

ALYSSA L. (KOCH) MOCK

Assistant Professor
 Electrical and Computer Engineering
 College of Engineering, Applied Science and Technology
 Weber State University
 Ogden, Utah USA
alyssamock@weber.edu

Education

University of Nebraska – Lincoln (Lincoln, NE)
 Doctorate of Philosophy – Electrical Engineering, 2017
 Dissertation: *Generalized Ellipsometry on Complex Nanostructures and Low-Symmetry Materials*
 University of Nebraska – Lincoln (Lincoln, NE)
 Bachelors of Science – Mechanical Engineering (Regent's Full Tuition Scholarship - 4 years) 2011

Professional Positions

Weber State University – Electrical and Computer Engineering August 2021-Present
Assistant Professor

Naval Research Laboratories under a National Research Council Associateship Award March 2019-July 2021
 Marko Tadjer - Supervisor
Post-doctoral Researcher – fabrication and characterization of thin film monoclinic β -Ga₂O₃ based devices

Linköpings universitet, Institutionen för fysik, kemi och biologi, Linköping Sweden February 2018-February 2019
 Vanya Darakchieva's Lab at Linköpings universitet
Post-doctoral Researcher – growth and characterization of III-Nitrides and β -Ga₂O₃

University of Nebraska – Lincoln, Department of Electrical Engineering January 2018-February 2018
 Mathias Schubert's Lab at University of Nebraska – Lincoln
Post-doctoral Researcher – Low symmetry materials characterization

University of Nebraska – Lincoln, Department of Electrical Engineering 2012-2017
 Eva Schubert's Lab at University of Nebraska – Lincoln
Graduate Research Assistant
 August 2012-August 2013
 January 2016-January 2017
Graduate Teaching Assistant
 August 2013-January 2016
 Electrical Circuits Lab II (Fall 2015, 13 students), (Spring 2015, 18 students), (Fall 2014, 10 students),
 (Spring 2014, 24 students), (Fall 2013, 13 students)
 Photonics Lab (Fall 2014, 8 students)
 Electrical Circuits for Mechanical Engineers (Summer 2014, 5 Students), (Summer 2015, 7 Students)
 Guest Lectures: Engineering Statistics and Transistor Circuits

University of Nebraska – Lincoln, Department of Mechanical Engineering 2011-2012
 Namas Chandra's Lab at University of Nebraska – Lincoln
Graduate Research Assistant

J.A. Woollam Co., Inc. 2009-2017
Coop/Intern

Graduate School Honors & Awards

July 2018: NRC Research Fellowship award to the Naval Research Laboratory in Washington, DC
April 2018: University of Nebraska College of Engineering Outstanding Doctoral Dissertation Award
August 2015: University of Nebraska College of Engineering Travel Grant - AVS Conference San Jose, CA
September 2015: AVS Dorothy M. and Earl S. Hoffman Travel Grant - AVS Conference San Jose, CA
April 2015: University of Nebraska Graduate Research Fair Poster Competition: Electrical Engineering 3rd Place
April 2015: University of Nebraska Graduate College of Engineering Poster Competition: Commendation
February 2015: SVC Bernard Henry Fellowship
April 2014: University of Nebraska Graduate College of Engineering Milton E. Mohr Award

Account of Scientific Work

38 total works (31 published or accepted, 7 submitted or in preparation), 10 first authorships, 5 high-impact publications in Phys. Rev. B, 1 book chapter, and 6 invited conference talks: ICSE-Berlin 2016, Photonics West-San Francisco 2018, ICMCTF-San Jose 2019, ICSE-Barcelona 2019, AVS-Ohio 2019, and ICSE-Beijing 2022.

Presentations

Lecture/Oral

ICSE-IX (Invited):

May 2022 Strain and stress relationships for Raman and infrared active phonon modes in monoclinic symmetry, with β -Ga₂O₃ as example
 (Upcoming: Beijing, China)

MRS Spring Meeting:

April 2021 Dielectric Properties, Electronic Transitions and Infrared Active Optical Phonon Modes of Molecular Beam Epitaxy Sc_xAl_{1-x}N Determined by Spectroscopic Ellipsometry
 (Virtual: Seattle, Washington)

Physics Colloquium (Invited):

April 2020 Low symmetry materials for device applications: Characterization and applications of monoclinic semiconductor β -Ga₂O₃
 (Virtual: New Mexico State University)

AVS 66 Conference Presentation (Invited):

October 2019 Generalized ellipsometric analysis on low-symmetry wide-bandgap materials
 (Columbus, Ohio)

ICSE-VIII (Invited):

May 2019 Generalized ellipsometry on low-symmetry materials (Barcelona, Spain)

ICMCTF (Invited):

May 2019 The Physics of Low Symmetry Metal Oxides with Special Attention to Phonons, Plasmons and Excitons (San Diego, California)

Epioptics-15:

July 2018 The physics of low symmetry metal oxides with special attention to phonons, plasmons and excitons and their potential for uses in power electronics and quantum technologies
 (Erice, Italy)

10th Workshop Ellipsometry:

March 2018 Optical and electronic properties of low-symmetry (Chemnitz, Germany)

Photonics West Conference Presentation (Invited):

January 2018 Optical and electronic properties of monoclinic Ga₂O₃ unraveled (San Francisco, California)

Naval Research Laboratory Seminar:

November 2017 Generalized ellipsometry on complex nanostructures and low-symmetry materials
 (Washington D.C.)

MMM Conference Presentation:

November 2017 Magneto-optical response of slanted columnar heterostructured thin films
 (Pittsburgh, Pennsylvania)

ICSEVII (Invited):**June 2016**

The eigen polarization model for monoclinic and triclinic symmetries: generalized ellipsometry analysis from the far infrared to the deep ultra violet for single crystalline β (gallia) Ga_2O_3 (Berlin, Germany)

AVS Conference Presentation:**October 2015**

Anisotropy, band-to-band transitions, phonon modes, and oxidation properties of cobalt-oxide core-shell slanted columnar thin films. (San Jose, CA)

Publications

A. Mock, A. Jacobs, E. Jin, M. Hardy, M. Tadjer, Long-wavelength dielectric properties and infrared active optical phonon modes of molecular beam epitaxy $\text{Sc}_x\text{Al}_{1-x}\text{N}$ determined by infrared spectroscopic ellipsometry, *Appl. Phys. Lett.* **117**, 232107 (2020)

M. Stokey, A. Mock, R. Korlacki, S. Knight, V. Darakchieva, S. Schoche, and M. Schubert, Infrared active phonons in monoclinic lutetium oxyorthosilicate, *J. Appl. Phys.* **127**, 115702 (2020)

S. Knight, R. Korlacki, C. Dugan, J.C. Petrosky, A. Mock, P.A. Dowben, J.M. Mann, M.M. Kimani, and M. Schubert, Infrared-active phonon modes in single-crystal thorium dioxide and uranium dioxide, *J. App. Phys.*, **127**, 12 (2020)

R. Korlacki, A. Mock, C. Briley, V. Darakchieva, B. Monemar, Y. Kumagai, K. Goto, M. Higashiwaki, and M. Schubert, Comment on "Characteristics of Multi-photon Absorption in a β - Ga_2O_3 Single Crystal", *J. Phys. Soc. Jpn.* **89**, 036001 (2020)

U. Kilic, A. Mock, D. Sekora, S. Valloppilly, N. Ianno, E. Schubert, and M. Schubert, Precursor-surface interactions revealed during plasma-enhanced atomic layer deposition of metal oxide thin films by n-situ spectroscopic ellipsometry, *Sci. Rep.* **10**, 10392 (2020)

M.J. Tadjer, J.A. Freitas Jr., J.C. Culbertson, M. Weber, E.R. Glaser, A. Mock, N.A. Mahadik, K. Schmieder, E. Jackson, J.C. Gallagher, B.N. Feigelson, and A. Kuramata, Structural and Electronic Properties of Si- and Sn-doped (-201) β - Ga_2O_3 Annealed in Nitrogen and Oxygen Atmospheres, *Journal of Physics D: Applied Physics* **50**, 53, 504002 (2020)

M. Schubert, A. Mock, R. Korlacki, S. Knight, B. Monemar, K. Goto, Y. Kumagai, A. Kuramata, Z. Galazka, G. Wagner, and M.J. Tadjer, 2020. Phonon Properties. In *Gallium Oxide* (pp. 501-534). Springer, Cham.

E.N. Jin, M.T. Hardy, A.L. Mock, J.L. Lyons, A.R. Kramer, M.J. Tadjer, N. Nepal, D.S. Katzer, and D.J. Meyer, Band alignment of $\text{Sc}_x\text{Al}_{1-x}\text{N}/\text{GaN}$ heterojunctions, *ACS Applied Materials & Interfaces* **12**, 46, 52192–52200 (2020)

R. Korlacki, M. Stokey, A. Mock, S. Knight, A. Papamichail, V. Darakchieva, and M. Schubert, Strain and stress relationships for Raman and infrared active phonon modes in monoclinic symmetry, with β - Ga_2O_3 as example, *Phys. Rev. B* **102**, 180101(R) (2020)

M.J. Tadjer, F. Alema, A. Osinsky, M. Mastro, N. Nepal, J. Woodward, R. Myers-Ward, E. Glaser, J. Freitas, A. Jacobs, J. Gallagher, A. Mock, D. Pennachio, J. Hajzus, M. Ebrish, T. Anderson, K. Hobart, J. Hite, C. Eddy, Jr., Characterization of β - Ga_2O_3 Homoepitaxial Films and MOSFETs Grown by MOCVD at High Growth Rates, *Journal of Physics D: Applied Physics* **54**, 3, 034005 (2020)

M.J. Tadjer, K. Sasaki, D. Wakimoto, J.C. Gallagher, A.G. Jacobs, A. Mock, A.D. Koehler, M. Ebrish, T.J. Anderson, K.D. Hobart, A. Kuramata, High Carrier Density Delta-Doped β - $(\text{Al}_x\text{Ga}_{1-x})_2\text{O}_3/\text{Ga}_2\text{O}_3$ Heterostructure Field-Effect Transistors by Ozone Molecular Beam Epitaxy, *In Submission AIP Advances*

C. Briley, D. Sekora, A. Mock, E. Schubert, C. Binek, H. Schmidt, and M. Schubert, Optical and magnetization properties of slanted hard-soft magnetic heterostructure nanocolumns, *In submission, J. Appl. Phys.*

J. Spencer, A. Mock, Y. Zhang, M.J. Tadjer, Review of Electronic Oxides, *Under Review, ACS Appl. Elec. Mat.*

J.A. Freitas, Jr., J.C. Culbertson, N. Nepal, A. Mock, M.J. Tadjer, Z. Feng, and H. Zhao, Influence of oxygen partial pressure on properties of monoclinic Ga_2O_3 deposited on Sapphire substrates, *Accepted for publication, JVST*

- A. Mock**, M. Ebrish, A. Papamichail, R. Myers-Ward, D.K. Gaskill, V. Stanishev, V. Darakchieva and M. Tadjer, Structural, optical and electrical characterization of graphene on epitaxial 4° off-axis C-face SiC, *In preparation*
- J. Spencer, **A. Mock**, M.J. Tadjer, Review of High Thermal Conductivity Thermal Management Solutions in GaN HEMTs, *Under Review, Book Chapter*
- J. Spencer, **A. Mock**, Y. Zhang, Heating Issues in Wide-Bandgap Semiconductor Devices, *Under Review, Book Chapter*
- A. Mock**, R. Korlacki, S. Knight, M. Stokey, A. Fritz, V. Darakchieva, and M. Schubert, Lattice dynamics of orthorhombic NdGaO₃, *Phys. Rev B*, **99** 184302 (2019)
- A. Mock**, C. Dugan, S. Knight, R. Korlacki, J. M. Mann, E. M. Hunt, J. Petrosky, P. A. Dowben, and M. Schubert, Band-to-band transitions and critical points in the near-infrared to vacuum ultraviolet dielectric functions of single crystalline urania and thoria, *Appl. Phys. Lett.* **114** 211901 (2019)
- D. Tran, N. Blumenschein, **A. Mock**, P. Sukkaew, H. Zhang, J. Muth, T. Paskova, P. Paskov, V. Darakchieva, Thermal conductivity of ultra-wide bandgap thin layers – High Al-content AlGaN and β -Ga₂O₃, *Physica B: Cond. Mat.* 411810 (2019)
- R.D. Carrascon, D.Q. Tran, P. Sukkaew, **A. Mock**, R. Ciecchonski, J. Ohlsson, Y. Zhu, O. Hultin, B. Monemar, P. Paskov, L. Samuelson, and V. Darakchieva, Optimization of GaN nanowires reformation process by MOCVD for device-quality GaN templates, *Phys. Status. Solidi. (b)* 1900581, (2019)
- M. Hilfiker, U. Kilic, **A. Mock**, V. Darakchieva, S. Knight, R. Korlacki, A. Mauze, Y. Zhang, J. Speck and M. Schubert, Dielectric function tensor (1.5 to 9.8eV), anisotropy, and band-to-band transitions of monoclinic β -(Al_xGa_{1-x})₂O₃ (x<0.21) films, *Appl. Phys. Lett.* **114** 231901 (2019)
- M. Schubert, **A. Mock**, R. Korlacki, and V. Darakchieva, Phonon order and reststrahlen bands of polar vibrations in crystals with monoclinic symmetry, *Phys. Rev. B* **99**, 041201(R) (2019)
- U. Kilic, **A. Mock**, R. Feder, D. Sekora, M. Hilfiker, E. Schubert, C. Argyropoulos, and M. Schubert, Tunable plasmonic resonances in Si-Au slanted columnar heterostructure thin films, *Sci. Rep.* **9**, 71 (2019)
- M. Schubert, **A. Mock**, R. Korlacki, S. Knight, Z. Galazka, G. Wagner, V. Wheeler, M. Tadjer, K. Goto, and V. Darakchieva, Longitudinal phonon plasmon mode coupling in β -Ga₂O₃ *Appl. Phys. Lett.* **114** 102102 (2019) – Editor’s Pick
- A. Mock**, R. Korlacki, S. Knight, and M. Schubert, Anisotropy, phonon modes, and lattice anharmonicity from dielectric function tensor analysis of monoclinic yttrium silicate, *Phys. Rev B*, **97**, 165203 (2018)
- A. Mock**, J. VanDerslice, R. Korlacki, J. A. Woollam, and M. Schubert, Elevated temperature dependence of the anisotropic visible-to-ultraviolet dielectric function of monoclinic β -Ga₂O₃, *Appl. Phys. Lett.* **112**, 041905 (2018)
- S. Knight, **A. Mock**, R. Korlacki, V. Darakchieva, B. Monemar, Y. Kumagai, K. Goto, M. Higashiwaki, and M. Schubert, Electron effective mass in Sn-doped monoclinic single crystal β -gallium oxide determined by mid-infrared optical Hall effect, *Appl. Phys. Lett.* **112**, 012103 (2018) – Editor’s Pick
- C. Dugan, G. Peterson, **A. Mock**, C. Young, J. Mann, M. Nastasi, M. Schubert, L. Wang, W. Mei, I. Tanabe, and J. Petrosky, Electrical and Material Properties of Hydrothermally Grown Single Crystal (111) UO₂ *European Physical Journal B*, **91**, No. 4 (2018)
- U. Kilic, D. Sekora, **A. Mock**, N. Ianno, E. Schubert, and M. Schubert, Critical point model dielectric function analysis of WO₃ grown by oxygen plasma enhanced atomic layer deposition, *J. Appl. Phys.* **124**, 115302 (2018)
- A. Mock**, R. Korlacki, C. Briley, V. Darakchieva, B. Monemar, Y. Kumagai, K. Goto, M. Higashiwaki, and M. Schubert Band-to-band transitions, selection rules, effective mass and exciton binding energy parameters in monoclinic β -Ga₂O₃, *Phys. Rev. B* **96**, 245205 (1-12) (2017)
- A. Mock**, R. Korlacki, S. Knight, and M. Schubert, Anisotropy, phonon modes, and lattice anharmonicity from dielectric function tensor analysis of monoclinic cadmium tungstate, *Phys. Rev. B* **95**, 165202 1-15 (2017)
- C. Briley, **A. Mock**, R. Korlacki, T. Hofmann, E. Schubert, and M. Schubert, Effects of annealing and conformal alumina passivation on anisotropy and hysteresis of magneto-optical properties of cobalt slanted columnar thin films, *Appl. Surf. Sci.* **421**, 320-324 (2017)

- A. Mock**, R. Korlacki, C. Briley, D. Sekora, T. Hofmann, P. Wilson, A. Sinitskii, E. Schubert, and M. Schubert, Anisotropy, band-to-band transitions, phonon modes, and oxidation properties of cobalt-oxide core-shell slanted columnar thin films, *Appl. Phys. Lett.* **108**, 051905 (2016)
- A. Mock**, T. Carlson, J. VanDerslice, J. Mohrmann, J. A. Woollam, E. Schubert, and M. Schubert, Multi-layered effective medium approximation approach to modeling environmental effects on alumina passivated highly porous silicon nanostructured thin films measured by in-situ Mueller matrix ellipsometry, *Appl. Surf. Sci.* **421**, 663-666 (2017)
- C. Rice, **A. Mock**, D. Sekora, D. Schmidt, T. Hofmann, E. Schubert, and M. Schubert, Control of slanting angle, porosity, and anisotropic optical constants via nucleation layer thickness in slanted columnar thin films *Appl. Surf. Sci.* **421** 766-771 (2017)
- K. B. Rodenhausen, R. S. Davis, D. Sekora, D. Liang, **A. Mock**, R. Neupane, D. Schmidt, T. Hofmann, E. Schubert, and M. Schubert, The retention of liquid by columnar nanostructured surfaces during quartz crystal microbalance measurements and the effects of adsorption thereon, *J. Colloid Interf. Sci.* **455**, 226 (2015)
- E. Wood, C. A. Nelson, and **A. Koch**, “Improved PID Control Using an Adaptive Two-Input Single-Output Coarse/Fine Approach” *ASME proc.*, Vol 6 2011, DOI: [10.1115/DETC@0011-47881](https://doi.org/10.1115/DETC@0011-47881)

Posters

- A. Mock**, S. Knight, R. Korlacki, A. Papamichael, A. Kuramata, Z. Galazka, G. Wagner, N. Blumenschein, J. Muth, V. Wheeler, M.J. Tadjer, V. Darakchieva and M. Schubert, “Properties of epitaxial β -Ga₂O₃ films determined by long-wavelength spectroscopic ellipsometry and their relation to strain, IWGO Columbus Ohio, August 2019
- H. Zhang, I. Persson **A. Mock**, P. Sukkaew, P. Persson, J.T. Chen and V. Darakchieva, “Comparative of GaN grown onto on-axis and vicinal SiC substrates by hot-wall MOCVD,” *IWN 2018 Japan*, November 2018
- G. Melendez, U. Kilic, D. Sekora, **A. Mock**, M. Hilfiker, E. Schubert, M. Schubert, “Spectroscopic Ellipsometry of Metal Oxide Ultra-Thin Films from ALD: *In-Situ* Layer-By-Layer Growth Monitoring”, *WoPhyS 2018*, October 2018 – Award Winner
- R. Korlacki, **A. Mock**, and M. Schubert, “Band-to-band transitions and hole effective mass anisotropy in β -Ga₂O₃”, 2nd International Workshop on Ga₂O₃ and Related Materials, September 2017
- U. Kilic, D. Sekora, **A. Mock**, C. Argyropoulos, N. Ianno, E. Schubert, and M. Schubert, “Atomic Layer Deposition of WO₃ Ultra Thin Films: In situ Ellipsometry Growth Monitoring and Ex situ Optical Characterization” *UNL Graduate Research Fair, Lincoln, Nebraska, U.S.A.*, (ECE Graduate Student Competition Award Winner) April 2017
- M. Ronning, Z. Madsen, D. Sekora, **A. Mock**, E. Schubert, and M. Schubert, “Three dimensional nanohybrid materials for applications in highly efficient photovoltaic devices” *UNL Summer Research Program Fair*, August 2016
- A. Mock**, D. Sekora, T. Hofmann, E. Schubert, M. Schubert, “Enhanced Temperature Stability of Slanted Columnar Thin Films by ALD Overcoating” *University of Nebraska – Lincoln Graduate Research Fair (College of Engineering Commendation Award and Department of Electrical Engineering 3rd Award Winner)*, April 2015
- A. Mock**, C. Rodriguez, T. Hofmann, E. Schubert, M. Schubert, “Improved Design for Highly Efficient Hybrid Photovoltaic Devices” *Nebraska EPSCoR RII Track 1 Grant External Review Panel Visit*, August 2014
- C. Rodriguez, **A. Mock**, T. Hofmann, E. Schubert, M. Schubert, “Low Temperature Atomic Layer Deposition and RF Magnetron Sputtering of ZnO for use as Transparent Conductive Oxides” *Nebraska EPSCoR RII Track 1 Grant External Review Panel Visit*, August 2014
- A. Mock**, D. Schmidt, D. Sekora, E. Schubert, M. Schubert, “Improved Design for Highly Efficient Hybrid Photovoltaic Devices” *University of Nebraska – Lincoln Graduate Research Fair*, April 2014

Skills: Deposition techniques – Glancing angle deposition, atomic layer deposition, magnetron sputtering, ion-beam evaporation, spin coating, REI Etching, photolithography (Heidelberg MLA150).
 Analysis and characterization techniques – Generalized ellipsometry (Thz-VUV), atomic force microscopy, scanning electron microscopy, Raman spectroscopy, X-ray diffraction, X-ray photoelectron spectroscopy, electrical characterization
 Software – WVASE32, CompleteEASE, Origin, NI Multisim, Matlab, Mathematica, Fortran, Latex

Undergraduate Student Mentoring at University of Nebraska – Lincoln

- From the Kansas State University: Mark Ronning (REU student, **presented poster**)
- From New Mexico State University: Cesar Rodriguez (**presented poster**)
- From UNL: Ryan Humphrey, Austin Koch, Tim Carlson (**co-author on a publication**), Megan Stokey (**co-author on a publication**), and Alex Fritz (**co-author on a publication**)

Graduate Student Mentoring

- From Virginia Tech, through Naval Research Laboratory: Joseph Spencer (1st year PhD student, **1 review paper upcoming, 1 book chapter upcoming**)
- From the University of Nebraska – Lincoln: Ufuk Kilic (5th year PhD student, **2 posters and 4 published papers**)
- From the University of Nebraska – Lincoln: Megan Stokey (1st year PhD student, **presented 2 posters and 3 papers published**)
- From the Linköping University: Hengfang Zhang (4th year PhD student, **presented poster**)
- From the Linköping University: Rosalia Delgado (2nd year PhD student, **1 paper published**)
- From the Linköping University: Alexis Papamichael (2nd year PhD student, **coauthored poster, 2 papers upcoming**)
- From the Linköping University: Dat Tran (2nd year PhD student, **1 published paper**)

Memberships: Pi Tau Sigma 2009-2011 Vice President (2010), Optical Society of America 2013-2015 Primary Programmer (2014-2015)