Alexander David Qualls

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UC Berkeley
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Education

BA University of California, Berkeley, Physics 05/2021
Cumulative GPA: 3.3/4.0

Higher Level Coursework

- Phys. 141B, Solid State Physics (A)
- Phys. 111B, Advanced Experiment Lab (A)
- Phys. 110A, Electromagnetism and Optics (B+)

Research Experience

Undergraduate Research Assistant, UC Berkeley, R. Ramesh Group 03/2019 - 05/2021

Limits of Ferroelectric Switching Dynamics

- Showed nanosecond polarization switching in $BaTiO_3$ and $BiFeO_3$ thin films by creating an integrated ultrafast voltage pulsing scheme
- Quantified depolarization dynamics relevant to device applications via data analysis in the context of standard ferroelectric domain theory, KAI model of growth-limited switching
- Found a decrease in switching time correlated with a decrease in the order parameter in $BaTiO_3$ thin films as temperatures approach the Curie temperature, supported the theory that switched polarization contributes to feedback in the switching process

Ultralow Ferroelectric Coercivity

- Measured thickness scaling of ferroelectric depolarization field and coercivity of low-coercivity $BaTiO_3$ thin films, showing deviation from Janovec–Kay–Dunn scaling, and having implications for scaled ferroelectric devices in applications
- Showed varying Oxygen pressure during deposition scales coercive field and remnant polarization, providing a path to optimize devices for low voltage, high charge response

Strain Effects in Ferroelectric Membranes

- Demonstrated improved switching time and coercive field in lifted-off $BaTiO_3$, showing promise for application in flexible nano sensor devices

Publications

Enabling ultra-low-voltage switching in BaTiO3
Y. Jiang, E. Parsonnet, **A. Qualls**, W. Zhao, S. Susarla, D. Pesquera, A. Dasgupta, M. Acharya, H. Zhang, T. Gosavi, C.-C. Lin, D.E. Nikonov, H. Li, I.A. Young, R. Ramesh, L.W. Martin, *Nat. Mater.* **21**, 779–785 (2022)

The Role of Lattice Dynamics in Ferroelectric Switching

Q. Shi, E. Parsonnet, X. Cheng, N. Fedorova, R.-C. Peng, A. Fernandez, **A. Qualls**, X. Huang, X. Chang, H. Zhang, D. Pesquera, S. Das, D. Nikonov, I. Young, L.-Q. Chen, L.W. Martin, Y.-L Huang, J. Íñiguez, R. Ramesh, *Nat. Comm.* **13**, 1110 (2022)

Epitaxial Ferroelectric $Hf_{0.5}Zr_{0.5}O_2$ with Metallic Pyrochlore Oxide Electrodes

Z. Zhang, S.-L. Hsu, V.A. Stoica, H. Paik, E. Parsonnet, **A. Qualls**, J. Wang, L. Xie, M. Kumari, S. Das, Z. Leng, M. McBriarty, R. Proksch, A. Gruverman, D.G. Schlom, L.-Q. Chen, S. Salahuddin, L. W. Martin, R. Ramesh, *Adv. Mater.* 2006089 (2021)

Toward Intrinsic Ferroelectric Switching in Multiferroic $BiFeO_3$

E. Parsonnet, Y.-L. Huang, T. Gosavi, **A. Qualls**, D. Nikonov, C.C. Lin, I. Young, J. Bokor, L.W. Martin, and R. Ramesh, *Phys. Rev. Lett.* **125**, 067601 (2020)

Beyond Substrates: Strain Engineering of Ferroelectric Membranes

D. Pesquera, E. Parsonnet, **A. Qualls**, R. Xu, A. J. Gubser, J. Kim, Y. Jiang, G. Velarde, Y.-L. Huang, H.Y. Hwang, R. Ramesh, L. W. Martin, *Adv. Mater.* 2003780 (2020)

Ultrahigh Capacitive Energy Density in Ion-Bombarded Relaxor Ferroelectric Films

J. Kim, S. Saremi, M. Acharya, G. Velarde, E. Parsonnet, P. Donahue, **A. Qualls**, D. Garcia, L.W. Martin, *Science*, **369**, 81-84 (2020)

Presentations and Invited Lectures

Methods of Manipulating and Dynamics of Ferroic Order in BiFeO3

E. Parsonnet, L. Caretta, **A. Qualls**, T. Gosavi, D. Nikonov, C.-C. Lin, I. Young, J. Bokor, L. W. Martin, R. Ramesh, *APS March Meeting*, Abs. **R53.004**, (2021)

Multiferroic Switching Dynamics in BiFeO3

E.Parsonnet, Y.-L. Huang, C.-C. Lin, T. Gosavi, **A. Qualls**, I. Young, L. W. Martin, J. Bokor, R. Ramesh, *APS March Meeting*, Abs. **P64.00012**, (2020)

Temperature Dependent Switching Dynamics in BaTiO3 at ns Speeds

A. Qualls, E. Parsonnet, Y. Jiang, W. Zhao, C.-C. Lin, T. Gosavi, L. Martin, R. Ramesh, *APS March Meeting Undergraduate Series*, Abs **A12.00011**, (2020)

Professional Experience

Senior Device and eTest Engineer 08/2021 - 07/2024

Kepler Computing Inc, Berkeley CA

- Performed a wide range of electrical measurements on micro- and nano-scale devices
- Planned high value experiments using a wide range of deposition technologies to optimize thin film oxide device stacks
- Contributed to development of novel computer memory device technology through materials physics and electrical engineering analysis of measurement results
- Operated liquid Nitrogen/resistive heating controlled, high vacuum enclosure for temperature dependant measurement
- Co-developed codebase for automated measurement and analysis to enable fast experiment cycle time
- Multiple patents pending in for computer memory and energy storage inventions

Technical Skills

Lab Skills: Electrical Device Characterization, High Speed Voltage Measurements, Low Temperature Material Characterization, Transport Measurements, Thin Film Sample Preparation, Integrated Pulse Generator/Arbitrary Waveform Generator/Oscilloscope/Digital Multimeter Setup and Use, Device Processing and Integration, Force Microscopy
Microscopy: Piezoresponse/Atomic Force Microscopy, X-Ray Diffraction/Fluorescence
Programming: Python, LabView, Mathematica, GitHub
Computer Applications: Cad, Adobe Creative Cloud Suite

Teaching Experience

Educational Video Production 03/2020 - 01/2022
- Creating entry-level educational videos covering physics and math concepts on tiktok.com and youtube.com, over 150,000 subscribers with a reach of over 4,000,000

SPS Community Outreach, Berkeley CA 10/2019 - 05/2021
- Teaching physics demonstrations to middle school students at UC Berkeley STEM outreach events

Personal Tutor 09/2016 - 05/2021
- Teaching guitar, ukulele, and high school through college level math both in person and through Zoom video conferencing

Personal Information and Interests

Citizenship: United States, Poland
Music: Choir (2007-2021), Guitar, Violin
Sports: Baseball (2008-2018)

References

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Tanay Gosavi, PhD (Manager-Kepler)
Principal Engineer, Manager Device and eTest team,
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