

**William Bowman**

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**Summary**

I am a Materials Science Ph.D. Student using aberration-corrected scanning transmission electron microscopy (STEM) to research solid oxide fuel cell materials. My research focuses on understanding the influence of grain boundaries and interfaces on the electrical properties of oxygen conducting oxides. I have experience performing energy dispersive x-ray (EDX) chemical nanoanalysis in the STEM, but prefer electron energy-loss spectroscopy (EELS) for the additional electronic structure information available in the near-edge fine structure.

I've been fortunate to have access to both a JEOL ARM200F with EDX and EELS, and a monochromated Nion UltraSTEM 100 with EELS; which together allow me to perform elemental mapping and to probe electronic structure via ultra-high energy resolution EELS. I also regularly operate a JEOL 2010F S/TEM, and two FEI scanning electron microscopes (SEMs): the XL-30 and the Nova200 NanoLab FIB/SEM. While both are very reliable and user-friendly instruments, the Nova outperforms on routine image quality. Furthermore, the Nova's focused ion beam (FIB) lift-out capability really aids TEM characterization of a lot of interesting features like buried interfaces and deposited thin films.

**Work eligibility:** I am a US citizen currently located in the US and eligible to work in the US. I really enjoy experiencing new places and cultures, so an opportunity to relocate within the US or internationally would be great!

**Skills**

**Material synthesis:** I have experience optimizing syntheses for doped CeO<sub>2</sub>-based nanoparticles by spray drying (rapid solution evaporation) and solvo-thermal routes. Spray drying is a relatively simple approach that produces particles of random morphology and sizes ranging from 30 to 50 nm. I've found that solvo-thermal synthesis offers much better shape control, particularly for nano-cubes ranging from tens to hundreds of nanometers (which make pretty neat TEM specimens).

**Materials characterization:** Characterization comprises the majority of my research activities, which I've outlined in the *summary* section. To recap, I am familiar with x-ray diffraction (XRD), impedance spectroscopy, SEM imaging and EDX, specimen preparation by FIB lift-out and dimpling, atomic resolution TEM and STEM imaging, STEM EELS and EDX.

**Programming:** I started scripting Matlab to do my homework and for my research, but then I got really interested in coding so I started learning other languages. I've switched nearly entirely to Python for my research related coding needs. I use the Pyzo IDE (IEP) which is free and ships with NumPy, SciPy, MatPlotLib and others. I am constantly adding new and old scripts to my research code public GitHub repository, so feel free to check that out if you're interested. And send me a message if you'd like to discuss any of the code.

I made the site you are reading using the Bootstrap and Font Awesome CSS/JS libraries. I am also working on a Rails web app that will let my Mom archive and display her collection of antiques.

**Other:** Basic Spanish; I can also ride my bike with no hands and ice skate backwards.

### ***Education***

2016 Arizona State University, Materials Science and Engineering Ph.D.

2012 Arizona State University, Materials Science and Engineering B.S.E.

### ***Experience***

2012 – Present: Ph.D. Research Assistant, Crozier Research Group, Arizona State University

2010 – 2012: Undergraduate Researcher, Crozier Research Group, Arizona State University

2011: Summer Undergraduate Research Fellow, National Institute of Standards and Technology

2010 – 2011: Undergraduate Researcher, Holbert Research Group, Arizona State University

### ***Publications, proceedings and presentations (Bowman, W.J.)***

- Bowman, W.J., Darbal, A.D., Crozier, P.A. Correlating grain boundary misorientation, composition and electronic structure of Gd/Pr co-doped ceria in the scanning transmission electron microscope. *Microscopy and Microanalysis* **In preparation** (2015).
- Bowman, W.J., Darbal, A.D., Kelly, M, Rohrer, G.S., Crozier, P.A. Relationship between grain boundary conductivity and character determined by stereological EBSD. *Journal of the American Ceramic Society* **In preparation** (2015).
- Bowman, W.J., Hernandez, C., McGuinness, K. Crozier, P.A. Grain boundary conductivity and composition in Ca-doped ceria. *Solid State Ionics* **Submitted** (2014).
- Bowman, W.J., Zhu, J., Sharma, R., Crozier, P.A. Electrical conductivity and grain boundary characterization of Gd-doped and Gd/Pr co-doped ceria electrolytes. *Solid State Ionics* **In press** (2014).
- Bowman, W.J., Darbal, A.D., Zhu, J., Crozier, P.A., Nanocharacterization and electrical properties of grain boundaries in Gd/Pr doubly-doped ceria. *Microscopy and Microanalysis Proceedings* (2014).
- Bowman, W.J., Darbal, A.D., Aoki, T., Zhu, J., Hussaini, Z., Crozier, P.A. Oxygen Vacancies at Grain Boundaries in Doubly-Doped Ceria Determined using EELS. *Microscopy and Microanalysis Proceedings* (2014).
- Bowman, W.J., Darbal, A.D., Zhu, J., Crozier, P.A., Modification of grain boundary conductivity in polycrystalline doped ceria. *Gordon Research Conferences: Studies in Solid State Ceramics* **Contributed poster** (2014).

- Bowman, W.J., Crozier, P.A. Correlating transition metal-modified grain boundary conductivity with atomic level structure and composition in Gd-doped ceria electrolytes. *Materials Research Society Spring Meeting Contributed talk* (2014).
- Bowman, W.J., Aoki, T., Crozier, P.A. Monochromated electron energy loss spectroscopy of transition metal-modified grain boundaries in Gd-doped ceria electrolytes. *Materials Research Society Spring Meeting Contributed talk* (2014).
- Bowman, W.J., Sharma, R., Crozier, P. A. Characterization of Structure and Grain Boundary Composition in Undoped and Doped Ceria Synthesized by Spray Drying for Solid Oxide Fuel Cells. *Microscopy and Microanalysis Proceedings* (2013).
- Bowman, W.J., Crozier, P. A. TEM Characterization of Grain Boundaries And Defects In Un-doped And Doped Ceria For Solid Oxide Fuel Cells. *Microscopy and Microanalysis Proceedings* (2012).
- Bowman, W.J., Talin, A.A., Sharma, R., Sharma, V., Crozier, P.A. Correlating Nanostructure and Ion Conductivity in Gd and Pr Doped and Co-Doped Ceria for Solid Oxide Fuel Cell Electrolytes Synthesized by Spray-Drying. *Materials Research Society Spring Meeting Contributed talk* (2012).

### ***Synergistic Activities***

- Recipient of Arizona State University (ASU) Fulton Undergraduate Research Initiative research funding awards and travel grants (2011 – 2012). Recipient of National Institute of Standards and Technology's Summer Undergraduate Research Fellowship (2011). Recipient of National Science Foundation Graduate Research Fellowship (2012). Recipient of ASU Graduate College's Doctoral Enrichment Fellowship (2012 – 2013). Recipient of ASU Outstanding Graduate Student Award for Community Outreach (2014). Recipient of the Microscopy Society of America's Presidential Scholar Award for the Microscopy and Microanalysis Conference (2014). Recipient of US Microscopy Society of America and International Microscopy Congress student travel grants to International Microscopy Congress – Prague, CZ (2014).
- Travelled to Ghana to develop international research collaboration with Ghanaian researchers under an NSF Research Collaborative Network grant (2013)
- Outreach Chair for Electrochemical Society ASU Graduate Student Chapter (2013 – 2014)
- ASU SHADES program multicultural mentor for Physics undergraduate students (2013 – Present)

***Ph.D. Thesis Advisor:*** Peter A. Crozier (Arizona State University)

***Past and Current Collaborators:*** Toshihiro Aoki (ASU), Sean Bishop (Massachusetts Institute of Technology), Di Chen (Massachusetts Institute of Technology), Amith Darbal (AppFive LLC), Tridip Das (Michigan State University), Zahra Hussaini (ASU), Madeleine Kelly (Carnegie Mellon University), Jason Nicholas (Michigan State University), Greg Rohrer (Carnegie Mellon University), Renu Sharma (NIST Gaithersburg), Vaneet Sharma (ASU), Brian Sheldon (Brown University), Jay Sheth (Brown University), A. Alec Talin (NIST Gaithersburg), Jiangtao Zhu (ASU)

***Undergraduate Research Mentees:*** Cruz Hernandez (ASU), Kimberly McGuinness (ASU), Christy Sennavongsa (ASU)