Cao, R. K. Vasudevan, R. Xu, S. Saremi, Q. Li, J. Kim, M. R. McCarter, L. R. Dedon, T. Angsten, N. Balke, S. Jesse, M. Asta, S. V. Kalinin and L. W. Martin, “*Three-State Ferroelastic Switching and Large Electromechanical Responses in PbTiO₃ Thin Films*,” **Advanced Materials** **29**, 1702069 (2017).
38. S. M. Neumayer, A. V. Ievlev, L. Collins, R. Vasudevan, M. A. Baghban, O. Ovchinnikova, S. Jesse, K. Gallo, B. J. Rodriguez and S. V. Kalinin, “*Surface Chemistry Controls Anomalous Ferroelectric Behavior in Lithium Niobate*,” **ACS Applied Materials and Interfaces** **10**, 29153 (2018).
39. G. Lindgren, A. Ievlev, S. Jesse, O. S. Ovchinnikova, S. V. Kalinin, R. K. Vasudevan and C. Canalias, “*Elasticity Modulation Due to Polarization Reversal and Ionic Motion in the Ferroelectric Superionic Conductor KTiOPO₄*,” **ACS Applied Materials and Interfaces** **10**, 32298 (2018).
40. Y. Cao, Q. Li, M. Huijben, R. K. Vasudevan, S. V. Kalinin and P. Maksymovych, “*Electronic Switching by Metastable Polarization States in BiFeO₃ Thin Films*,” **Physical Review Materials** **2**, 094401 (2018).
41. D. K. Pradhan, S. Kumari, R. K. Vasudevan, E. Strelcov, V. S. Puli, D. K. Pradhan, A. Kumar, J. M. Gregg, A. K. Pradhan, S. V. Kalinin and R. S. Katiyar, “*Exploring the Magnetolectric Coupling at the Composite Interfaces of FE/FM/FE Heterostructures*,” **Scientific Reports** **8**, 17381 (2019).
42. S. M. Neumayer, L. Collins, R. Vasudevan, C. Smith, S. Somnath, V. Y. Shur, S. Jesse, A. L. Kholkin, S. V. Kalinin and B. J. Rodriguez, “*Decoupling Mesoscale Functional Response in PLZT across the Ferroelectric-Relaxor Phase Transition with Contact Kelvin Probe Force Microscopy and Machine Learning*,” **ACS Applied Materials and Interfaces** **10**, 42674 (2018).

LOCAL STRUCTURE-GROWTH-PROPERTY RELATIONS IN COMPLEX OXIDES

43. 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).
44. 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).
45. 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).
46. 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).
47. 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).
48. 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).

49. A. Tselev, R. K. Vasudevan, A. G. Gianfrancesco, L. Qiao, T. L. Meyer, H.N. Lee, M. D. Biegalski, A. P. Baddorf and S. V. Kalinin, “*Growth Mode Transition in Complex Oxide Heteroepitaxy: Atomically Resolved Studies*,” *Crystal Growth and Design* **16**, 2708 (2016).
50. P. Ponath, A. O’Hara, H.X. Cao, A. B. Posadas, R. K. Vasudevan, M. B. Okatan, S. Jesse, M. Berg, Z. Li, D. Zhang, A. J. Kellock, A. de Lozanne, J. Zhou, S. V. Kalinin, D. J Smith, and A. A. Demkov, “*Contradictory nature of Co doping in ferroelectric BaTiO₃*”, *Physical Review B*. **94**, 205121 (2016).
51. F. Kurnia, C. Liu, G. Liu, R. K. Vasudevan, S. M. Yang, S. V. Kalinin, N. Valanoor, and J. N. Hart, “*Localised nanoscale resistive switching in GaP thin films with low power consumption*,” *Journal of Materials Chemistry C*. **5**, 2153 (2017).
52. R. K. Vasudevan, H. Dixit, A. Tselev, L. Qiao, T. L. Meyer, V. R. Cooper, A. P. Baddorf, H. N. Lee, P. Ganesh and S. V. Kalinin, “*Surface Reconstructions and Modified Surface States in La_{1-x}Ca_xMnO₃*,” *Physical Review Materials* **2**, 104418 (2018).

MACHINE LEARNING AND STATISTICAL METHODS FOR UNCOVERING PHYSICS FROM IMAGING DATA

53. 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).
54. 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).
55. 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).
56. R. K. Vasudevan, M. Ziatdinov, S. Jesse and S. V. Kalinin, “*Phases and interfaces from real space atomically resolved data: physics based deep data image analysis*,” *Nano Letters* **16**, 5574 (2016).
57. R. K. Vasudevan, M. Ziatdinov, C. Chen and Sergei V. Kalinin, “*Analysis of citation networks as a new tool for scientific research*”, *MRS Bulletin* **41**, 1009 (2016).
58. S. V. Kalinin, E. Strelcov, A. Belianinov, S. Somnath, R. K. Vasudevan, E. J. Lingerfelt, R. K. Archibald, C. Chen, R. Proksch, N. Laanait and S. Jesse, “*Big, Deep and Smart Data in Scanning Probe Microscopy*,” *ACS Nano* **10**, 9068 (2016).
59. 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).
60. L. Vlcek, A. Maksov, M. Pan, S. Jesse, R. K. Vasudevan and S. V. Kalinin “*Knowledge Extraction from atomically resolved images*,” *ACS Nano* **11**, 10313 (2017).
61. L. Vlcek, R. K. Vasudevan, S. Jesse and S. V. Kalinin, “*Consistent integration of experimental and ab initio data into effective physical models*,” *Journal of Chemical Theory and Computation* **13**, 5179 (2017).
62. S. Somnath, K. J. H. Law, A. N. Morozovska, P. Maksymovych, Y. Kim, X. Lu, M. Alexe, R. Archibald, S. V. Kalinin S. Jesse and R. K. Vasudevan, “*Ultrafast IV Imaging by Bayesian Inversion*,” *Nature Communications* **9**, 513 (2018).

63. S. R. Young, A. Maksov, M. Ziatdinov, Y. Cao, M. Burch, J. Balachandran, L. Li, S. Somnath, R. M. Patton, S. V. Kalinin, and R. K. Vasudevan, “*Data mining for better material synthesis: The case of pulsed laser deposition of complex oxides*,” *Journal of Applied Physics* **123**, 115303 (2018).
64. M. Ziatdinov, O. Dyck, A. Maksov, X. Li, X. Sang, K. Xiao, R. R. Unocic, R. Vasudevan, S. Jesse and S. V. Kalinin, “*Deep Learning of Atomically Resolved Scanning Transmission Electron Microscopy Images: Chemical Identification and Tracking Local Transformations*,” *ACS Nano* **11**, 12742 (2017).
65. L. Li, Y. Yang, D. Zhang, Z.-G. Ye, S. Jesse, S. V. Kalinin and R. K. Vasudevan, “*Machine learning-enabled identification of material phase transitions based on experimental data: Exploring collective dynamics in ferroelectric relaxors*,” *Science Advances* **4**, 8672 (2018).
66. D. K. Pradhan, S. Kumari, E. Strelcov, D. K. Pradhan, R. S. Katiyar, S. V. Kalinin, N. Laanait and R. K. Vasudevan, “*Machine learning of phase diagrams from local measurements: Mapping the temperature-composition space to confidence*,” *npj Computational Materials* **4**, 23 (2017).
67. J. C. Agar, Y. Cao, B. Naul, S. Pandya, S. Walt, A. I. Luo, J. T. Maher, N. Balke, S. Jesse, S. V. Kalinin, R. K. Vasudevan and L. W. Martin, “*Machine Detection of Enhanced Electromechanical Energy Conversion in PbZrTiO₃ Thin Films*,” *Advanced Materials* **30**, 1800701 (2018).
68. R. K. Vasudevan, N. Laanait, E. M. Ferragut, K. Wang, D. Geohegan, K. Xiao, M. Ziatdinov, S. Jesse, O. Dyck and S. V. Kalinin, “*Mapping mesoscopic phase evolution during E-beam induced transformations via deep learning of atomically resolved images*,” *npj Computational Materials* **4**, 30 (2018)
69. L. Vlcek, M. A. Ziatdinov, A. Maksov, A. Tselev, S. V. Kalinin and R. K. Vasudevan, “*Learning from Imperfections: Predicting Structure and Thermodynamics from Atomic Imaging of Fluctuations*,” *ACS Nano* **13**, 718 (2019).
70. N. Borodinov, S. Neumayer, S. V. Kalinin, O. Ovchinnikova, R. K. Vasudevan and S. Jesse, “*Deep Neural Networks for Understanding Noisy Data Applied to Physical Property Extraction in Scanning Probe Microscopy*,” *npj Computational Materials* **5**, 25 (2019).

OTHER PAPERS NOT BELONGING TO ABOVE CATEGORIES

71. P. Liu, R. B. Dinwiddie, J. K. Keum, R. K. Vasudevan, S. Jesse, N. A. Nguyen, J. M. Lindahl and V. Kunc, “*Rheology, Crystal Structure and Nanomechanical Properties in Large-scale Additive Manufacturing of Polyphenylene Sulfide/Carbon Fiber Composites*,” *Composites Science and Technology* **168**, 263 (2018).

Conference Proceedings (ungrouped)

72. R. K. Vasudevan, A.G. Gianfrancesco, A.P. Baddorf, and S.V. Kalinin, “*Full information acquisition and analysis of reflection high energy electron diffraction data for epitaxial growth processes*,” *Microscopy and Microanalysis* **22** (S3), 376 (2016).
73. S. V. Kalinin, R. K. Vasudevan, A Borisevich, A Belianinov, R. Archibald, C Symons, E. Lingerfelt, B. Sumpter, L. Vlcek and S. Jesse, “*Big, deep, and smart data from atomically resolved images: exploring the origins of materials functionality*,” *Microscopy and Microanalysis* **22** (S3), 1416 (2016).
74. R. K. Vasudevan, M. Ziatdinov, S. Jesse and S.V. Kalinin, “*Phase determination from atomically resolved images: physics-constrained deep data analysis through an unmixing approach*,” *Microscopy and Microanalysis* **22** (S3), 1452 (2016).

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