

## Prof. Eric Seabron

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### Education

**University of Illinois - Urbana Champaign, Urbana, IL**

*PhD in Material Science and Engineering, July 2017*

*Graduate Certificate in Energy and Sustainable Systems Engineering, May 2016*

*MS in Material Science and Engineering, May 2015*

*Thesis Advisors: Dr. William Wilson (Harvard), Dr. Xuling Li (UT Austin), Dr. John Rogers (Northwestern U)*

- Electromagnetic and Thermal FEA modeling
- Chemical Vapor Deposition of aligned Carbon Nanotubes
- Scan Probe Metrology methods such as Atomic Force Microscopy, Microwave Impedance Microscopy, and Scanning Near Field Optical Microscopy.
- Optical spectroscopy including a pump-probe and a transient absorption in the near-IR
- Python coding for Computer Vision and data analysis

**Morgan State University, Baltimore, MD**

*BS in Electrical Engineering, July 2013*

*Advisor: Dr. Michel Reece, Department of Electrical and Computer Engineering, Morgan State University*

- Electromagnetic FEA and RF circuit modeling to design Microwave Devices such as tunable filters and RF amplifiers for software defined radios.

### Current Employment

**Assistant Professor at Howard University Department of Electrical Engineering**

Howard University, Washington DC. August 2021 – present

- Conducting Research on optical crystals in the near to mid-IR
- Writing and developing novel research concept for future grants and proposals
- Leveraging Academic connections outside the laboratory to conduct multi-disciplinary materials and electronic design research in Quantum Information Platforms and Transformational Computing (ie Neuromorphic/Analog Computing Architectures)
- Developing a research vision to support student literacy in Next-Generation Transformational Computing platforms

### Past Employment

**NRC Postdoctoral Fellow**

Naval Research Laboratory, Washington DC. July 2020 – August 2021

- **Research Description:** I conducted FTIR and RAMAN of hyperbolic optical crystals for understand fundamental light-matter interactions in the mid-IR. I investigated unique optical modes in these materials using electromagnetic theory and numerical simulations to correlate the theoretical optical dispersion to the experimental results. We successfully identified and revealed novel physics of both volume and surface Phonon-Polariton modes.
- **Outcomes:** We are currently writing two high impact manuscripts on polariton physics of hyperbolic Calcite and initiated research on a third study involving mapping the optical surface modes using optical scan probe microscopy.

**Principal Microelectronics Engineer**

Northrop Grumman Corporation Advanced Technology Laboratory, Linthicum, MD. August 2017 – July 2020

- **I currently hold an active secret level security clearance.**
- **Materials Metrology and Characterization.** As the tool owner for a cutting-edge Scanning SQUID Microscope, I develop sample prep and user procedures, organize the experimental queue for maximum sample throughput, and help design cryogenic experiments that take advantage of the unique capabilities of the tool. I created partnerships between NIST and other third-party entities resulting in many productive seminars and research collaborations.
- **Computer Vision and Statistics.** I developed Computer Vision and Directory management Python algorithms to detect defect features in vast amounts of Magnetometry image data. This included using Python based global

optimizers to create robust solutions for feature detection in image datasets. I have also developed algorithms to reveal non-obvious material defects from SEM images and statistically correlate the defect data to process variables resulting in lasting process improvements.

- **Process Integration and Development.** I routinely work with processes and tools that include Chemical Vapor Deposition, Photolithography, SEM and AFM Metrology. I develop metrology and characterization plans for back-end processes for multiple programs. I implemented statistical design of experiments to optimize CNT CVD growth process. Process Integration: I tracked wafer lots and ensured efficient process flows
- **Simulation and Modeling.** I have performed Computation Fluid Dynamics and Thermal analysis using ANSYS Multi-Physics FEA software for numerous programs.
- **Awards:** Two seed funding (SPARK) grants for internal research projects, 3 BRAVO awards for outstanding technical work, and 5 IP awards for invention disclosures.
- **Work Summary:** I led a team in Carbon Nanotube (CNT) chemical vapor deposition growth which led to significant advances for wafer scale CNT growth which is a critical challenge in the scalability of CNT based devices. I also conducted process development research in various groups including Silicon Microelectronics failure analysis, GeTe Phase Change switch design, and Scanning SQUID Magnetometry of superconducting Niobium based circuits. My role doing process Integration and development included device layout, fabrication flow, and cleanroom technical work such as Lithography, Electron Microscopy, and Scan Probe Microscopy. I also developed Python scripts for Data Analysis and Computer Vision for rapid image processing and quality control.

#### **Adjunct Faculty Lecturer**

Electrical Engineering Department at Morgan State University, Baltimore MD. January 2018 – May 2020

#### **Robotics Instructor**

Upward Bound program at Baltimore City Community College, Baltimore, MD. August 2019 – May 2020.

#### **Graduate Research Assistant**

Fredrick Seitz Materials Research Laboratory at the University of Illinois, Urbana-Champaign, IL. June 2013 – July 2017

#### **Outreach Coordinator/Assistant Program Director**

St. Elmo Brady STEM Academy at Booker T Washington Elementary School, Champaign, IL. Sept 2014 – November 2016

#### **Product Development Intern (UAV Electronics)**

Horizon Hobby Inc, Champaign, IL. April 2014 - August 2014

#### **Quality Control Research Intern**

CERN-ATLAS Team, Geneva, Switzerland. May 2011 – August 2011

#### **Undergraduate Research Assistant**

Center of Microwave, Satellite, and RF Engineering at Morgan State University, Baltimore, MD. October 2010 - May 2013

#### **Technical Skills and Experience**

**Current Research Interest:** Phase Change Memory and Neuromorphic materials, reconfigurable RF/Microwave electronics (ie antennas and filters), reconfigurable optoelectronics and plasmonics, Optical Crystals and Metasurfaces, optical neuromorphic computing, CVD Carbon Nanotube and Graphene growth and Boron/Nitrogen/Silicon in situ doping, Low Dimensional Quantum Materials and Devices, Quantum Information and Communication, Nanoscale Imaging and Scan Probe Microscopy.

**Past Research Experience:** RF Circuit and Antenna Design, Carbon Nanotube Growth and Electronics, Low-dimensional Semiconductors for high speed transistor/switches, Microscopy methods for nanoscale electronic materials, Energy and Sustainability systems optimization, Photovoltaics for Residential and Space Applications, Advanced Materials Process Development, UAV engineering, Microelectronics circuit layout and development.

**Scientific Experience:** Atomic Force Microscopy, Microwave Impedance Microscopy, Conductive AFM, Electric Force/Kelvin Probe AFM, Force Curve Mapping, Scanning Optical Near-Field Microscopy, Scanning SQUID Microscopy, Scanning E-beam Microscopy, Confocal Microscopy, RAMAN Spectroscopy, FTIR Spectroscopy, Chemical Vapor Deposition, Atomic Layer Deposition, Photolithography tools, Metal deposition tools, and RF/DC Probe Test Station, Finite

Element Analysis based Multi-physics Modeling, Monte Carlo Simulation Methods, Decision/Risk Analysis, Statistical Data Analysis, Computer Vision and Image Recognition.

**Computer Programming and Software Expertise:** Ansoft's COMSOL Multiphysics, Agilent's Advanced Design System (ADS), ANSYS High Frequency Simulation Software (HFSS), ANSYS Multiphysics, COMSOL Multiphysics, AutoCAD, LTSpice, website/database design, Microsoft Office suite, MATLAB, Python, Igor, C++, CRAN (R), L<sup>A</sup>T<sub>E</sub>X, Linux OS.

### Publications

1. **Seabron, E.**, Ellis, C., Jackson, E., Tischler, J., Meeker, M., Land, A., Stroud, R., 2022. Volume phonon polaritons in one-dimensional grating in a natural hyperbolic Calcite with in-plane anisotropy. *Manuscript in progress*.
2. Yahiaoui, R., Chase, Z.A., Kyaw, C., **Seabron, E.**, Mathews, J. and Searles, T.A., 2021. Dynamically tunable single-layer VO<sub>2</sub>/metasurface based THz cross-polarization converter. *Journal of Physics D: Applied Physics*, 54(23), p.235101.
3. **Seabron, E.**, MacLaren, S., Jones, K., & Wilson, W. L., 2019. "A dynamic-difference approach to scan probe microwave reflectivity mapping of the nanoscale electronic properties of single-walled carbon nanotubes." *Journal of Applied Physics*, 125(17), 174303.
4. **Seabron, E.**, "Characterization of nanoscale electronic materials using novel methods for scan probe microscopy.", PhD Thesis, March 2018, <https://www.ideals.illinois.edu/handle/2142/98396>
5. Choi, W., **Seabron, E.**, Mohseni, P.K., Kim, J.D., Gokus, T., Cernescu, A., Pochet, P., Johnson, H.T., Wilson, W.L. and Li, X., 2017. "Direct electrical probing of periodic modulation of zinc-dopant distributions in planar gallium arsenide nanowires." *ACS nano*, 11(2), pp.1530-1539.
6. **Seabron, E.**, MacLaren, S., Xie, X., Rotkin, S.V., Rogers, J.A. and Wilson, W.L., 2015. "Scanning probe microwave reflectivity of aligned single-walled carbon nanotubes: Imaging of electronic structure and quantum behavior at the nanoscale." *ACS nano*, 10(1), pp.360-368.
7. **Seabron, E.**, "Exploring Nanoscale Characterization of Low Dimensional Electronic Materials", Master's Thesis, March 2015, <https://www.ideals.illinois.edu/handle/2142/88126>
8. Xie, X., Wahab, M.A., Li, Y., Islam, A.E., Tomic, B., Huang, J., Burns, B., **Seabron, E.**, Dunham, S.N., Du, F. and Lin, J., 2015. "Direct current injection and thermocapillary flow for purification of aligned arrays of single-walled carbon nanotubes." *Journal of Applied Physics*, 117(13), p.134303.
9. Xie, X., Jin, S.H., Wahab, M.A., Islam, A.E., Zhang, C., Du, F., **Seabron, E.**, Lu, T., Dunham, S.N., Cheong, H.I. and Tu, Y.C., 2014. "Microwave purification of large-area horizontally aligned arrays of single-walled carbon nanotubes." *Nature communications*, 5, p.5332.

### Notable Presentations

- "Scan-probe Spectroscopy/Microscopy of Quantum Materials: Spatially Resolved Quasiparticle Dynamics probed at the Nanoscale", High Frequency Scanning Probe Microscopy Workshop at NIST-Boulder, Boulder CO, December 2019.
- "Multi-Cycled In-Situ Etch Activation and Epitaxial Growth of CNTs", Northrop Grumman Materials Forum, Linthicum MD, September 2018.
- "Doping Dynamics of Laterally-Grown p-n Junction GaAs Nanowires Revealed Using Scan-Probe Microscopy Techniques", Materials Research Society Spring 2015 Conference, San Francisco CA, April 2015
- "Microwave Impedance Microscopy (MIM) of Aligned Single Walled Carbon Nanotubes: Imaging Electronic Nanotube Character at the Nanoscale", SPIE International Optics Conference, San Diego CA, August 2014
- "Novel Design of a Tunable Low Noise Amplifier for Software Defined Radios", NASA site review presentation, Morgan State University, May 2013
- "Analysis of Gain-Noise Tradeoffs in Cascaded LNA Designs", CAARMS 18 presentation, Princeton University, June 2012
- "End-Cap Extension Muon Drift Chamber Commissioning", CERN REU Presentation, Site de Meyrin (ATLAS site) in Geneva Switzerland, August 2011