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North Carolina State University
851 Main Campus Drive
Room 120F Partners III
Raleigh NC 27695

Areas of Specialty

- Complex-oxide interfaces
- Molecular Beam Epitaxy
- Electronic Materials
- III-V Quantum dot/quantum wells
- Synchrotron diffraction/spectroscopy
- Condensed Matter Physics

Education

Doctorate, Applied Physics *August, 2004 –July 2009*
University of Michigan, Ann Arbor, Michigan
Thesis: Direct X-Ray Studies of Epitaxial Semiconductor Quantum Dots
Thesis Advisor: Prof. Roy Clarke

Masters of Science, Electrical Engineering *August, 2004 - May, 2007*
University of Michigan, Ann Arbor, Michigan

Bachelors of Science, Physics (*Summa Cum Laude*)
Southern University and A&M College, Baton Rouge, Louisiana *August 2001-- July 2004*
Thesis: The High Voltage Analysis of Monitored Drift Tube Performance for the ATLAS Muon Spectrometer

Experience

North Carolina State University *August ,2015 – Present*
Department of Physics, Raleigh, NC
Assistant Professor of Physics

Yale University, Charles Ahn Lab *August ,2009 – July 2015*
Department of Applied Physics, New Haven, Connecticut
Postdoctoral Research Associate

- Molecular beam epitaxy growth and characterization of epitaxial complex-oxides, Silicon and GaN based nanoscale systems.
- Atomic scale synchrotron x-ray diffraction imaging of nanostructures
- X-ray magnetic circular dichroism and X-ray absorption spectroscopy studies of epitaxial thin films
- Successfully designed and led synchrotron experiments at the Brookhaven National Laboratory, NY and the Argonne National Laboratory, IL to understand metal-insulator transitions in thin-film rare-earth nickelate systems
- Co-authored proposals and program reviews for research funding agencies and national laboratory collaborations
- Supervised 3 undergraduate summer research students

University of Michigan, Roy Clarke Lab *July 2005 to July 2009*
Department of Applied Physics, Ann Arbor, Michigan

Graduate Research Assistant

- Developed method to image thin-film structures with sub-atomic resolution using synchrotron x-ray sources.
- Developed first combination of anomalous diffraction techniques and the Coherent Bragg Rod Analysis method for element-specific structural determination of nanoscale structures.
- Developed a real-time transmission x-ray diagnostic technique to image turbine blade components to detect and understand defect characteristics which lead to failure

National Academies of Science *Sept. 2007-Nov. 2007*
Washington DC

Mirzayan Science and Technology Policy Fellow

- Recipient of Christine Mirzayan Science & Technology Fellowship
- Coordinated collaborative efforts on the Global Energy Assessment Study with the National Academies Board on International Scientific Organizations and the H. John Heinz III Center

European Particle Physics Research Council (CERN) *May 2004- July 2004*
Genva, Switzerland

May 2003- July 2003

Summer Intern

- Investigated the effects of sense wire sags on the resolution of the Muon Detector System for ATLAS and the Large Hadron Collider.
- Investigated a cosmic-ray procedure for rapidly detection of defective components of the Muon Detector System for ATLAS and the Large Hadron Collider.

National Renewable Energy Laboratory *May 2002-July 2002*
Golden, Colorado

Summer Intern

- Designed a program using Visual Basic to simulate the Atomic Force Microscope (AFM). Program implemented by the Measurement and Characterization Department at NREL to identify defects in AFM images and increase the accuracy of these images.

Honors and Awards

- Physics and Chemistry of Surfaces and Interfaces Young Scientist Award, January, 14 2009, American Vacuum Society
- Christine Mirzayan Science and Technology Policy Fellowship, August 2007, National Academies of Science
- University of Michigan Applied Physics Graduate Fellowship
- Student Grand Marshall, Southern University, July 2004
- Who is Who in American Colleges and Universities, 2003-2004
- 1st Place, Physics Research Presentation, Beta Kappa Xi, 2004
- 2003 Science and Engineering Academic Excellence Scholarship
- National Collegiate Mathematics Award, 2001-2002
- All American Collegiate Award, 2001-2002
- 2002-2003 College of Sciences Excellence Award
- 2001/2002 Honors College and Junior Division Highest GPA Award
- 2001/2002 Chemistry Excellence Award

Skills

- Development of characterization tools for atomic scale characterization of interfaces and defects in crystalline nanoscale structures
- Collaborative research in an international setting
- Molecular Beam Epitaxial growth of semiconductor and oxide thin films
- X-ray diffraction and energy dispersive techniques using synchrotron and laboratory sources
- Direct methods for x-ray phase retrieval
- Proficient in programming in MATLAB, PERL, C, C++, ROOT, SPEC and FORTRAN

Selected Invited Talks

- 2015 Advanced Light Source User Meeting, Berkeley, CA, October, 2015
    - *Electronic and Orbital Engineering at Complex Oxide Interfaces*
- University of South Florida, Atomic-scale engineering of the electronic and orbital properties of complex oxides, January 8th 2015
- Brookhaven National Laboratory Condensed Matter Colloquium, Brookhaven, NY, 2014
    - *Correlating atomic structure and emergent phenomena at complex oxide interfaces*
- 2013 Energy Materials Nanotechnology West meeting, Houston, TX
    - *Correlating atomic structure and emergent phenomena at complex oxide interfaces*
- 2012 Aspen Winter Conference, Aspen, CO
    - *Physical structure and metal-insulator transitions in strained nickelate heterostructures*
- Calvin College Department of Physics Seminar , Grand Rapids, MI, Dec, 2007
    - *Imaging Interfaces with X-rays*
- Swiss Light Source Seminar, Villigen, Switzerland, July 2007
    - *COBRA: A Direct Method for Phase Retrieval*
- Southern University College of Sciences Symposium, Baton Rouge, LA, May 2007
    - *Unlocking Nature's Secrets with X-rays*

Selected Contributed Presentations

- 2015 Materials Research Society Fall Meeting, Boston, MA
    - *Electronic and Structural Coupling at Complex Oxide-Semiconductor Interfaces*
- 2010 17th International Workshop on Oxide Electronics, Awaji-shima, Japan
    - *The Interfacial Structure of Complex oxides on Semiconductors*
- 2009 Physics and Chemistry of Surfaces and Interfaces, Santa Barbara, CA
    - *A new x-ray method to image self-assembled quantum dot structures.*
- 2008 American Physics Society March Meeting, New Orleans LA
    - *Anomalous COBRA studies of InGaAs/GaAs.*
- 2007 American Physics Society March Meeting, Denver CO
    - *Structure and morphology of (111) textured Au/Co/Au trilayers grown on glass by MBE.*
- 2004 National Conference of Black Physics Students, Washington DC
    - *Cosmic Ray Muon Calibration for ATLAS*
- 2003 Emerge Workshop, Atlanta GA
    - *GradPortal: Bridging Graduate Resources*
- 2002 Dirac Centenary Conference, Baylor University, Waco TX
    - *The Effect of Tip Design on Imaging in the Atomic Force Microscope*
- 2002 Honors College State Conference, Lafayette, LA
    - *Quantum Web: A Model for Online Learning*

Refereed Publications

- (33) K. Zou, S. Mandal, S. Albright, R. Peng, Y. Pu, **Divine Kumah**, C. Lau, G. Simon, O. E. Dagdeviren, Xi He, Ivan Bozovic, U. D. Schwarz, Eric I. Altman, D. Feng, F. J. Walker, S. Ismail-Beigi, C. H. Ahn, The role of double TiO2 layers at the interface of FeSe/SrTiO3 superconductors. Physical Review B 93 (18), 180506 (May 2016)
- (32) **D. P. Kumah**, M. Dogan, J. H. Ngai, D. Qiu, Z. Zhang, D. Su, E. D. Specht, S. Ismail-Beigi, C. H. Ahn, and F. J. Walker. Engineered Unique Elastic Modes at a BaTiO3/(2×1)−Ge(001) Interface. Phys. Rev. Lett. 116, 106101, (7 March 2016)

- (31) J. H. Ngai, K. Ahmadi-Majlan, J. Moghadam, M. Chrysler, **D. P. Kumah**, C. H. Ahn, F. J. Walker, T. Droubay, M. Bowden, S. A. Chambers, X. Shen and D. Su. Electrically Coupling Multifunctional Oxides to Semiconductors: A Route to Novel Material Functionalities. MRS Advances Vol 1, Issue 4, 55-263 , (January 2016)
- [30] L. Kornblum, E. Jin, **D.P. Kumah**, A.T. Ernst, C.C. Broadbridge, C. H. Ahn, and F. J. Walker. Oxide 2D electron gases as a route for high carrier densities on (001) Si. Applied Physics Letters 106, 201602 (2015)
- [29] A. S. Disa, **Divine P. Kumah**, A. Malashevich, H. Chen, D. A. Arena, E. Specht, F. J. Walker, S. Ismail-Beigi, and C. H. Ahn. Orbital engineering in symmetry-breaking polar heterostructures.. Physical Review Letters 114 (2), 026801 (2015)(Editor's Suggestion and Viewpoint)
- (28**)** E. N. Jin, L. Kornblum, **Divine P. Kumah**, K. Zou, C. C. Broadbridge, J. H. Ngai, C. H. Ahn and F. J. Walker. A high density two-dimensional electron gas in an oxide heterostructure on Si (001).. Applied Physics Materials. 2, 116109 (2014)
- (27**)** **Divine P. Kumah,** A. Malashevich, A. S. Disa, D. A. Arena, F. J. Walker, S. Ismail-Beigi, C. H. Ahn, " **Effect of surface termination on the electronic properties of LaNiO3 films** " Physical Review Applied, 2, 054004 (2014)
- (26) **DP Kumah**, AS Disa, JH Ngai, H Chen, A Malashevich, J. W. Reiner, S. Ismail-Beigi, F.J. Walker and C.H. Ahn, "Tuning the Structure of Nickelates to Achieve Two-Dimensional Electron Conduction" Advanced Materials, 26, 1935 (2014)
- (25)C. Xiong, W. H. P. Pernice, J.H. Ngai, J. W. Reiner, **D.P. Kumah**, F. J. Walker, C. H. Ahn and H. X. Tang, "Active integrated optics on silicon: ferroelectric BaTiO3 devices", (Nano. Lett., 14, 1419 (2014)
- (24) J.H. Ngai, **D.P. Kumah**, C.H. Ahn, F. J. Walker, Hysteretic electrical transport in BaTiO3/Ba(1-x)Sr(x)TiO3/Ge heterostructures . App. Phys. Lett, 104 , 062905 (2014)
- (23) **D. P. Kumah**, Y. Yacoby, S. A. Pauli, P. R. Willmott and R. Clarke. La-doped BaTiO3 heterostructures: Compensating the polarization discontinuity. APL Mat. 1, 062107 (2013). (**APL Materials Editor's Pick**, January 2014)
- (22)AS Disa, **DP Kumah**, JH Ngai, ED Specht, DA Arena, FJ Walker and CH Ahn. Phase diagram of compressively strained nickelate thin films. APL Materials 1 (3), 032110 (2013)
- (21)J.A. Moyer, **D.P. Kumah**, C.A.F. Vaz, D.A. Arena, V.E. Henrich. Role of epitaxial strain on the magnetic structure of Fe-doped CoFe2O4. J. of M. Mag. Mat., Volume 345, 180 (2013)
- (20)Chen, H.; **Kumah, D. P**; Disa, A. S; Walker, F. J; Ahn, C. H; Ismail-Beigi, S. "Modifying the Electronic Orbitals of Nickelate Heterostructures via Structural Distortions." Phys. Rev. Lett. 110, 186402 (2013)
- (19)JA Moyer, CAF Vaz, **DP Kumah**, DA Arena, VE Henrich. Enhanced magnetic moment in ultrathin Fe-doped CoFe2O4 films. Phys. Rev. B 86, 174404 (2012)
- (18) M. S. J. Marshall, **D. P. Kumah**, J. W. Reiner, A. P. Baddorf, C. H. Ahn, and F. J. Walker. Piezoelectric force microscopy of crystalline oxide-semiconductor heterostructures Appl. Phys. Lett. 101, 102902 (2012)
- (17)J. A. Moyer, **D. P. Kumah**, C. A. F. Vaz, D. A. Arena, and V. E. Henrich Epitaxial strain-induced changes in the cation distribution and resistivity of Fe-doped CoFe2O4. Appl. Phys. Lett. 101, 021907 (2012)
- (16)E. Cohen, N. Elfassy, G. Koplovitz, S. Yochelis, S. Shusterman, **D. P. Kumah**, Y. Yacoby, R. Clarke and Y. Paltiel Surface X-Ray Diffraction Results on the III-V Droplet Heteroepitaxy Growth Process for Quantum Dots: Recent Understanding and Open Questions. Sensors 11, 10624 (Nov. 2011)

- (15) J. A. Moyer, C. A. F. Vaz, D. A. Arena, **D. P. Kumah**, E. Negusse, and V. E. Henrich, and R. Clarke. Magnetic structure of Fe-doped CoFe2O4 probed by x-ray magnetic spectroscopies. Phys. Rev. B 84, 054447 (2011)
- (14) E. Cohen, S. Yochelis, O. Westreich, S. Shusterman, **D. P. Kumah**, R. Clarke, Y. Yacoby, and Y. Paltiel, Structure of droplet-epitaxy-grown InAs/GaAs quantum dots Appl. Phys. Lett. 98, 243115 (2011)
- (13) **D. P. Kumah**, J. H. Wu, N. S. Husseini, V. D. Dasika, R. S. Goldman, Y. Yacoby, and R. Clarke. Correlating structure, strain, and morphology of self-assembled InAs quantum dots on GaAs. Appl. Phys. Lett. 98, 021903 (2011)
- (12) **D. P. Kumah** ; Reiner J. W.; Segal Y.; Kolpak A. M.; Zhang Z.; Su D.; Zhu Y.; Sawicki M. S.; Broadbridge C. C.; Ahn C. H.; Walker F. J., The atomic structure and polarization of strained SrTiO3/Si. Appl. Phys. Lett. 97, 251902 (2010)
- **(11)D. P. Kumah, S. Shusterman, Yossi Paltiel, Y. Yacoby and R. Clarke, Atomic-scale mapping of quantum dots formed by droplet epitaxy. Nature Nano. 4, 835 - 838 (2009)**
- (10) Schlepütz C. M.; Willmott P. R.; Pauli S. A.; Herger R.; Martoccia D.; Björck M.; **Kumah D.;** Clarke R.; Yacoby Y. Surface x-ray diffraction of complex metal oxide surfaces and interfaces-a new era. AIP Conf. Proc. 1092, 9 (2009)
- **(9) D. P. Kumah, A. Riposan, C. N. Cionca, N. S. Husseini, R. Clarke, J. Y. Lee, J. M. Millunchick, Y. Yacoby, C. M. Schlepütz, M. Björck, and P. R. Willmott . Resonant coherent Bragg rod analysis of strained epitaxial heterostructures. Appl. Phys. Lett. 93, 081910 (2008).**
- (8) N. Husseini, **D. Kumah**, J. Yi, C. Torbet , D. Arms , E. Dufresne, T. Pollock, J. Wayne Jones, R. Clarke. Mapping single-crystal dendritic microstructure and defects in nickel-base superalloys with synchrotron radiation . Acta Mat., Volume 56 , Issue 17, 4715 (October 2008)
- (7) Liu L.; Husseini N. S.; T. Christopher J.; **Kumah D. P**.; Clarke R.; Pollock T. M.; Jones J. W.. In Situ Imaging of High Cycle Fatigue Crack Growth in Single Crystal Nickel-Base Superalloys by Synchrotron X-Radiation J. Eng. Mater. Technol. 130, 021008 (2008)
- (6) R. Herger, P. R. Willmott, C. M. Schlepütz, M. Björck, S. A. Pauli, D. Martoccia, B. D. Patterson, **D. Kumah**, R. Clarke, Y. Yacoby, and M. Döbeli. Structure determination of monolayer-by-monolayer grown La(1-x)SrxMnO3 thin films and the onset of magnetoresistance. Phys. Rev B 77, 085401(Febuary 1 2008)
- (5) C. N. Cionca, A. Riposan, **D. P. Kumah**, N. S. Husseini, D. A. Walko, Y. Yacoby, J. M. Millunchick,and R. Clarke. Strain and composition mapping of epitaxial nanostructures. Appl. Phys. Lett. 92, 151914 (18 April 2008)
- (4) J. B. González-Díaz, A. García-Martín, G. Armelles, J. M. García-Martín, C. Clavero, A. Cebollada, R. A. Lukaszew, J. R. Skuza, **D. P. Kumah**, and R. Clarke. Surface-magnetoplasmon nonreciprocity effects in noble-metal/ferromagnetic heterostructures. Phys. Rev. B 76, 153402 (5 October 2007)
- **(3) P. R. Willmott, S. A. Pauli, R. Herger, C. M. Schlepütz, D. Martoccia, B. D. Patterson, B. Delley, R. Clarke, D. Kumah, C. Cionca, and Y. Yacoby. Structural Basis for the Conducting Interface between LaAlO3 and SrTiO3 .Phys. Rev. Lett. 99, 155502 (9 October 2007)**
- (2) D. Boschetto, G. Mourou, A. Rousse, A. Mordovanakis, Bixue Hou, J. Nees, **D. Kumah**, R. Clarke. Spatial coherence properties of a compact and ultrafast laser-produced plasma keV x-ray source. Appl. Phys. Lett. 90, 011106 (Jan. 2007)
- (1) **D P Kumah** , R Clarke, A Cebollada, C Clavero, J M García-Martín, J R Skuza and R A Lukaszew. Atomic layer epitaxy of (111) Au/Co/Au trilayers. J. Phys. D: 40 2699 (April 2007)