

Luke Lyle
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Education

- Carnegie Mellon University** Spring 2020
Ph.D., Materials Science and Engineering, Magna cum laude
- Carnegie Mellon University** Spring 2018
M.S., Materials Science and Engineering, Magna cum laude
- State University of New York at Buffalo** Spring 2016
B.S. with honors, Physics, Magna cum laude
B.A., Mathematics, Magna cum laude

Thesis

- Carnegie Mellon University** Pittsburgh, PA
Research and Development of β -Ga₂O₃ for Power Electronics and UV Photodetectors 8/2016-8/2020
- Studied growth and characterization of Ga₂O₃ for optoelectronic and power device applications under Professor Lisa Porter
 - Characterized (Al,Ga,In)₂O₃ films grown via MOCVD chemically, optically, structurally and electrically
 - Fabricated (Al,Ga,In)₂O₃ photodetectors using photolithography and measured optoelectronic properties
 - Investigated electrical characteristics of (100), (010), (001), and ($\bar{2}$ 01) β -Ga₂O₃ Schottky diodes via IV, CV, and IVT
 - Examined the influence of surface orientation on metal Ti contact formation to β -Ga₂O₃ via XPS
 - Surveyed β -Ga₂O₃-metal contact interfaces using cross sectional STEM/HRTEM

Appointments

- Pennsylvania State University** State College, PA
Assistant Research Professor 11/2021-Present
- Specialize in electronic materials growth, characterization, processing, and device fabrication in the Electro-Optics and Electronics division
 - Supervise and collaborate with undergraduates, graduate students, and postdoctoral researchers to meet project goals
 - Develop proposals, presentations, and design experiments for sponsor and departmental needs
 - Currently act as a lead or collaborator on over a dozen separate projects
- Carnegie Mellon University** Pittsburgh, PA
Postdoctoral Research Fellow 8/2020-11/2021
- Awarded Swartz Center Innovation Fellowship of \$100k from the Swartz Center for Entrepreneurship at Carnegie Mellon
 - Developed novel growth method for gallium oxide-based materials
 - Designed and manufactured semiconductor growth system
 - Executed comprehensive market analysis of wide bandgap semiconductor materials
- UES Inc.** Dayton, OH
Research Assistant 5/2019-8/2019
- Explored the effects of annealing under vacuum on the Ti/Ga₂O₃ interface via XPS and TEM
 - Schottky diodes were fabricated and annealing effects were examined electrically via IV and CV measurements
 - Developed a model for understanding Ti/Au ohmic contact to β -Ga₂O₃
 - Obtained clearance and conducted research at a National Lab
- Carnegie Mellon University** Pittsburgh, PA
Teaching Assistant 8/2016-8/2020
- Helped establish best teaching practices by interfacing with students in lab and classroom settings
 - Led class discussions and hosted office hours to facilitate university educational goals
 - Assisted with grading of quizzes, exams, and homework
- Saint-Gobain-Seeded Gel** Niagara Falls, NY
Quality Control Chemist 5/2016-8/2016
- Verified quality of alumina powders by measuring their volume, surface area, size distribution, and hardness
 - Performed chemical analysis using ICP mass spectrometry and EDS
 - Coordinated with a team of chemists to meet project deadlines

- Studied ion transport in large-bore metal insulating and macrocapillaries under Professor Chad Sosolik
- Irradiated insulating and conducting macrocapillaries with Rb^+ ions and examined transmission current through capillary
- Interfaced equipment to monitor time dependence of transmission current
- Calibrated electron beam ion trap (EBIT) for semiconductor device irradiation

STEM Outreach

State University of New York at Buffalo

Buffalo, NY

President – Society of Physics Students

9/2015-5/2016

- Planned outreach activities at various institutions by organizing physics-related demonstrations
- Organized and led departmental tutoring for students in introductory physics courses
- Established monthly speaker series of professors and undergraduate students presenting their research
- Leveraged a budget of \$1,000 to update undergraduate offices

State University of New York at Buffalo

Buffalo, NY

Ambassador – College of Arts and Sciences

9/2015-5/2016

- Developed science demonstrations for elementary school students to gain interest in STEM fields
- Organized science outreach day for K-8 using developed physics demonstrations for hundreds of students
- Tutored students in upper undergraduate mathematics classes such as linear algebra and partial differential equations

Publications

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- L.A.M. Lyle, S. House, J. Yang, L.M. Porter, “Nanoscale Characterization of Chemical and Structural Properties of the $\beta\text{-Ga}_2\text{O}_3$ Interface” ACS Applied Electronic Materials. Submitted.
- S. Mukhopadhyay, L.A.M. Lyle, H. Pal, K. Das, L.M. Porter, “Evidence of Thermionic Emission in Forward Biased $\beta\text{-Ga}_2\text{O}_3$ Schottky Diodes at Boltzmann Doping Limit” J. Appl. Phys. **131** 25702 (2022).
- L.A.M. Lyle, T. C. Back, C. T. Bowers, A. J. Green, K. D. Chabak, D. L. Dorsey, E. R. Heller, L.M. Porter, “Electrical and Chemical Analysis of Ti/Au Contacts to $\beta\text{-Ga}_2\text{O}_3$ ”. APL Mater. **9** 061104 (2021).
- L.A.M. Lyle, K. Jiang, E.V. Favela, K. Das, A. Popp, Z. Galazka, G. Wagner, and L.M. Porter, “Effect of Metal Contacts on (100) $\beta\text{-Ga}_2\text{O}_3$ Schottky Barriers”. J. Vac. Sci. Technol. A. **39** 033202 (2021).
- A. Jadhav, L. A. M. Lyle, K. Jiang, E. V. Favela, K. Das, A. Popp, Z. Galazka, G. Wagner, B. Sarkar, and Lisa M. Porter, “Temperature Dependence of Barrier Height Inhomogeneity in $\beta\text{-Ga}_2\text{O}_3$ Schottky Barrier Diodes”. J. Vac. Sci. Technol. B. **39** (4) 1-6 (2021).
Editors Pick.
- L.A.M. Lyle. “Research and Development of Electrical Contacts to $\beta\text{-Ga}_2\text{O}_3$ for Power Electronics and UV Photodetectors” Carnegie Mellon University (2020)
- L.A.M. Lyle, S. Okur, V.S.N. Chava, M. Kelley, R.F. Davis, G.S. Tompa, M.V.S. Chandrashekar, A.B. Greytak, and L.M. Porter, “Characterization of Epitaxial $\beta\text{-(Al,Ga,In)}_2\text{O}_3$ – Based Films and Applications as UV Photodetectors”. J. Elec. Mat. **49** (6) 3490-3498 (2020). **2021 TMS Functional Materials Division JEM Best Paper Award.**
- K. Jiang, L.A.M. Lyle, E. V. Favela, T. Lin, D. Moody, K. K. Das, A. Popp, Z. Galazka, G. Wagner, and L. M. Porter, “Electrical Properties of (100) $\beta\text{-Ga}_2\text{O}_3$ Schottky Diodes with Four Different Metals” ECS Trans. **92** (7) 71-78 (2019).
- L.A.M. Lyle, K. Jiang, K. Das, and L.M. Porter, “Schottky Contacts to $\beta\text{-Ga}_2\text{O}_3$,” in Gallium Oxide - Technology, Devices and Applications, edited by Stephen J. Pearton, Fan Ren and Michael Mastro. Elsevier (2018).
- S. Okur, G. S. Tompa, T. Salagaj, L.A.M. Lyle, R.F. Davis, L.M. Porter “Gallium Oxide Large Area UV Sensors” DOE-SMI-0017885. United States (2018).
- Y. Yao, S. Okur, L.A.M. Lyle, G.S. Tompa, T. Salagaj, N. Sbrockey, R.F. Davis and L.M. Porter “Growth and Characterization of α -, β -, and ϵ -phases of Ga_2O_3 using MOCVD and HVPE Techniques” Mater. Res. Lett. **6** (5) 268-275 (2018).
- Y. Yao, L.A.M. Lyle, J.A. Rokholt, S. Okur, G.S. Tompa, T. Salagaj, N. Sbrockey, R.F. Davis, and L.M. Porter “Growth and Characterization of α -, β -, and ϵ -Phases of Ga_2O_3 Epitaxial Layers on Sapphire,” ECS Trans. **80** (7) 191-196 (2017).
- D.D. Kulkarni, L.A.M. Lyle, C.E. Sosolik, “Ion Transport through Macrocavillaries – Oscillations due to Charge Patch Formation,” Nucl. Instrum. Methods **382**, 54-59 (2016).

Presentations

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- L.A.M. Lyle, K. Jiang, E.V. Favela, K. Das, A. Popp, Z. Galazka, G. Wagner, R.F. Davis and L.M. Porter, “Electrical Behavior of Schottky Contacts to (100) $\beta\text{-Ga}_2\text{O}_3$ ”. 62nd Electronic Materials Conference, June 2020, oral.
- L.A.M. Lyle, K. Jiang, E.V. Favela, K. Das, A. Popp, Z. Galazka, G. Wagner, R.F. Davis and L.M. Porter, “Characterization of Schottky and Ohmic contacts on (100) $\beta\text{-Ga}_2\text{O}_3$ ”. AVS 66th International Symposium, Columbus, OH October 2019, oral.
- L.A.M. Lyle, S. Okur, J. Letton, V.S.N. Chava, R.F. Davis, G.S. Tompa, MVS Chandrashekar, and L.M. Porter, “UV Photodetectors based on $\beta\text{-(Al,In,Ga)}_2\text{O}_3$ -Alloy films” 61st Electronic Materials Conference, Ann Arbor, MI, July 2019, oral.
- L.A.M. Lyle, S. Okur, J. Letton, V.S.N. Chava, R.F. Davis, G.S. Tompa, MVS Chandrashekar, and L.M. Porter, “Characterization of $\beta\text{-(Al,In,Ga)}_2\text{O}_3$ Epitaxial films for UV Photodetector Applications” AVS 65th International Symposium, Long Beach, CA, October 2018, oral.

- L.A.M. Lyle**, S. Okur, J. Letton, V.S.N. Chava, R.F. Davis, G.S. Tompa, MVS Chandrashekhar, and L.M. Porter, “*Growth and Characterization of $(Al_xGa_{1-x})_2O_3$, Ga_2O_3 , and $(In_xGa_{1-x})_2O_3$ Epitaxial Films for UV Photodetectors*,” 2018 US Workshop on Gallium Oxide, Columbus, OH, August 2018, oral.
- L.A.M. Lyle**, S. Okur, R.F. Davis, G.S. Tompa, and L.M. Porter, “*Growth and Characterization of $(Al_xGa_{1-x})_2O_3$, Ga_2O_3 , and $(In_xGa_{1-x})_2O_3$ Epitaxial Films*” Western Pennsylvania AVS Meeting, October 2017, poster.
- L.A.M. Lyle** and S. Ganapathy, “*Phase Transition in Vanadium Dioxide Nanostructures*,” University of Rochester Symposium for Physics Students, Rochester, NY, April 2016, oral.
- L.A.M. Lyle**, D.D. Kulkarni, and C.E. Sosolik, “*Ion Transport in Macrocapillaries*,” Southeastern Section of the American Physical Society, Mobile, AL, November 2015, oral.

Awards

MRI Seed Grant, 2022

Awarded a seed grant of \$50k from the Materials Research Institute at Pennsylvania State University.

The Minerals, Metals, and Materials Society – Functional Materials Division Paper of the Year Award, 2021

Paper of the Year Award for the Journal of Electronics Materials. Chosen out of ~850 other papers for “*Characterization of Epitaxial β -(Al,Ga,In) $_2O_3$ – Based Films and Applications as UV Photodetectors*”.

Editor’s Pick, 2021

“*Temperature Dependence of Barrier Height Inhomogeneity in β - Ga_2O_3 Schottky Barrier Diodes*” awarded Editor’s Pick in Journal of Vacuum Science and Technology B.

Innovation Fellowship, 2020

Awarded \$100k of funding for an appointment in the Materials Science and Engineering Department at Carnegie Mellon University from the Schwartz Center for Entrepreneurship as Principal Investigator for “*Liquid Phase Epitaxy of Gallium Oxide*”. I was chosen out of a pool of 50 applicants.

Student Project Supervision

Jacob Steele, undergraduate, <i>Mo Schottky contacts to Ga_2O_3</i>	Fall 2020 – Spring 2021
Kunyao Jiang, graduate, <i>Schottky contacts to Ga_2O_3</i>	Spring 2019 – Spring 2020
Tianxing Lin, graduate, <i>Atomic Layer Deposition of Ga_2O_3</i>	Fall 2018 – Fall 2019
Priscilla Chung, undergraduate, <i>Investigation of Ga_2O_3 Surface Morphology</i>	Spring 2018 – Fall 2019
Kunyao Jiang, graduate, <i>Raman spectroscopy of Ga_2O_3</i>	Fall 2018 – Spring 2019
Diamond Moody, undergraduate, <i>Tungsten Schottky contacts to Ga_2O_3</i>	Fall 2018 – Spring 2019
Timothy Cote, undergraduate, <i>Development of a Solar-Blind UV Photodetector Device</i>	Fall 2017 – Spring 2018

Teaching Experience

Microstructures and Properties	Fall 2019
Transport in Materials	Spring 2019
Solid State Devices for Energy Conversion	Fall 2018
Engineering Optical and Thermal Energy Transport	Spring 2018
Materials Engineering Essentials	Fall 2017
Defects in Materials	Spring 2017

Professional Skills

Materials Characterization: Atomic Force Microscopy (AFM), White Light Interferometry, X-Ray Diffraction (XRD), Laue diffraction, Current-Voltage (IV), Capacitance-Voltage (CV), Current-Voltage-Temperature (IVT), X-Ray Photoelectron Spectroscopy (XPS), Electron Probe Microanalysis (EPMA), Energy Dispersive X-ray Spectroscopy (EDS), UV-visible Spectroscopy (UV-Vis), Focused Ion Beam (FIB), Transmission Electron Microscope (TEM), Raman Spectroscopy, Noise/Optoelectronic measurements

Material Growth, Deposition and Processing: Metalorganic Chemical Vapor Deposition (MOCVD), Electron Beam Evaporation, Sputtering, Liquid phase epitaxy (LPE), Halide Vapor Phase Epitaxy (HVPE), Atomic Layer Deposition (ALD), Reactive Ion Etching/Inductively Coupled Plasma (RIE/ICP), Photolithography

Software: Microsoft Office, MATLAB, Mathematica, CrystalMaker Suite, CasaXPS, Paraview, LaTeX