Charudatta Phatak

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Education

B.Tech, Metallurgical and Materials Science Engineering, IIT-Bombay, India, 2004
M.Tech, Metallurgical and Materials Science Engineering, IIT-Bombay, India, 2005.
Ph.D, Materials Science Engineering, Carnegie Mellon University, PA, 2009.

Professional Experience

2020-present: Group Leader, Materials Science Division, ANL.
2020-present: Adjunct Faculty, Department of Materials Science and Engineering, Northwestern University.
2016-present: Materials Scientist, Materials Science Division, ANL.
2014–2016: Assistant Materials Scientist, Materials Science Division, ANL.
2012–2014: Assistant Materials Scientist, Nanoscience and Technology Division, ANL.
2011–2012: Assistant Materials Scientist, Materials Science Division; ANL.
2009–2011: Postdoctoral Researcher, Materials Science Division, ANL.

Research Interests

- Domain behavior and interactions in nanopatterned functional ferromagnets and oxide nanostructures.
- Understanding grain boundary behavior in solid electrolytes for fuel cells and Li ion batteries.
- Novel materials for low power, unconventional, and neuromorphic computing.
- Development of multi-dimensional imaging using TEM and X-ray microscopy.
- Advanced computational methods for data acquisition and analysis in electron microscopy.

Honors

- Presidential Student Award, Microscopy Society of America, 2008.
- Northwestern-Argonne Early Career Award, 2014.
- Strategic Laboratory Leadership Program Honoree, University of Chicago Booth School of Business, 2019.
- Impact Argonne Award, 2021.

Professional Activities

- Symposium organizer and chair at Annual Meeting of the Minerals, Metals and Materials Society, 2016, 2018, 2019, 2020.
- Programming committee for International Conference on Magnetism, 2018.
- Program committee of the 61st Annual Conference on Magnetism and Magnetic Materials, 2011, 2016.
- Member, Center for Nanoscale Materials User Executive Committee, 2015-2018.
- Chair, IEEE Nanotechnology Council Chicago Chapter.
- Referee for Nature, Nano Letters, ACS Nano, Appl. Phys. Lett., and Nanotechnol.
- Reviewer: DOE-BES, NSF, Deutsche Forschungsgemeinschaft (DFG).

Current Research Funding

- "Emergent Behavior on Nanoscale Functional Heterostructures", Department of Energy, Basic Energy Sciences, Materials Science and Engineering Division, $5,480,000, 10/1/21-9/30/23.
- "Ultra-Dense, Near-Perfect, Atomic and Synaptic Memory", Department of Energy, Basic Energy Sciences, $5,268,000, 10/1/21-09/30/24.
- "AutoPtycho: Autonomous, Sparse-sampled Ptychographic Imaging", Argonne Laboratory Directed Research and Development, $409,000, 04/01/21-03/31/23.
- "Layered Transition Metal Dichalcogenides Barriers for Interconnects", Argonne Laboratory Directed Research and Development, $440,000, 01/12/2022-11/30/2024.

Outreach and Mentoring

- I believe strongly in the importance of mentoring and I work hard to foster a 'mentor' friendly' environment within my group. I mentor a junior staff within my own division and across Argonne, in addition to students and postdocs from Northwestern University. I am involved in a number of diversity and outreach activities at Argonne, including educational activities for schools as well as a committee member of the Women in Science and Technology group. I was also until recently the student activity chair of the IEEE Chicago section.

Teaching

- I teach graduate course at Northwestern University: Nanoscale Magnetic Materials for Information Storage. I have also given guest lectures on electron tomography and nanomagnetic materials at local universities such as Illinois Institute of Technology, and Oakton community college. I have served as a thesis committee member for several graduate students. I have also supervised 3 postdoctoral fellows at Argonne National Laboratory, and 2 graduate students at Northwestern University.

Selected Invited Presentations:

1) C. Phatak, "Visualization Of Three Dimensional Magnetization Of Magnetic Nanostructures", 79th Annual Meeting of the Deutsche Physikalische Gesellschaft (DPG) Berlin, March 2015.

2) C. Phatak, "Exploring the domain behavior of magnetic nanostructures using Lorentz microscopy", ALS Seminar, Lawrence Berkley National Laboratory, August 2015.

3) C. Phatak, "Integrated Multimodal Imaging: From Functional Nanostructures To Lithium Ion Battery Cathodes", XXV International Materials Research Congress, Cancun, Mexico, August 14-19, 2016.

4) C. Phatak, V. Brajuskovic, S. Zhang, A. Petford-Long, W. Jiang, S. G. E. te Velthuis, A. Hoffmann, O. Heinonen, and M. De Graef, "Domain Behavior in Functional Materials Studied Using In-Situ Lorentz Transmission Electron Microscopy", Electron Holography Workshop 2017, Saitama, Japan, Feb 15-17 2017.

5) C. Phatak, “Domain behavior in functional materials studied using Lorentz microscopy”, CEMES-CNRS, Toulouse, France, October 2017.

6) C. Phatak et al., “Imaging Magnetic Domains in Functional Nanoscale Heterostructures using Lorentz microscopy,”, Microscopy and Microanalysis 2018 Meeting, Baltimore, MD, Aug 6-9 2018.

7) C. Phatak, “Frontiers in imaging functionalbehavior in nanoscale heterostructures using Lorentz transmission electron microscopy”, 2020 Argonne APS/CNM User Meeting, September 2020.

8) C. Phatak et al., “Frontiers in imaging functional behavior in nanoscale heterostructures using Lorentz transmission electron microscopy”, Virtual MRS Meeting, Nov 27 – Dec 4 2020.

9) C. Phatak, et al., “Advances in Imaging Magnetic Domains in Functional Materials using Lorentz microscopy”, Microscopy and Microanalysis 2022 Meeting, Portland, OR, Aug 2022.

10) C. Phatak, et al.,” Imaging of magnetic domain behavior in van der Waals ferromagnets”, 2023 MRS Spring Meeting, San Francisco, CA, Apr 2023.

List of Publications (h-index: 25)

1) M. Gee, C. Phatak, and R. Darling, “Determination of wear mechanisms by stepwise erosion and stereological analysis,” *Wear*, **258**, 412–425 (2005).

2) C. Phatak and M. De Graef, “Is a Cs Corrector Necessary for Lorentz Vector Field Tomography?,” *Microsc. Microanal.*, **13** (S2), 1332–1333 (2007).

3) C. Phatak, M. Beleggia, and M. De Graef, “Vector field electron tomography of magnetic materials: theoretical development.,” *Ultramicroscopy*, **108** (6), 503–13 (2008).

4) C. Phatak, J. A. Bain, J. G. Zhu, and M. De Graef, “Aberration Corrected Lorentz Microscopy for Perpendicular Magnetic Recording Media,” *Microsc. Microanal.*, **14** (S2), 832–833 (2008).

5) C. Phatak, M. DeGraef, A. Petford-Long, M. Tanase, and A. Imre, “Reconstruction of 3D Magnetic Induction Using Lorentz TEM,” *Microsc. Microanal.*, **14** (S2), 1054–1055 (2008).

6) C. Phatak, M. Tanase, A. K. Petford-Long, and M. De Graef, “Determination of magnetic vortex polarity from a single Lorentz Fresnel image.,” *Ultramicroscopy*, **109** (3), 264–7 (2009).

7) C. Phatak, E. Humphrey, M. DeGraef, and a Petford-Long, “Determination of the 3-D Magnetic Vector Potential using Lorentz Transmission Electron Microscopy,” *Microsc. Microanal.*, **15** (S2), 134 (2009).

8) C. Phatak, M. De Graef, and A. Petford-Long, “Improved Phase Reconstruction for Magnetic Materials in a Low-Aberration Environment,” *Microsc. Microanal.*, **15** (S2), 1276 (2009).

9) Budruk, C. Phatak, A. K. Petford-Long, and M. De Graef, "Domain Observations in Fe-Pd-Co by Dynamic in-situ Lorentz TEM," *Microsc. Microanal.*, **16** (S2), 1236 (2010).

10) N. Shukla, M. M. Nigra, M. a. Bartel, T. Nuhfer, C. Phatak, and a. J. Gellman, "Angle Resolved TEM Imaging of Pt Nanoparticles," *Catal. Letters*, **140**, 85–89 (2010).

11) C. Phatak, A. Petford-Long, and M. De Graef, "Three-Dimensional Study of the Vector Potential of Magnetic Structures," *Phys. Rev. Lett.*, **104**, 253901 (2010).

12) C. Phatak, A. Petford-Long, O. Heinonen, M. Tanase, and M. De Graef, "Nanoscale structure of the magnetic induction at monopole defects in artificial spin-ice lattices," *Phys. Rev. B*, **83**, 174431 (2011).

13) A. Budruk, C. Phatak, A. K. Petford-Long, and M. De Graef, "In situ Lorentz TEM magnetization study of a Ni–Mn–Ga ferromagnetic shape memory alloy," *Acta Mater.*, **59** (12), 4895–4906 (2011).

14) A. Budruk, C. Phatak, A. K. Petford-Long, and M. De Graef, "In situ Lorentz TEM magnetization studies on a Fe–Pd–Co martensitic alloy," *Acta Mater.*, **59** (17), 6646–6657 (2011).

15) C. Phatak, R. Pokharel, M. Beleggia, and M. De Graef, "On the magnetostatics of chains of magnetic nanoparticles," *J. Magn. Magn. Mater.*, **323** (22), 2912–2922 (2011).

16) C. Phatak, A. K. Petford-Long, and O. Heinonen, "Direct Observation of Unconventional Topological Spin Structure in Coupled Magnetic Discs," *Phys. Rev. Lett.*, **108**, 67205 (2012).

17) C. Phatak, M. Pan, A. K. Petford-Long, S. Hong, and M. De Graef, "Magnetic interactions and reversal of artificial square spin ices," *New J. Phys.*, **14** (7), 75028 (2012).

18) J. P. Morgan, J. Akerman, A. Stein, C. Phatak, R. M. L. Evans, S. Langridge, and C. H. Marrows, "Real and effective thermal equilibrium in artificial square spin ices," *Phys. Rev. B*, **87**, 24405 (2013).

19) G. Lee, B. Lai, C. Phatak, R. S. Katiyar, and O. Auciello, "Tailoring dielectric relaxation in ultra-thin high-dielectric constant nanolaminates for nanoelectronics," *Appl. Phys. Lett.*, **102**, 142901 (2013).

20) G. Lee, B. Lai, C. Phatak, R. S. Katiyar, and O. Auciello, "Interface-controlled high dielectric constant Al2O3 / TiOx nanolaminates with low loss and low leakage current density for new generation nanodevices," *J. Appl. Phys.*, **114**, 27001 (2013).

21) E. Humphrey, C. Phatak, and M. De Graef, "Modified Transport-of-Intensity Approach for Electrostatic and Magnetic Phase Shift Separation," *Microsc. Microanal.*, **19** (S2), 788–789 (2013).

22) E. Humphrey, C. Phatak, a. K. Petford-Long, and M. De Graef, "Separation of Electrostatic and Magnetic Phase Shifts using a Modified Transport-of-Intensity Equation," *Ultramicroscopy*, **139**, 5–12 (2014).

23) C. Phatak, Y. Liu, E. B. Gulsoy, D. Schmidt, E. Franke-Schubert, and A. Petford-Long, "Visualization of the magnetic structure of sculpted three-dimensional cobalt nanospirals.," *Nano Lett.*, **14** (2), 759–64 (2014).

24) S. H. Chang, J. Kim, C. Phatak, K. D'Aquila, S. K. Kim, S. J. Song, C. S. Hwang, J. A. Eastman, J. W. Freeland, and S. Hong, "X-ray Irradiation Induced Reversible Resistance Change in Pt/TiO2/Pt Cells," *ACS Nano*, **8** (2), 1584–1589 (2014).

25) K. D'Aquila, C. Phatak, M. V. Holt, B. D. Stripe, S. Tong, W. I. Park, S. Hong, and A. K. Petford-Long, "Bipolar resistance switching in Pt/CuOx/Pt via local electrochemical reduction," *Appl. Phys. Lett.*, **104**, 242902 (2014).

26) C. Phatak, A. K. Petford-Long, M. Beleggia, and M. De Graef, "Theoretical study of ferroelectric nanoparticles using phase reconstructed electron microscopy," *Phys. Rev. B*, **89**, 214112 (2014).

27) B. Lee, R. S. Katiyar, B.-K. Lai, C. Phatak, and O. Auciello, "Dielectric behavior related to TiOx phase change to TiO2 in TiOx/Al2O3 nanolaminate thin films," *MRS Commun.*, **4** (2), 67–72 (2014).

28) C. Phatak and M. De Graef, "Imaging of Domains and Vortices in Multifunctional Materials," in *Mesoscopic Phenomenon in Multifunctional Materials*, vol. 198, A. Saxena and A. Planes, Eds. Berlin, Heidelberg: Springer Berlin Heidelberg, 2014, pp. 137–158.

29) S. Zhang, A. K. Petford-Long, O. Heinonen, and C. Phatak, "Vortex jump behavior in coupled nanomagnetic heterostructures," *Appl. Phys. Lett.*, **105**, 212409 (2014).

30) C. Phatak and D. Gürsoy, "Iterative reconstruction of magnetic induction using Lorentz transmission electron tomography.," *Ultramicroscopy*, **150**, 54–64 (2015).

31) Y. Choi, P. Sharma, C. Phatak, D. J. Gosztola, Y. Liu, J. Lee, B. Lee, J. Li, A. Gruverman, S. Ducharme, and S. Hong, "Enhancement of Local Piezoresponse in Polymer Ferroelectrics via Nanoscale Control of Microstructure," *ACS Nano*, **9** (2), 1809–1819 (2015).

32) C. Phatak, A. Masseboeuf, L. de Knoop, C. Gatel, and M. Hytch, "Three Dimensional Visualization of Electromagnetic Fields from One Dimensional Nanostructures," *Microsc. Microanal.*, **21** (S3), 1977–1978 (2015).

33) S. Zhang, A. Petford-long, and C. Phatak, "Three dimensional magnetic field reconstruction of artificial Skyrmion heterostructures," *Microsc. Microanal.*, **21** (S3), 1959–1960 (2015).

34) C. Phatak, Y. Nashed, and T. Peterka, "Towards Multiresolution Phase Retrieval using Electron Ptychography," *Microsc. Microanal.*, **21** (S3), 2151–2152 (2015).

35) C. Phatak, A. K. Petford-Long, H. Zheng, J. F. Mitchell, S. Rosenkranz, and M. R. Norman, "Ferromagnetic domain behavior and phase transition in bilayer manganites investigated at the nanoscale," *Phys. Rev. B*, **92**, 224418 (2015).

36) S. Hong, S. H. Chang, C. Phatak, B. Magyari-Köpe, Y. Nishi, S. Chattopadhyay, and J. H. Kim, "(Invited) Mechanism Study of Reversible Resistivity Change in Oxide Thin Film," *ECS Trans.*, **69** (3), 51–55 (2015).

37) C. Phatak, A. K. Petford-Long, and M. De Graef, "Recent advances in Lorentz microscopy," *Curr. Opin. Solid State Mater. Sci.*, **20** (2), 107–114 (2016).

38) C. Phatak, L. de Knoop, F. Houdellier, C. Gatel, M. J. Hÿtch, and A. Masseboeuf, "Quantitative 3D electromagnetic field determination of 1D nanostructures from single projection.," *Ultramicroscopy*, **164**, 24–30 (2016).

39) C. Phatak, O. Heinonen, M. De Graef, and A. Petford-Long, "Nanoscale skyrmions in a non-chiral metallic multiferroic: Ni2MnGa," *Nano Lett.*, **16** (7), 4141–4148 (2016).

40) S. Zhang, A. K. Petford-Long, and C. Phatak, "Creation of artificial skyrmions and antiskyrmions by anisotropy engineering," *Sci. Rep.*, **6**, 31248 (2016).

41) V. Brajuskovic, F. Barrows, C. Phatak, and a. K. Petford-Long, "Real-space observation of magnetic excitations and avalanche behavior in artificial quasicrystal lattices," *Sci. Rep.*, **6**, 34384 (2016).

42) S. Zhang, Z. Zhou, G. Grocke, A. Petford-long, Y. Liu, X. Chen, and C. Phatak, "Visualization of Magnetization in CoFe Nanofibers by Lorentz TEM and Electron Holography," *Microsc. Microanal.*, **22** (S3), 1692–1693 (2016).

43) X. Yang, D. Gürsoy, C. Phatak, V. De Andrade, E. B. Gulsoy, and F. De Carlo, "Learning From Scanning Transmission Electron Microscopy to Enhance Transmission X-ray Microscopy : How We Can Merge STEM and TXM Datasets ?," *Microsc. Microanal.*, **22** (S3), 240–241 (2016).

44) K. A. Mohan, K. C. Prabhat, C. Phatak, M. De Graef, and C. A. Bouman, "Iterative Reconstruction of the Magnetization and Charge Density using Vector Field Electron Tomography," *Microsc. Microanal.*, **22** (S3), 1686–1687 (2016).

45) A. Demortiere, C. Phatak, A. Kovacs, J. Caron, N. Repnin, M. Duchamp, N. J. Zaluzec, P. Kral, I. S. Aranson, R. Dunin-Borkowski, A. Snezhko, and D. Miller, "Zig-zag Self-assembly of Magnetic Octahedral Fe3O4 Nanocrystals using in situ Liquid Transmission Electron Microscopy," *Microsc. Microanal.*, **22** (S5), 36–37 (2016).

46) X. Yang, F. De Carlo, C. Phatak, and D. Gürsoy, "A convolutional neural network approach to calibrating the rotation axis for X-ray computed tomography," *J. Synchrotron Radiat.*, **24** (2), 469–475 (2017).

47) S. S. L. Zhang, C. Phatak, A. K. Petford-Long, and O. G. Heinonen, "Tailoring magnetic skyrmions by geometric confinement of magnetic structures," *Appl. Phys. Lett.*, vol. 111, no. 24, 2017.

48) Y. Zhang, G. M. D. Godaliyadda, N. Ferrier, E. B. Gulsoy, A. Bouman, and C. Phatak, "Deep Learning , Dynamic Sampling and Smart Energy-dispersive Spectroscopy," *Proc. Front. Opt. 2017*, pp. 4–6, 2017.

49) C. Phatak, V. Brajuskovic, F. Barrows, and A. Petford-Long, “Modified Transport-of-Intensity Approach for Mapping In-situ Magnetic Induction,” *Microsc. Microanal.*, vol. 23, no. S1, pp. 930–931, 2017.

50) Y. Zhang, G. M. D. Godaliyadda, Y. S. G. Nashed, N. Ferrier, E. Begum Gulsoy, and C. Phatak, “Under-sampling and Image Reconstruction for Scanning Electron Microscopes,” *Microsc. Microanal.*, vol. 23, no. S1, pp. 136–137, 2017.

51) P. N. Lapa, J. Ding, C. Phatak, J. E. Pearson, J. S. Jiang, A. Hoffmann, and V. Novosad, “Magnetic vortex nucleation/annihilation in artificial-ferrimagnet microdisks,” *J. Appl. Phys.*, vol. 122, no. 8, p. 83903, 2017.

52) F. Barrows, P. Nealey, T. Segal-Peretz, L. Stan, J. Elam, A. Mane, E. Porath, C. Phatak, and A. Petford-Long, “Honeycomb Networks of Metal Oxides from Self-Assembling PS-PMMA Block Copolymers,” *Microsc. Microanal.*, vol. 23, no. S1, pp. 1654–1655, 2017.

53) Y. Sharma, R. Agarwal, C. Phatak, B. Kim, S. Jeon, R. S. Katiyar, and S. Hong, “Long-range Stripe Nanodomains in Epitaxial (110) BiFeO3 Thin Films on (100) NdGaO3 Substrate,” *Sci. Rep.*, vol. 7, no. 1, p. 4857, 2017.

54) K. C. Prabhat, K. Aditya Mohan, C. Phatak, C. Bouman, and M. De Graef, “3D reconstruction of the magnetic vector potential using model based iterative reconstruction,” *Ultramicroscopy*, vol. 182, pp. 131–144, 2017.

55) J. Park, D. Kim, D. Jin, C. Phatak, K. Y. Cho, Y. G. Lee, S. Hong, M. H. Ryou, and Y. M. Lee, “Size effects of micro-pattern on lithium metal surface on the electrochemical performance of lithium metal secondary batteries,” *J. Power Sources*, vol. 408, no. September, pp. 136–142, 2018.

56) F. Barrows, A. Petford-Long, and C. Phatak, “Topological Defects and Interaction of Electron Waves and Localized Magnetic Charge,” *Microsc. Microanal.*, vol. 24, no. S1, pp. 940–941, 2018.

57) V. Brajuskovic, A. Addi, C. Phatak, and A. K. Petford-Long, “Observation of transient states during magnetization reversal in a quasicrystal artificial spin ice,” *Phys. Rev. B*, vol. 98, no. 9, p. 94424, 2018.

58) Y. Zhang, G. M. D. Godaliyadda, N. Ferrier, E. B. Gulsoy, C. A. Bouman, and C. Phatak, “SLADS-Net: Supervised Learning Approach for Dynamic Sampling using Deep Neural Networks,” *Electron. Imaging*, vol. 2018, no. 15, pp. 131-1–1316, 2018.

59) C. Phatak, F. Barrows, V. Brajuskovic, S. Bakaul, O. Heinonen, M. De Graef, W. Jiang, S. G. E. te Velthuis, A. Hoffmann, and A. Petford-Long, “Imaging Magnetic Domains in Functional Nanoscale Heterostructures using Lorentz microscopy,” *Microsc. Microanal.*, vol. 24, no. S1, pp. 910–911, 2018.

60) X. Xu, S. Haile, and C. Phatak, “In-situ Electron Holography Study of Grain Boundaries in Cerium Oxide,” *Microsc. Microanal.*, vol. 24, no. S1, pp. 1466–1467, 2018.

61) C. Campbell, B. Lee, Y. M. Lee, K. Y. Cho, Y.-G. Lee, S. Hong, and C. Phatak, "Correlative SPM/TEM Investigation of the Electrochemical Deposition of Lithium Metal," *Microsc. Microanal.*, vol. 24, no. S1, pp. 1524–1525, 2018.

62) K. Aditya Mohan, K. C. Prabhat, C. Phatak, M. De Graef, and C. A. Bouman, "Model-Based Iterative Reconstruction of Magnetization using Vector Field Electron Tomography," *IEEE Trans. Comput. Imaging*, 2018.

63) B. Kim, F. P. Barrows, Y. Sharma, R. S. Katiyar, C. Phatak, A. K. Petford-Long, S. Jeon, and S. Hong, "Ferroelectric Domain Studies of Patterned (001) BiFeO3 by Angle-Resolved Piezoresponse Force Microscopy," *Sci. Rep.*, vol. 8, no. 1, p. 203, 2018.

64) T. R. Kim, C. Phatak, A. K. Petford-long, Y. Liu, C. Taylor, B. Zhang, S. Myers, A. Greene, T. Seki, M. Alex, G. A. Bertero, and R. Sinclair, "Correlative Magnetic Imaging of Heat-Assisted Magnetic Recording Media in Cross Section Using Lorentz TEM and MFM," *IEEE Trans. Magn.*, vol. 54, no. 1, p. 6500105, 2018.

65) A. Hierro-Rodriguez, D. Gürsoy, C. Phatak, C. Quirós, A. Sorrentino, L. M. Álvarez-Prado, M. Vélez, J. I. Martín, J. M. Alameda, E. Pereiro, and S. Ferrer, "3D reconstruction of magnetization from dichroic soft X-ray transmission tomography," *J. Synchrotron Radiat.*, vol. 25, no. 4, pp. 1144–1152, Jul. 2018.

66) C. Campbell, Y. M. Lee, K. Y. Cho, Y. G. Lee, B. Lee, C. Phatak, and S. Hong, "Effect of nanopatterning on mechanical properties of Lithium anode," *Sci. Rep.*, vol. 8, no. 1, pp. 1–9, 2018.

67) Y. Zhang, G. M. D. Godaliyadda, N. Ferrier, E. B. Gulsoy, C. A. Bouman, and C. Phatak, "Reduced Electron Exposure for Energy-Dispersive Spectroscopy using Dynamic Sampling," *Ultramicroscopy*, vol. 184, pp. 90–97, 2018.

68) C. Phatak, A. Petford-Long, "Direct Evidence of Topological Defects in Electron Waves through Nanoscale Localized Magnetic Charge", *Nano Letters*, vol.8, no.11, pp. 6989-6994, 2018.

69) F. Barrows, V. Brajuskovic, A. K. Petford-Long, and C. Phatak, "Emergent Magnetic Ordering and Topological Frustration in Quasicrystal Artificial Spin Ice," *Phys. Rev. B*, vol. 99, no. 9, p. 94424, 2019.

70) W. Jiang, S. Zhang, X. Wang, C. Phatak, Q. Wang, W. Zhang, M. Benjamin Jungfleisch, J. E. Pearson, Y. Liu, J. Zang, X. Cheng, A. K. Petford-Long, A. Hoffmann, S. G. E. Te Velthuis, "Quantifying chiral exchange interaction for Néel-type skyrmions via Lorentz transmission electron microscopy", *Phys. Rev. B,* vol. 99, p. 104402, 2019.

71) C. Phatak, C. S. Miller, Z. Thompson, and A. Petford-Long, "Understanding Curvature Effects on Magnetic Domains in 3D Nanostructures," *Microsc. Microanal*., vol. 25, no. S2, pp. 26–27, 2019.

72) J.Y. Kim, D.O. Shin, T. Chang, K.M. Kim, J. Jeong, J. Park, Y.M. Lee, K.Y. Cho, C. Phatak, S. Hong, and Y.-G. Lee, "Effect of the dielectric constant of a liquid electrolyte on lithium metal anodes," *Electrochim. Acta*, vol. 300, pp. 299–305, Mar. 2019.

73) J. Ahn, J. Park, J.Y. Kim, S. Yoon, Y.M. Lee, S. Hong, Y.-G. Lee, C. Phatak, and K.Y. Cho, "Insights into Lithium Surface: Stable Cycling by Controlled 10 μm Deep Surface Relief, Reinterpreting the Natural Surface Defect on Lithium Metal Anode," *ACS Appl. Energy Mater.*, vol. 2, no. 8, pp. 5656–5664, Aug. 2019.

74) C. Phatak, C. S. Miller, Z. Thompson, E. B. Gulsoy, and A. K. Petford-Long, "Curved Three-Dimensional Cobalt Nanohelices for Use in Domain Wall Device Applications", *ACS Appl. Nano Mater.* **3**, 6009 (2020).

75) X. Xu, Y. Liu, J. Wang, D. Isheim, V. P. Dravid, C. Phatak, and S. M. Haile, "Variability and origins of grain boundary electric potential detected by electron holography and atom-probe tomography", *Nat. Mater*. **19**, 887 (2020).

76) X. Xu, F. Barrows, V. P. Dravid, S. M. Haile, and C. Phatak, "Quantifying leakage fields at ionic grain boundaries using off-axis electron holography", *J. Appl. Phys*. **128**, 214301 (2020).

77) F. Barrows, X. Xu, S. Haile, C. Phatak, and A. Petford-Long, "Electron Holography Investigation of Resistive Switching CeO2 / STO Nanocolumns.", *Microscopy and Microanalysis, 26*(S2), 1950-1951 (2020).

78) K. Byerly, Y. Krimer, C. Phatak, E. Theisen, and M. E. McHenry, "Magnetostrictive loss reduction through stress relief annealing in an FeNi-based metal amorphous nanocomposite," *J. Mater. Res.*, **36**(2), 2843-2855 (2021).

79) C. Campbell, Y. M. Lee, K. Y. Cho, Y.-G. Lee, S. Hong, and C. Phatak, "Understanding the Selective Deposition of Li Metal on Nonuniform Electrode Surfaces Using Atomic Force Microscopy," *J. Electrochem. Soc.*, **168**(2), 020534 (2021).

80) V. Brajuskovic and C. Phatak, "Understanding curvature effects on the magnetization reversal of patterned permalloy Archimedean spirals," *Appl. Phys. Lett.*, **118**, 152409 (2021).

81) X. Xu, C. Carr, B. D. Myers, R. Huang, W. Yuan, S. Choi, D. Yi, C. Phatak, S. M. Haile, "Local Multimodal Electro-Chemical-Structural Characterization of Solid-Electrolyte Grain Boundaries," *Adv. Energy Mater.*, **11**(10), 2003309 (2021).

82) T. Zhou, M. Cherukara, and C. Phatak, "Differential programming enabled functional imaging with Lorentz transmission electron microscopy," *npj Comput. Mater.*, **7**(1), 141 (2021).

83) F. Barrows, H. Arava, C. Zhou, P. Nealey, T. Segal-Peretz, Y. Liu, S. Bakaul, C. Phatak, A. Petford-Long, "Mesoscale Confinement Effects and Emergent Quantum Interference in Titania Antidot Thin Films," *ACS Nano*, **15**(8), 12935–12944 (2021).

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