

Joshua A. Taillon

MATERIALS RESEARCH ENGINEER · CHARACTERIZATION EXPERT

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Current Appointment

National Institute of Standards and Technology

NRC POSTDOCTORAL RESEARCH FELLOW · MATERIALS MEASUREMENT SCIENCE DIVISION

Gaithersburg, MD

October 2016 - PRESENT

Education

University of Maryland, College Park

PH.D./M.S. IN MATERIALS SCIENCE AND ENGINEERING

- Thesis: *Advanced analytical microscopy at the nanoscale: Applications in wide bandgap and solid oxide fuel cell materials*
- Advised by Prof. Lourdes Salamanca-Riba
- NSF Graduate Research Fellow

College Park, MD

August 2016/May 2014

Cornell University

B.S. IN MATERIALS SCIENCE AND ENGINEERING

- Graduated *Magna cum laude* with departmental honors
- Minor in Applied Economics and Management
- Senior research thesis in computational materials science

Ithaca, NY

June 2011

Skills

Materials Characterization	Extensive experience with FIB (Ga ⁺ /Xe ⁺), SEM, TEM, Nanotomography, EDS, EELS, XPS, EBSD, XRD, etc.
Scientific Programming	Python, Matlab, Java, Bash scripting, Mathematica, LaTeX
Materials Processing	Wet etching, Chemical vapor deposition, Electron beam evaporation
Software Skills	<i>Microscopy</i> : HyperSpy, DigitalMicrograph, ImageJ, Avizo, etc.; <i>Crystallography</i> : VESTA, CrystalMaker, JMol; <i>Energy Simulation</i> : VASP, Gaussian, ELK, Quantum Espresso; <i>Productivity</i> : All common office tools, extensive experience using Linux/BSD command line environments

Research Experience

National Institute of Standards and Technology

NRC POSTDOCTORAL RESEARCH FELLOW · MATERIALS MEASUREMENT SCIENCE DIVISION

- Exploring the application of compressive sensing to enhance throughput during 3D imaging and chemical analysis in the FIB-SEM
- Contributing development to open-source hyperspectral data analysis software (*HyperSpy*)
- Collaboration with Dr. Keana Scott

Gaithersburg, MD

October 2016 - PRESENT

University of Maryland

NSF GRADUATE RESEARCH FELLOW · DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

- Thesis focused on development and use of electron and ion beam methods to characterize various materials systems
- Frequently collaborated with outside research groups to train students and solve assorted analysis challenges
- Advised by Prof. Lourdes Salamanca-Riba

College Park, MD

July 2011 - August 2016

Analytical microscopy characterization of interfacial states at the 4H-SiC/SiO₂ interface:

- Used high resolution TEM and electron energy loss spectroscopy to investigate the effects of post-processing on SiC MOSFETs
- Implemented novel EELS methodologies to probe the nature of the interfacial transition layer in SiC MOS devices
- Discovered unique electronic states of silicon in nitric oxide annealed devices using unsupervised machine learning EELS analyses
- Developed oxide spin-etching process with monolayer sensitivity for XPS depth profiling
- Collaboration with the U.S. Army Research Laboratory, Auburn University, and Rutgers University

Three-dimensional nanotomographic characterization of solid oxide fuel cell cathode degradation:

- Used FIB-SEM 3D tomography methods to reconstruct and probe SOFC cathode microstructures
- Developed innovative image processing and microstructure quantification routines using *Python* and *Avizo*
- Quantified changes in SOFC cathode structures as a function of H₂O, CO₂, and Cr-vapor exposure
- Collaboration with Prof. Eric Wachsman

Cornell University

UNDERGRADUATE SENIOR THESIS RESEARCH · DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

- Computational search for high temperature superconductors in elemental barium and sodium-calcium phases under high pressure
- Discovered novel crystal structure of barium using genetic algorithm search techniques and density functional theory calculations
- Awarded for best overall thesis and best research poster presentation; Advised by Asst. Prof. Richard Hennig (now at University of Florida)

Ithaca, NY

August 2010 - May 2011

Honors

FELLOWSHIPS & GRANTS

2016 - 2018	NRC Research Associateship , National Research Council	Gaithersburg, MD
2013 - 2016	Graduate Research Fellowship , National Science Foundation	College Park, MD
2011 - 2016	University Fellowship , University of Maryland	College Park, MD
2010 - 2011	MS&E Junior Fellowship , Cornell University Department of Materials Science and Engineering	Ithaca, NY

AWARDS

Nov. 2016	Graduate Student Award , Materials Research Society Fall Meeting	Boston, MA
June 2015	Materials Science Award , University of Maryland ResearchFest	College Park, MD
June 2014	Entrepreneurship Award , University of Maryland NanoDay Competition	College Park, MD
Dec. 2013	Outstanding Student Presentation , Materials Research Society Fall Meeting	Boston, MA
May 2011	First Place , Cornell MS&E Senior Thesis Poster Competition	Ithaca, NY
May 2011	Best Overall Thesis , Cornell MS&E Senior Thesis Competition	Ithaca, NY

Research Interests

Computational Microscopy	Novel applications of FIB-SEM and TEM methodologies and data processing for advanced materials analysis, bridging the gap between advanced signal processing and materials microscopy
Compressive Sensing	Speeding data collection and reducing electron dose through intelligent signal acquisition strategies
Autonomous Metrology	Improving microscopy data collection rates and results through intelligent (and autonomous) determination of measurement parameters using active learning
Machine Learning for Materials	Utilizing unsupervised methods to discover hidden relationships in hyperspectral datasets
Open-source Development	Bringing advanced data analysis methods to the microscopy community through open-source software collaborations
Materials Research	Applying cutting edge characterization methodologies in a wide range of materials systems, including alternative energy, wide bandgap, and energy conversion materials

Teaching and Professional Experience

Cornell University

UNDERGRADUATE TEACHING ASSISTANT · DEPARTMENT OF COMPUTER SCIENCE

- Teaching Assistant for CS 1110: Introduction to Computing Using Java and CS 1130: Transition to Object Oriented Programming
- Led weekly laboratory sessions of thirty students
- Assisted students during weekly office hours, answering questions and administering quizzes
- Graded weekly assignments and communicated detailed student feedback for every submission
- Courses included engineering and liberal arts students, requiring effective communication across multiple disciplines

Ithaca, NY

August 2008 - May 2011

Amphenol PCD

INDUSTRIAL ENGINEERING CO-OP

- Worked closely with the Industrial Engineering Manager to bring new industrial connector products to the market
- Led the design of a custom telecommunications connector, proposing designs and tweaking the product to meet the customer's needs
- Supervised manufacturing staff during the initial quantity production of the new product; designed manufacturing work instructions
- Designed 3D models and engineering drawings for industrial and military/aerospace product lines
- Supported the Industrial Marketing and Sales Manager as an engineering representative in customer interactions

Beverly, MA

Fall 2009; Summer 2010

Professional Affiliations

Microanalysis Society

Materials Research Society

Microscopy Society of America

Publications

Research productivity

SUMMARY STATISTICS:

- 7 peer-reviewed articles; 7 conference proceedings
- 3 invited presentations; 26 contributed presentations
- 52 unique citations; *h*-index: 4 (from Google Scholar)

REFEREED JOURNAL ARTICLES

DETECTION OF UNIQUE INTERFACIAL STATES IN SiC MOS DEVICES VIA SPECTRAL UNMIXING OF EELS SPECTRUM IMAGES

Joshua A. Taillon, Voshadhi Amarasinghe, Leonard Feldman, Tsvetanka Zheleva, Aivars Lelis, Lourdes Salamanca-Riba

Submitted to Applied Physics Letters.

IMPROVING MICROSTRUCTURAL QUANTIFICATION IN FIB/SEM NANOTOMOGRAPHY

Joshua A. Taillon, Christopher Pellegrinelli, Yilin Huang, Eric D. Wachsman, Lourdes G. Salamanca-Riba

Ultramicroscopy, In Press. DOI: 10.1016/j.ultramicro.2017.07.017

TEACHING AN OLD MATERIAL NEW TRICKS: EASY AND INEXPENSIVE FOCUSED ION BEAM (FIB) SAMPLE PROTECTION USING CONDUCTIVE POLYMERS

Joshua A. Taillon, Valery Ray, Lourdes G Salamanca-Riba

Microscopy and Microanalysis, vol. 23, no. 4, pp. 872–877, 2017. DOI: 10.1017/S143192761700054X

NEAR-FIELD OPTICAL PROPERTIES OF FULLY ALLOYED NOBLE METAL NANOPARTICLES

Chen Gong, Mariama Rebello Sousa Dias, Garrett C. Wessler, Joshua A. Taillon, Lourdes G. Salamanca-Riba, Marina S. Leite

Advanced Optical Materials, vol. 5, no. 1, p. 1600568, 2017. DOI: 10.1002/adom.201600568

LONG-TERM CR POISONING EFFECT ON LSCF-GDC COMPOSITE CATHODES SINTERED AT DIFFERENT TEMPERATURES

Chunyan Xiong, Joshua A. Taillon, Christopher Pellegrinelli, Yi-Lin Huang, Lourdes G. Salamanca-Riba, Bo Chi, Li Jian, Jian Pu, Eric D. Wachsman

Journal of The Electrochemical Society, vol. 163, no. 9, F1091–F1099, 2016. DOI: 10.1149/2.0841609jes

BORON-DOPED FEW-WALLED CARBON NANOTUBES: NOVEL SYNTHESIS AND PROPERTIES

Colin Preston, Da Song, Joshua A. Taillon, John Cumings, Liangbing Hu

Nanotechnology, vol. 27, no. 44, p. 445601, 2016. DOI: 10.1088/0957-4484/27/44/445601

SYSTEMATIC STRUCTURAL AND CHEMICAL CHARACTERIZATION OF THE TRANSITION LAYER AT THE INTERFACE OF NO-ANNEALED 4H-SiC/SiO₂ METAL-OXIDE-SEMICONDUCTOR FIELD-EFFECT TRANSISTORS

Joshua A. Taillon, Joon Hyuk Yang, Claude A Ahyi, John Rozen, John R Williams, Leonard C Feldman, Tsvetanka S Zheleva, Aivars J Lelis, Lourdes G Salamanca-Riba

Journal of Applied Physics, vol. 113, no. 4, p. 044517, 2013. DOI: 10.1063/1.4789924

CONFERENCE PROCEEDINGS

ELECTRON MICROSCOPY (BIG AND SMALL) DATA ANALYSIS WITH THE OPEN SOURCE SOFTWARE PACKAGE HYPERSPY

Francisco Pena, Tomas Ostasevicius, Vidar Tonaas Fauske, Pierre Burdet, Petras Jokubauskas, Magnus Nord, Mike Sarahan, Eric Prestat, Duncan N. Johnstone, Joshua A. Taillon, al.

Microscopy and Microanalysis, vol. 23, no. S1, pp. 214–215, 2017. DOI: 10.1017/S1431927617001751

THREE DIMENSIONAL MICROSTRUCTURAL CHARACTERIZATION OF CATHODE DEGRADATION IN SOFCs USING FIB/SEM AND TEM

Joshua A. Taillon, Christopher Pellegrinelli, Yilin Huang, Eric D Wachsman, Lourdes Salamanca-Riba

Microscopy and Microanalysis, vol. 21, no. S3, pp. 2161–2162, 2015. DOI: 10.1017/S1431927615011587

CHARACTERIZATION OF THE OXIDE-SEMICONDUCTOR INTERFACE IN 4H-SiC/SiO₂ STRUCTURES USING TEM AND XPS

Joshua A. Taillon, Karen Gaskell, Gang Liu, Leonard Feldman, Sarit Dahr, Tsvetanka Zheleva, Aivars Lelis, Lourdes Salamanca-Riba

Microscopy and Microanalysis, vol. 21, no. S3, pp. 1537–1538, 2015. DOI: 10.1017/S1431927615008466

INVESTIGATING THE RELATIONSHIP BETWEEN OPERATING CONDITIONS AND SOFC CATHODE DEGRADATION

Christopher Pellegrinelli, Yi-Lin Huang, Joshua A. Taillon, Lourdes G. Salamanca-Riba, Eric D. Wachsman

ECS Transactions, vol. 68, no. 1, pp. 773–784, 2015. DOI: 10.1149/06801.0773ecst

A STUDY OF SOFC CATHODE DEGRADATION IN H₂O ENVIRONMENTS

Christopher Pellegrinelli, Yi-Lin Huang, Joshua A. Taillon, Lourdes G Salamanca-Riba, Eric D Wachsman

ECS Transactions, vol. 64, no. 2, pp. 17–28, 2014. DOI: 10.1149/06402.0017ecst

TOWARDS A FUNDAMENTAL UNDERSTANDING OF THE CATHODE DEGRADATION MECHANISMS

Eric D Wachsman, Yi-Lin Huang, Christopher Pellegrinelli, Joshua A. Taillon, Lourdes G Salamanca-Riba

ECS Transactions, vol. 61, no. 1, pp. 47–56, 2014. DOI: 10.1149/06101.0047ecst

THREE DIMENSIONAL MICROSTRUCTURAL CHARACTERIZATION OF CATHODE DEGRADATION IN SOFCs USING FOCUSED ION BEAM AND SEM

Joshua A. Taillon, Christopher Pellegrinelli, Yilin Huang, Eric D Wachsman, Lourdes G. Salamanca-Riba

ECS Transactions, vol. 61, no. 1, pp. 109–120, 2014. DOI: 10.1149/06101.0109ecst

OTHER PUBLICATIONS

ADVANCED ANALYTICAL MICROSCOPY AT THE NANOSCALE: APPLICATIONS IN WIDE BANDGAP AND SOLID OXIDE FUEL CELL MATERIALS

Joshua A. Taillon

Ph.D. Thesis, University of Maryland — College Park, 2016. DOI: 10.13016/m29806

AB INITIO DISCOVERY OF NOVEL CRYSTAL STRUCTURE STABILITY IN BARIUM AND SODIUM-CALCIUM COMPOUNDS UNDER PRESSURE USING DFT

Joshua A. Taillon, W W Tipton, R G Hennig

arXiv e-prints, 2012. arxiv: <https://arxiv.org/abs/1207.3320>

Presentations

INVITED

COMPUTATIONAL FRONTIERS IN MICROSCOPY AND MICROANALYSIS

Joshua A. Taillon

Presented at *A Celebration of Microscopy and Microanalysis*

Gaithersburg, MD
Sept. 2017

COMPRESSED SENSING APPLICATIONS IN MICROSCOPY AND MICROANALYSIS

Joshua A. Taillon

Presented at the *NIST CS-Bio-Metrology Working Group Meeting*

Gaithersburg, MD
May 2017

ANALYTICAL AND MICROSTRUCTURAL MICROSCOPY APPROACHES FOR MATERIALS CHARACTERIZATION

Joshua A. Taillon

Presented at the *U.S. Army Research Laboratory Methodology Seminar Series*

Adelphi, MD
Dec. 2016

ANALYTICAL ELECTRON MICROSCOPY OF INTERFACIAL STATES IN 4H-SiC/SiO₂ MOS DEVICES

Joshua A. Taillon, *et al.*

Presented for Graduate Student Award consideration at the *2016 Fall Materials Research Society Meeting*

Boston, MA
Nov. 2016

CONTRIBUTED

TEM-EELS INVESTIGATION OF BORON AND PHOSPHORUS PASSIVATED 4H-SiC/SiO₂ INTERFACE STRUCTURES

Christopher Klingshirn, Joshua A. Taillon, *et al.*

Presented at the *2017 March American Physical Society Meeting*

New Orleans, LA
Mar. 2017

QUANTIFIABLE COMPARATIVE EVALUATION OF FIB/SEM INSTRUMENTS

Valery Ray, Joshua A. Taillon, *et al.*

Presented at the *2017 FIB/SEM User Group Meeting*

Gaithersburg, MD
Mar. 2017

ANALYTICAL ELECTRON MICROSCOPY OF INTERFACIAL STATES IN 4H-SiC/SiO₂ MOS DEVICES

Joshua A. Taillon, *et al.*

Presented at the *2016 Fall Materials Research Society Meeting*

Boston, MA
Nov. 2016

ADVANCED ANALYTICAL MICROSCOPY AT THE NANOSCALE: APPLICATIONS IN WIDE BANDGAP AND SOLID OXIDE FUEL CELL MATERIALS

Joshua A. Taillon

Oral defense of Ph.D. Thesis

College Park, MD
July 2016

PERFORMANCE AND DEGRADATION OF SOFC CATHODES AT REDUCED TEMPERATURE

Christopher Pellegrinelli, Joshua A. Taillon, *et al.*

Presented at the *2016 Spring Electrochemical Society Meeting*

San Diego, CA
May 2016

REVEALING HIDDEN INTERFACIAL STATES IN NO PASSIVATED 4H-SiC/SiO₂ STRUCTURES USING TEM-EELS AND XPS

Joshua A. Taillon, *et al.*

Presented at the *2016 March American Physical Society Meeting*

Baltimore, MD
Mar. 2016

PROBING THE NATURE OF INTERFACIAL STATES IN NO PASSIVATED 4H-SiC/SiO₂ STRUCTURES USING TEM-EELS AND XPS

Joshua A. Taillon, *et al.*

Presented at the *2015 Fall Materials Research Society Meeting*

Boston, MA
Dec. 2015

TOMOGRAPHIC AND HYPERSPECTRAL ANALYSIS OF POROUS THREE-DIMENSIONAL SOLID OXIDE FUEL CELL CATHODES AT MULTIPLE LENGTH SCALES

Joshua A. Taillon, *et al.*

Presented at the *2015 Fall Materials Research Society Meeting*

Boston, MA
Nov. 2015

CHARACTERIZATION OF THE OXIDE-SEMICONDUCTOR INTERFACE IN 4H-SiC/SiO₂ MOS STRUCTURES USING TEM AND XPS

Joshua A. Taillon, *et al.*

Presented at the *10th Annual SiC MOS Program Review*

College Park, MD
Aug. 2015

CHARACTERIZATION OF THE OXIDE-SEMICONDUCTOR INTERFACE IN 4H-SiC/SiO₂ STRUCTURES USING TEM AND XPS

Joshua A. Taillon, *et al.*

Presented at the *2015 Microscopy and Microanalysis Meeting*

Portland, OR
Aug. 2015

THREE DIMENSIONAL MICROSTRUCTURAL CHARACTERIZATION OF CATHODE DEGRADATION IN SOFCs USING FIB/SEM AND TEM

Joshua A. Taillon, *et al.*

Presented at the *2015 Microscopy and Microanalysis Meeting*

Portland, OR
Aug. 2015

INVESTIGATING THE RELATIONSHIP BETWEEN OPERATING CONDITIONS AND SOFC CATHODE DEGRADATION

Christopher Pellegrinelli, Joshua A. Taillon, *et al.*

Presented at the *2015 SOFC-XIV Electrochemical Society Conference on Electrochemical Energy Conversion and Storage*

Glasgow, Scotland
July 2015

THREE DIMENSIONAL MICROSTRUCTURAL CHARACTERIZATION OF SOFCs USING FOCUSED ION BEAM AND SEM

Joshua A. Taillon, *et al.*

Presented at the *2015 FIB/SEM User Group Meeting*

Laurel, MD
Feb. 2015

CHARACTERIZATION OF THE OXIDE-SEMICONDUCTOR INTERFACE IN 4H-SiC/SiO₂ STRUCTURES USING TEM AND XPS

Joshua A. Taillon, *et al.*

Presented at the *2014 Fall Materials Research Society Meeting*

Boston, MA
Dec. 2014

THREE DIMENSIONAL MICROSTRUCTURAL CHARACTERIZATION OF CATHODE DEGRADATION IN SOFCs USING FOCUSED ION BEAM AND SEM

Joshua A. Taillon, *et al.*

Presented at the *Americas Amira & Avizo User Group Meeting*

Boston, MA
Oct. 2014

CHARACTERIZATION OF THE OXIDE-SEMICONDUCTOR INTERFACE IN 4H-SiC/SiO₂ STRUCTURES USING TEM AND XPS

Joshua A. Taillon, *et al.*

College Park, MD

- Presented at the 9th Annual SiC MOS Workshop Aug. 2014
- THREE DIMENSIONAL MICROSTRUCTURAL CHARACTERIZATION OF CATHODE DEGRADATION IN SOFCs USING FOCUSED ION BEAM AND SEM**
 Joshua A. Taillon, *et al.* Orlando, FL
 Presented at the 2014 Spring Electrochemical Society Meeting May 2014
- CHARACTERIZATION OF THE OXIDE-SEMICONDUCTOR INTERFACE IN NO, P, AND N-PLASMA PASSIVATED 4H-SiC/SiO₂ STRUCTURES USING TEM AND XPS**
 Joshua A. Taillon, *et al.* Boston, MA
 Presented at the 2013 Fall Materials Research Society Meeting Dec. 2013
- CHARACTERIZATION OF THE OXIDE-SEMICONDUCTOR INTERFACE IN NO, P, AND N-PLASMA PASSIVATED 4H-SiC/SiO₂ STRUCTURES USING TEM**
 Joshua A. Taillon, *et al.* College Park, MD
 Presented at the 8th Annual SiC MOS Workshop Aug. 2013
- CHARACTERIZATION OF THE OXIDE-SEMICONDUCTOR INTERFACE IN NO, P, AND N-PLASMA PASSIVATED 4H-SiC/SiO₂ STRUCTURES USING TEM**
 Joshua A. Taillon, *et al.* South Bend, IN
 Presented at the 55th Electronic Materials Conference June 2013
- CHARACTERIZATION OF THE OXIDE-SEMICONDUCTOR TRANSITION LAYER IN NO, P, AND N-PLASMA PASSIVATED 4H-SiC/SiO₂ STRUCTURES USING TRANSMISSION ELECTRON MICROSCOPY**
 Joshua A. Taillon, *et al.* Baltimore, MD
 Presented at the 2013 March American Physical Society Meeting Mar. 2013
- SYSTEMATIC CHARACTERIZATION OF THE SiC/SiO₂ TRANSITION LAYER IN NO-ANNEALED MOSFETS**
 Joshua A. Taillon, *et al.* Boston, MA
 Presented at the 2012 Fall Materials Research Society Meeting Nov. 2012
- FABRICATION OF ZNO NANOWIRE ARRAYS FOR HYBRID PHOTOVOLTAIC APPLICATIONS**
 Joshua A. Taillon, *et al.* Boston, MA
 Poster presented at the 2012 Fall Materials Research Society Meeting Nov. 2012
- SYSTEMATIC CHARACTERIZATION OF THE SiC/SiO₂ TRANSITION LAYER IN NO-ANNEALED MOSFETS**
 Joshua A. Taillon, *et al.* College Park, MD
 Presented at the 7th Annual SiC MOS Workshop Aug. 2012
- FABRICATION OF ZNO NANOWIRE ARRAYS FOR HYBRID PHOTOVOLTAIC APPLICATIONS**
 Lourdes Salamanca-Riba, Joshua A. Taillon, *et al.* Boston, MA
 Presented at the 2012 Fall American Physical Society March Meeting Nov. 2012
- AB INITIO DISCOVERY OF NOVEL CRYSTAL STRUCTURE STABILITY IN BARIUM AND SODIUM-CALCIUM COMPOUNDS UNDER PRESSURE USING DFT**
 Joshua A. Taillon, *et al.* Ithaca, NY
 Presented at the 2011 Cornell University Senior Research Thesis Symposium June 2011