Ross John Harder

Curriculum Vitae

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Education

1994	B.Sc.	University of Wisconsin - Milwaukee
1997	M.S.	University of Wisconsin - Milwaukee
2002	Ph. D.	University of Wisconsin - Milwaukee
		Thesis Advisor: Prof Dilano K. Saldin
		Thesis Title: Phase Retrieval Methods for Suface Crystallography

Employment

2013-Present	Physicist, X-ray Science Division, Argonne National Laboratory
2008-2013	Assistant Physicist, X-ray Science Division, Argonne National Laboratory
2006-2007	Postdoctoral Research Associate, Dept. of Physics, University College London
2003-2005	Postdoctoral Research Associate, Dept. of Physics, University of Illinois - Urbana Champaign

Research Interests

- Nanometer scale imaging methods including coherent x-ray diffraction imaging, transmission x-ray microscopy and scanning x-ray microprobes. Particularly in-situ and operando applications to materials science.

Publications

Articles

1. Coughlan, H. D., C. Darmanin, N. W. Phillips, F. Hofmann, J. N. Clark, **R. J. Harder**, D. J. Vine, and B. Abbey (2015). Radiation damage in a micron-sized protein crystal studied via reciprocal space mapping and Bragg coherent diffractive imaging. *Structural Dynamics* **2**(4), 041704.
2. Liu, X., M. A. G. Aranda, B. Chen, P. Wang, **R. Harder**, and I. Robinson (2015). In Situ Bragg Coherent Diffraction Imaging Study of a Cement Phase Microcrystal during Hydration. *Crystal Growth & Design* **15**(7), 3087–3091.
3. Clark, J. N., L. Beitra, G. Xiong, D. Zhu, M. Chollet, G. J. Williams, B. Abbey, **R. J. Harder**, and I. K. Robinson (2015). Imaging transient melting of a nanocrystal using an X-ray laser. *Proceedings of the National Academy of Sciences* **112**(24), 201417678–7448.
4. Ulvestad, A., A. Singer, J. N. Clark, H. M. Cho, J. W. Kim, **R. Harder**, J. Maser, Y. S. Meng, and O. G. Shpyrko (2015). BATTERIES. Topological defect dynamics in operando battery nanoparticles. *Science* **348**(6241), 1344–1347.
5. Ulvestad, A., J. N. Clark, **R. Harder**, I. K. Robinson, and O. G. Shpyrko (2015). 3D Imaging of Twin Domain Defects in Gold Nanoparticles. *Nano Lett.* 150515140100008.
6. Huang, X., R. Conley, N. Bouet, J. Zhou, A. Macrander, J. Maser, H. Yan, E. Nazaretski, K. Lauer, **R. Harder**, I. K. Robinson, S. Kalbfleisch, and Y. S. Chu (2015). Achieving hard X-ray nanofocusing using a wedged multilayer Laue lens. *Opt. Express* **23**(10), 12496–12507.
7. Huang, X., K. Lauer, J. N. Clark, W. Xu, E. Nazaretski, **R. Harder**, I. K. Robinson, and Y. S. Chu (2015). Fly-scan ptychography. *Scientific reports* **5**.
8. Zhu, C., **R. Harder**, A. Diaz, V. Komanicky, A. Barbour, R. Xu, X. Huang, Y. Liu, M. S. Pierce, A. Menzel, and H. You (2015). Ptychographic x-ray imaging of surfaces on crystal truncation rod. *Applied Physics Letters* **106**(10), 101604.
9. Shemilt, L., E. Verbanis, J. Schwenke, A. K. Estandarte, G. Xiong, **R. Harder**, N. Parmar, M. Yusuf, F. Zhang, and I. K. Robinson (2015). Karyotyping Human Chromosomes by Optical and X-Ray Ptychography Methods. *Biophysical journal* **108**(3), 706–713.

10. Ulvestad, A., J. N. Clark, A. Singer, D. Vine, H. M. Cho, **R. Harder**, Y. S. Meng, and O. G. Shpyrko (2015). In situ strain evolution during a disconnection event in a battery nanoparticle. *Physical Chemistry Chemical Physics* **17**(16), 10551–10555.
11. Kim, J. W., S. Manna, S. H. Dietze, A. Ulvestad, **R. Harder**, E. Fohtung, E. E. Fullerton, and O. G. Shpyrko (2014). Curvature-induced and thermal strain in polyhedral gold nanocrystals. *Applied Physics Letters* **105**(17), 173108.
12. Singer, A., A. Ulvestad, H.-M. Cho, J. W. Kim, J. Maser, **R. Harder**, Y. S. Meng, and O. G. Shpyrko (2014). Nonequilibrium Structural Dynamics of Nanoparticles in LiNi1/2Mn3/2O4 Cathode under Operando Conditions. *Nano Lett.* **14**(9), 5295–5300.
13. Ulvestad, A., A. Singer, H.-M. Cho, J. N. Clark, **R. Harder**, J. Maser, Y. S. Meng, and O. G. Shpyrko (2014). Single Particle Nanomechanics in Operando Batteries via Lensless Strain Mapping. *Nano Lett.* 140822145952004.
14. Liang, M., **R. Harder**, and I. K. Robinson (2014). Brownian motion studies of viscoelastic colloidal gels by rotational single particle tracking. *IUCrJ* **1**(3), 172–178.
15. Nazaretski, E., X. Huang, H. Yan, K. Lauer, R. Conley, N. Bouet, J. Zhou, W. Xu, D. Eom, D. Legnini, **R. Harder**, C. H. Lin, Y. S. Chen, Y. Hwu, and Y. S. Chu (2014). Design and performance of a scanning ptychography microscope. *The Review of scientific instruments* **85**(3), 033707.
16. Clark, J. N., X. Huang, **R. J. Harder**, and I. K. Robinson (2014b). Dynamic Imaging Using Ptychography. *Physical review letters* **112**(11), 113901.
17. Ulvestad, A., H. M. Cho, **R. Harder**, J. W. Kim, S. H. Dietze, E. Fohtung, Y. S. Meng, and O. G. Shpyrko (2014). Nanoscale strain mapping in battery nanostructures. *Applied Physics Letters* **104**(7), 073108.
18. Burdet, N., G. R. Morrison, X. Huang, X. Shi, J. N. Clark, F. Zhang, M. Civita, **R. Harder**, and I. K. Robinson (2014). Observations of artefacts in the x-ray ptychography method. *Opt. Express* **22**(9), 10294–10303.
19. Huang, X., H. Yan, **R. Harder**, Y. Hwu, I. K. Robinson, and Y. S. Chu (2014). Optimization of overlap uniformness for ptychography. *Opt. Express* **22**(10), 12634–12644.
20. Huang, X., H. Yan, E. Nazaretski, R. Conley, N. Bouet, J. Zhou, K. Lauer, L. Li, D. Eom, D. Legnini, **R. Harder**, I. K. Robinson, and Y. S. Chu (2013). 11 nm hard X-ray focus from a large-aperture multilayer Laue lens. *Scientific reports* **3**, pages.
21. Shi, X., J. N. Clark, G. Xiong, X. Huang, **R. Harder**, and I. K. Robinson (2013). Mechanical breakdown of bent silicon nanowires imaged by coherent x-ray diffraction. *New Journal of Physics* **15**(12), 123007.
22. Badger, J., J. Lal, **R. Harder**, H. Inouye, S. C. Gleber, S. Vogt, I. Robinson, and L. Makowski (2013). Three-dimensional Imaging of Crystalline Inclusions Embedded in Intact Maize Stalks. *Scientific reports* **3**, 2843.
23. Cha, W., N. C. Jeong, S. Song, H.-j. Park, T. C. T. Pham, **R. Harder**, B. Lim, G. Xiong, D. Ahn, I. McNulty, J. Kim, K. B. Yoon, I. K. Robinson, and H. Kim (2013). Core–shell strain structure of zeolite microcrystals. *Nat Mater* **12**(8), 729–734.
24. **Harder, R.** and I. K. Robinson (2013). Coherent X-Ray Diffraction Imaging of Morphology and Strain in Nanomaterials. *JOM* **65**(9), 1202–1207.
25. Yang, W., X. Huang, **R. Harder**, J. N. Clark, I. K. Robinson, and H.-k. Mao (2013). Coherent diffraction imaging of nanoscale strain evolution in a single crystal under high pressure. *Nature Communications* **4**, 1680–.
26. Clark, J. N., L. Beitra, G. Xiong, A. Higginbotham, D. M. Fritz, H. T. Lemke, D. Zhu, M. Chollet, G. J. Williams, M. Messerschmidt, B. Abbey, **R. J. Harder**, A. M. Korsunsky, J. S. Wark, and I. K. Robinson (2013). Ultrafast Three-Dimensional Imaging of Lattice Dynamics in Individual Gold Nanocrystals. *Science* **341**(6141), 56–59.
27. Holt, M., **R. Harder**, R. Winarski, and V. Rose (2013). Nanoscale Hard X-Ray Microscopy Methods for Materials Studies*. *Annu. Rev. Mater. Res.* **43**(1), 183–211.
28. Huang, X., **R. Harder**, S. Leake, J. Clark, and I. Robinson (2012). Three-dimensional Bragg coherent diffraction imaging of an extended ZnO crystal. *Journal of applied crystallography* **45**(Pt 4), 778–784.
29. Clark, J. N., X. Huang, **R. Harder**, and I. K. Robinson (2012). High-resolution three-dimensional partially coherent diffraction imaging. *Nature Communications* **3**, 993–.
30. Shi, X., G. Xiong, X. Huang, **R. Harder**, and I. Robinson (2012). Radiation-induced bending of silicon-on-insulator nanowires probed by coherent x-ray diffractive imaging. *New Journal of Physics* **14**(6), 063029.
31. Huang, X., M. Wojcik, N. Burdet, I. Peterson, G. Morrison, D. J. Vine, D. Legnini, **R. Harder**, Y. S. Chu, and I. Robinson (2012). Quantitative X-ray wavefront measurements of Fresnel zone plate and K-B mirrors using phase retrieval. *Opt. Express* **20**(21), 24038–24048.

32. Fohtung, E., J. W. Kim, K. T. Chan, **R. Harder**, E. E. Fullerton, and O. G. Shpyrko (2012). Probing the three-dimensional strain inhomogeneity and equilibrium elastic properties of single crystal Ni nanowires. *Applied Physics Letters* **101**(3), 033107.
33. Leake, S. J., **R. Harder**, and I. K. Robinson (2011). Coherent diffractive imaging of solid state reactions in zinc oxide crystals. *New Journal of Physics* **13**(11), 113009.
34. Watari, M., R. A. McKendry, M. Vögtli, G. Aeppli, Y.-A. Soh, X. Shi, G. Xiong, X. Huang, **R. Harder**, and I. K. Robinson (2011). Differential stress induced by thiol adsorption on facetted nanocrystals. *Nat Mater* **10**(11), 862–866.
35. Xiong, G., X. Huang, S. J. Leake, M. C. Newton, **R. Harder**, and I. K. Robinson (2011). Coherent x-ray diffraction imaging of ZnO nanostructures under confined illumination. *New Journal of Physics* **13**(3), 033006.
36. Dufresne, E. M., B. Adams, M. Chollet, **R. Harder**, Y. Li, H. Wen, S. J. Leake, L. Beitra, X. Huang, and I. K. Robinson (2011). A technique for high-frequency laser-pump X-ray probe experiments at the APS. *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment* **649**(1), 191–193.
37. Xiong, G., O. Moutanabbir, X. Huang, S. A. Paknejad, X. Shi, **R. Harder**, M. Reiche, and I. K. Robinson (2011). Elastic relaxation in an ultrathin strained silicon-on-insulator structure. *Applied Physics Letters* **99**(11), 114103.
38. **Harder, R.** and X. Xiao (2011). Coherent Cone-Beam X-ray Microscopy. *AIP Conference Proceedings* **1365**(1), 429–432.
39. Huang, X., **R. Harder**, G. Xiong, X. Shi, and I. Robinson (2011). Propagation uniqueness in three-dimensional coherent diffractive imaging. *Physical Review B* **83**(22), 224109.
40. **Harder, R.**, M. Liang, Y. Sun, Y. Xia, and I. K. Robinson (2010). Imaging of complex density in silver nanocubes by coherent x-ray diffraction. *New Journal of Physics* **12**(3), 035019.
41. Cha, W., S. Song, N. C. Jeong, **R. Harder**, K. B. Yoon, I. K. Robinson, and H. Kim (2010). Exploration of crystal strains using coherent x-ray diffraction. *New Journal of Physics* **12**(3), 035022.
42. Favre-Nicolin, V., F. Mastropietro, J. Eymery, D. Camacho, Y. M. Niquet, B. M. Borg, M. E. Messing, L.-E. Wernersson, R. E. Algra, E. P. A. M. Bakkers, T. H. Metzger, **R. Harder**, and I. K. Robinson (2010). Analysis of strain and stacking faults in single nanowires using Bragg coherent diffraction imaging. *New Journal of Physics* **12**(3), 035013.
43. Hruszkewycz, S. O., **R. Harder**, X. Xiao, and P. H. Fuoss (2010). The effect of exit beam phase aberrations on parallel beam coherent x-ray reconstructions. *Review of Scientific Instruments* **81**(12), 123706.
44. Newton, M., **R. Harder**, X. Huang, G. Xiong, and I. Robinson (2010). Phase retrieval of diffraction from highly strained crystals. *Physical Review B* **82**(16), 165436.
45. Newton, M. C., S. J. Leake, **R. Harder**, and I. K. Robinson (2009). Three-dimensional imaging of strain in a single ZnO nanorod. *Nat Mater* **9**(2), 120–124.
46. Robinson, I. and **R. Harder** (2009). Coherent X-ray diffraction imaging of strain at the nanoscale. *Nat Mater* **8**(4), 291–298.
47. Leake, S. J., M. Newton, **R. Harder**, and I. Robinson (2009). Longitudinal coherence function in X-ray imaging of crystals. *Opt. Express* **17**(18), 15853–15859.
48. **Harder, R.**, M. Pfeifer, G. williams, I. Vartaniants, and I. Robinson (2007). Orientation variation of surface strain. *Physical Review B* **76**(11), 115425.
49. Stadler, L.-M., **R. Harder**, I. K. Robinson, C. Rentenberger, H. P. Karnthaler, B. Sepiol, and G. Vogl (2007). Coherent x-ray diffraction imaging of grown-in antiphase boundaries in Fe65Al35. *Phys. Rev. B* **76**(1), 014204.
50. Gryko, P., M. Liang, **R. Harder**, and I. K. Robinson (2007). Observation of interference effects in coherent diffraction of nanocrystals under X-ray standing-wave illumination. *Journal of Synchrotron Radiation* **14**(6), 471–476.
51. Pfeifer, M. A., G. J. Williams, I. A. Vartanyants, **R. Harder**, and I. K. Robinson (2006). Three-dimensional mapping of a deformation field inside a nanocrystal. *Nature* **442**(7098), 63–66.
52. Lyman, P., V. Shneerson, R. Fung, **R. Harder**, E. Lu, S. Parihar, and D. Saldin (2005). Atomic-scale visualization of surfaces with x rays. *Physical Review B* **71**(8), 081402.
53. Saldin, D. K., **R. J. Harder**, V. L. Shneerson, and W. Moritz (2002). Surface x-ray crystallography with alternating constraints in real and reciprocal space: the case of mixed domains. *J. Phys.: Condens. Matter* **14**(16), 4087–4100.

54. Saldin, D. K., **R. J. Harder**, V. L. Shneerson, and W. Moritz (2001). Phase retrieval methods for surface x-ray diffraction. *J. Phys.: Condens. Matter* **13**(47), 10689–10707.
55. Saldin, D. K., **R. Harder**, H. Vogler, W. Moritz, and I. K. Robinson (2001). Solving the structure completion problem in surface crystallography. *Computer Physics Communications* **137**(1), 12–24.

Book Chapters

56. **Harder, R.** (2012). "Coherent Diffraction Imaging of Strain on the Nanoscale". In: *Characterization of Materials*. Hoboken, NJ, USA: John Wiley & Sons, Inc.
57. **Harder, R. J.** and D. K. Saldin (2003). "Holographic surface crystallography: Substrate as reference". In: *Solid-State Photoemission and Related Methods*. Ed. by Schattke, W. and M. A. van Hove. Wiley.

PhD thesis

58. **Harder, R. J.** (2002). "Phase Retrieval Methods For Surface Crystallography". PhD thesis.

Invited Talks

- Argonne National Laboratory, Chemistry and Catalysis Early experiments and unique opportunities with the APS MBA Upgrade "Coherent Diffraction Imaging at APS" May 2015
- Argonne National Laboratory, Advanced Materials/Mesoscale Engineering Early experiments and unique opportunities with the APS MBA Upgrade "Coherent Diffraction Imaging at APS" May 2015
- Argonne National Laboratory, Integrated Imaging Initiative Workshop on Tomography and Ptychography 2014 "Coherent Diffraction Imaging"
- International Workshop on Advanced X-ray Sources and Diagnostics (WAXSD2014) Chengu, China September 2014 "Coherent Diffraction Imaging"
- TMS2014 "Coherent X-ray Diffraction Imaging of Strain on the Nanoscale" 2014
- Gordon Research Conference - X-ray Science "Coherent X-ray Diffraction Imaging of Strain on the Nanoscale" 2013
- 17th Pan American Synchrotron Radiation Instrumentation, Satellite Workshops - High Pressure "Coherent Diffraction Imaging of Strain in Samples Under Pressure" 2013
- Advanced Photon Source Users Meeting, Workshop on Nanoscale Imaging of Next-Generation Materials 2013
- Brookhaven National Laboratory, Photon Science Division Seminar "Coherent X-ray Diffraction Imaging of Strain on the Nanoscale" 2013
- TMS2013 "Coherent X-ray Diffraction Imaging of Strain on the Nanoscale" 2013
- Advanced Photon Source Users Meeting, XIS Workshop "Probing Strain and Defects in Single Crystals with CDI" 2012
- XDL2011 "Probing Strain and Defects in Single Crystals with CDI" Cornell High Energy Synchrotron Source, 2011
- XRM2010 "Imaging Strains on the Nano-scale with Coherent X-ray Diffraction" 2010
- TMS2010 "Imaging Strains on the Nano-scale with Coherent X-ray Diffraction" 2010
- University Of Wisconsin-Milwaukee Physics Dept. Colloquium "Imaging Strains on the Nano-scale with Coherent X-ray Diffraction" 2010
- Advanced Photon Source User Science Seminar "Nanometer Scale Image Through Coherent X-ray Diffraction" 2009
- Coherence2007 "Investigation of complex objects through coherent x-ray diffraction in the Bragg geometry" 2007
- Advanced Photon Source Users Meeting "Nanometer Scale Image Through Coherent X-ray Diffraction" 2007

Professional Service

- Co-organizer of symposium in TMS2013 and 2015 ”Characterization of Materials through High Resolution Coherent Imaging”
- Hosted beam line experiments for the National School on Neutron and X-ray Scattering in 2010-13
- Review user science proposals for the Advanced Light Source in 2011-15
- Review user science proposal for National Synchrotron Light Source II 2014-15
- Review papers for many journals including Journal of Synchrotron Radiation, New Journal of Physics, Journal of Applied Crystallography, Scientific Reports and Applied Physics Letters.
- Co-organizer XRM2010 in Chicago Illinois 2010