GEORGIA INSTITUTE OF TECHNOLOGY

CURRICULUM VITAE FOR WILLIAM ALAN DOOLITTLE

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CURRICULUM VITAE FOR WILLIAM ALAN DOOLITTLE

JOSEPH M. PETTIT PROFESSOR

SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING

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CURRICULUM VITAE FOR WILLIAM ALAN DOOLITTLE
JOSEPH M. PETTIT PROFESSOR
SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING

I. EARNED DEGREES

a. BEE 1989 Georgia Institute of Technology School of Electrical and Computer Engineering
b. Ph.D. 1996 Georgia Institute of Technology School of Electrical and Computer Engineering

II. EMPLOYMENT HISTORY

a. Joseph M. Pettit Professor, Georgia Institute of Technology, School of Electrical and Computer Engineering, 2019-present
b. Professor, Georgia Institute of Technology, School of Electrical and Computer Engineering, 2012-2019
c. Associate Professor, Georgia Institute of Technology, School of Electrical and Computer Engineering, 2006-2012
d. Assistant Professor, Georgia Institute of Technology, School of Electrical and Computer Engineering, 2001-2006
e. Research Engineer II, Georgia Institute of Technology, School of Electrical and Computer Engineering, 1996-2000

III. HONORS AND AWARDS

A. INTERNATIONAL OR NATIONAL AWARDS

a. National Science Foundation CAREER Award, 2004
b. MURI: Cross-disciplinary Electronic-ionic Research Enabling Biologically Realistic Autonomous Learning (CEREBRAL)
c. MURI: Epitaxial Multifunctional Materials and Applications (EMMA) - Revolutionary Epitaxial Solutions Creating a Platform for a New Generation of Military Applications, 2004
d. MURI: Laboratory Instrumentation Design Research for Scaleable Next Generation Epitaxy: Non-Equilibrium Wide Application Epitaxial Patterning by Intelligent Control – (NEW -EPIC), 2003
e. With student Michael Moseley, Won the North American Molecular Beam Epitaxy Conference Best Student Presentation Award in 2009 and again in 2010
f. With student Brendan Gunning, Won the best Contribution at the by invitation only, longest continually running compound semiconductor meeting, the Workshop on Compound Semiconductor Materials and Devices 2015

g. Best Poster Award: A. Ghosh, A. S. Weidenbach, B. Zivasatienraj, T. M. McCrone, and W. A. Doolittle, “Understanding non-volatile programming in $LiNbO_2$ memristors via Electrochemical Impedance Spectroscopy (EIS),” MRS 23rd Solid State Ionics (SSI) Conference, Poster Session, Boston, MA, USA, July 17–22, 2022.
h. Best Student Oral Prize: Z. Engel, K. Motoki, C. M. Matthews, and W. A. Doolittle, “Demonstration of Sc0.2Al0.8N HEMT Structures with a Sheet Resistance of 150 Ω/□ and a Sheet Charge of 5.9x1013 cm-2 with Phase Pure, Metal Rich Growth,” The International Conference on Molecular Beam Epitaxy (ICMBE) 2022, Oral session, Sheffield, UK, Sep. 4–9th, 2022.
i. Best Student Poster Award: K. Motoki, Z. Engel, C. M. Matthews, and W. A. Doolittle, “Observation of compositional modulation variation and reduction in rapidly grown AlGaN self-assembled superlattices by transmission electron microscopy,” International Workshop on Nitride Semiconductors (IWN) 2022, Poster session, Berlin, Germany, Oct. 9–14, 2022.
j. Best Student Oral Presentation Award: Z. Engel, K. Motoki, C. M. Matthews, and W. A. Doolittle, “Demonstration of Sc0.2Al0.8N HEMT Structures with a Sheet Resistance of 150 Ω/□ and a Sheet Charge of 5.9x1013 cm-2 with Phase Pure, Metal Rich Growth,” International Workshop on Nitride Semiconductors (IWN) 2022, Oral session, Berlin, Germany, Oct. 9–14, 2022.

B. Institute or School Awards

a. Awarded the 2002-2003 Student Government Faculty of the Year Award
b. Awarded the Richard M. Bass, Eta Kappa Nu Outstanding Teacher Award by ECE senior class, 2003
c. Awarded the 2005 ECE Outstanding Junior Faculty Member Award
d. Awarded the Lockheed Martin Aeronautics Company’s Dean’s Award for Teaching Excellence, March 2005
e. Awarded the 2006 Georgia Institute of Technology Class of 1940 Teaching Award
f. 2008 Georgia Institute of Technology Outstanding Achievement in Research Program Development Award
g. Awarded the Richard M. Bass, Eta Kappa Nu Outstanding Teacher Award by ECE senior class, 2011
h. Undergraduate student advisement of Hitesh Upadhyay resulted in a President's Undergraduate Research Award (PURA) for the topic “Implementation of a variable magnetic field hall measurement system using Labview”, Fall 2002 / Spring 2003
i. Undergraduate student advisement of Andrew Hellrigel resulted in him winning the Outstanding Undergraduate Researcher Award, Spring 2021

IV. RESEARCH, SCHOLARSHIP, AND CREATIVE ACTIVITIES

An asterisk marks those that resulted from work done at Georgia Tech and put the names of advisees (i.e., post-docs, graduate or undergraduate students) in boldface.

A. Published Books, Book Chapters, and Edited Volumes

A1. Books

Molecular Beam Epitaxy of III-Nitrides (In process).

A2. Refereed Book Chapters

1. D. H. Olson, A. Giri, J. A. Tomko, J. T. Gaskins, H. Ahmad, W. Alan Doolittle, and P. E. Hopkins, “Upper limits to thermal conductance across gallium nitride interfaces predictions and measurements,” Book chapter ready for submission.

A3. Edited Volumes

No Data

B. Refereed Publications and Submitted Articles

B1. Published and Accepted Journal Articles

B1a. Invited Journal Publications (Refereed)

1) * **Invited:** W. Alan Doolittle, **A. G. Carver, and W. Henderson**, “MBE of Complex Metal-oxides: Where have we come, where are we going and how are we going to get there?”, **J. of Vac. Sci. and Tech. B**, Vol. 23, No. 3, May/Jun (2005).
2) * **Invited: A. G. Carver**, W. Alan Doolittle, **W. Henderson, W. L. Calley**, “Molecular Beam Epitaxy of Lithium Niobate Multifunctional Materials Using a Chloride Refractory Metal Chemistry”, ECS Transactions, 2 (5) 103-114 (2006)
3) * **Invited: J. D. Greenlee, W. L. Calley, W. Henderson**, and W. Alan Doolittle, "Halide based MBE of Crystalline Metals and Oxides," Phys. Status Solidi C, vol. 9, no. 2, pp. 155-160, (2011).
4) * **Invited: Bill Zivasatienraj, M. Brooks Tellekamp**, W. Alan Doolittle, “Epitaxy of $LiNbO_3$: Historical Challenges and Recent Success”, Crystals, vol 11, no. 4,ISSN 2073-4352, https://doi.org/10.3390/cryst11040397.
5) * **Invited: W. Alan Doolittle**, Christopher M. Matthews, Habib Ahmad, Keisuke Motoki, Sangho Lee, Aheli Ghosh, Emily N. Marshall, Amanda L. Tang, Pratyush Manocha, P. Douglas Yoder, “Prospectives for AlN Electronics and Optoelectronics and the Important Role of Alternative Synthesis”, APL Perspectives, Appl. Phys. Lett. 123, 070501 (2023)

B1b. Journal Publications (Refereed)

1) * W. Alan Doolittle and A. Rohatgi, "A novel computer based pseudo-logarithmic capacitance/conductance DLTS system specifically designed for transient analysis," **Rev. Sci. Instrum.**, Vol. 63, No. 12, pp. 5733-5741, (1992).
2) * Z. Chen, K. Yastuke, W. Alan Doolittle, and A. Rohatgi, "Record low SiO_2 / Si interface state density for low temperature oxides prepared by direct plasma-enhanced chemical vapor deposition," **Appl. Phys. Lett.**, Vol. 63, No. 15, pp. 2117-2119, 11 Oct. (1993).
3) * W. Alan Doolittle, and A. Rohatgi, "A new figure of merit and methodology for quantitatively determining defect resolution capabilities in deep level transient spectroscopy analysis," **J. Appl. Phys**., Vol. 75, No. 9, pp. 4570-4575, 1 May (1994).
4) * W. Alan Doolittle and A. Rohatgi, "Comparison of Covariance Linear Predictive Modeling to the Modulation Function Method for Use in Deep Level Transient Spectroscopy," **J. Appl. Phys**., Vol. 75, No. 9, pp. 4560-4569, 1 May (1994).
5) * F. Fournier, R. A. Metzger, W. Alan Doolittle, A. Brown, C. Carter-Coman, N. M. Jokerst, and R. Bicknell-Tassius, "Growth Dynamics of InGaAs/GaAs by MBE," **J. Cryst. Growth**, Vol. 175-176, pt. 1, p. 203, May (1997).
6) * T. J. Kropewnicki, W. Alan Doolittle, C. Carter-Coman, S. Kang, P. A. Kohl, N. M. Jokerst, and A. S. Brown, "Selective Wet Etching of Lithium Gallate," **J. Electrochem. Soc. Lett**., Vol. 145, No. 5, L88-L90, May (1998).
7) * W. Alan Doolittle, T. Kropenwicki, C. Carter-Coman, S. Stock, P. Kohl, N. M. Jokerst, R. A. Metzger, S. Kang, K. Lee, G. May, and A. S. Brown, "Growth of GaN on Lithium Gallate Substrates for Development of a GaN Thin Compliant Substrate," **J. Vac. Sci. & Tech. B**, Vol. 16, No. 3, pp. 1300-1304, May/June, (1998).
8) * W. Alan Doolittle, S. Kang, T. J. Kropewnicki, S. Stock, P. A. Kohl, and A. S. Brown, "MBE Growth of High Quality GaN on $LiGaO_2$," **J. Electron. Mat**., Vol. 27, pp. L58-L60, No. 8, (1998).
9) * R. J. Matyi, W. Alan Doolittle, and A. S. Brown, "High resolution X-ray diffraction analysis of GaN/$LiGaO_2$," **J. Phys. D: Appl. Phys.**, Vol. 32, No. 10A, pp. A61-A64, (1999).
10) * S. Kang, W. Alan Doolittle, A. S. Brown, and S. R. Stock, "Electrical and structural characterization of $Al_xGa_{1-x}N$/GaN heterostructures grown on $LiGaO_2$ substrates," **Appl. Phys. Lett.**, Vol. 74, No. 22, pp. 3380-3382, 31 May (1999).
11) * W. Alan Doolittle, S. Kang, and A. S. Brown, "MBE growth of high quality GaN on $LiGaO_2$ for high frequency, high power electronic applications," **Solid St. Electronics**, Vol. 44, No. #2, pp. 229-238, Feb. (2000).
12) * K. Lee, W. Alan Doolittle, T. Kim, A. S. Brown, G. S. May, and S. Stock, "Using statistical experimental design to investigate the role of the initial growth conditions on GaN epitaxial films grown by molecular beam epitaxy," **J. Vac. Sci. & Tech. B**, 18(3), pp. 1448-1452, May/June (2000).
13) * A. S. Brown, W. Alan Doolittle, S. Kang, J.J. Shen, Z. L. Wang, and Z. Dai, "The growth of GaN on lithium gallate ($LiGaO_2$) substrates," **J. Elect. Mat**., Vol. 29, No. 7, pp. 894-896, July (2000).
14) * A. S. Brown and W. Alan Doolittle, "The Status and Promise of Compliant Substrate Technology," **Appl. Surface Science**, Vol. 166, pp. 392-398, 9 Oct. (2000).

15) * **G. Namkoong**, W. Alan Doolittle, S. R. Stock, and A. S. Brown, "Incorporation of Mg in GaN grown by plasma-assisted molecular beam epitaxy," **Appl. Phys. Lett.**, Vol. 77, No. 26, pp. 4386-4388, 25 Dec. (2000).
16) * **G. Namkoong**, W. Alan Doolittle, S. Huang, S. R. Stock, and A. S. Brown, "Low Temperature Nitridation Combined With High Temperature Buffer Annealing for High Quality GaN Grown by Plasma-Assisted MBE," **Materials Research Society Internet J. of Nitride Semiconductor Research,** Vol. 5, Art. # 10, (2000).
17) * K. Lee, W. Alan Doolittle, A. S. Brown, G. S. May, and S. Stock, "A comparative study on surface reconstruction of wurzite GaN on (0001) sapphire by RF plasma-assisted molecular beam epitaxy," **J. of Cryst. Growth**, Vol. 231, No. 1-2, pp. 8-16, (2001).
18) * S. Kang, W. Alan Doolittle, S. R. Stock, A. S. Brown, Z. R. Dai, and Z. L. Wang, "Characterization of AlGaN/GaN Heterojunctions Grown by Radio Frequency-plasma Assisted Molecular Beam Epitaxy," **J. Electron. Materials**, Vol. 30, No. 3, pp. 156-161, (2001).
19) * S.W. Seo, K.K. Lee, S. Kang, S. Huang, W. Alan Doolittle, N. M. Jokerst, and A. S. Brown, "GaN metal-semiconductor-metal photodetectors grown on lithium gallate substrates by molecular-beam epitaxy," **Appl. Phys. Lett.**, Vol. 79, No. 9, pp.1372-1374, 27 Aug. (2001).
20) * W. Alan Doolittle, A. S. Brown, S. Kang, S. W. Seo, S. Huang, and N. M. Jokerst, "Recent advances in III-nitride devices grown on lithium gallate," **Phys. Stat. Sol. A**, Vol. 188, No. 2, pp. 491-495, 23 Nov. (2001).
21) * M. Losurdo, P. Capezzuto, G. Bruno, **G. Namkoong**, W. Alan Doolittle, and A. S. Brown, "The Chemistry of Sapphire Nitridation in Relation to the GaN Structural Quality: Why Low Temperature 200 °C Nitridation?", **Phys. Stat. Sol. A**, Vol. 188, No. 2, pp. 561-565, Nov. (2001).
22) * S. Seo, K.K. Lee, S. Kang, S. Huang, W. Alan Doolittle, N. M. Jokerst, A. S. Brown, and M. A. Brooke, "The Heterogenous Integration of GaN Thin Film Metal-Semiconductor-Metal Photodetectors onto Silicon," **Photon. Technol. Lett.**, Vol. 14, No. 2, pp. 185-187, Feb. (2002).
23) * **G. Namkoong**, W. Alan Doolittle, A. S. Brown, M. Losurdo, P. Capezzuto, and G. Bruno, "Role of sapphire nitridation temperature on GaN growth by plasma assisted molecular beam epitaxy: Part I. Impact of the nitridation chemistry on material characteristics," **J. Appl. Phys.,** Vol. 91, No. 4, pp. 2499-2507, 15 Feb. (2002).
24) * M. Losurdo, P. Capezzuto, G. Bruno, **G. Namkoong**, W. Alan Doolittle, and A. S. Brown, "Role of sapphire nitridation temperature on GaN growth by plasma assisted molecular beam epitaxy: Part II. Interplay between chemistry and structure of layers," **J. Appl. Phys.**, Vol. 91, No. 4, pp. 2508-2518, 15 Feb. (2002).
25) * M. Losurdo, P. Capezzuto, G. Bruno, **G. Namkoong**, W. Alan Doolittle, and A. S. Brown, "Plasmas for The Low-Temperature Growth Of High-Quality GaN Films By Molecular Beam Epitaxy and Remote Plasma MOCVD," **Phys. Stat. Sol. A**, Vol. 190, No. 1, pp. 43-51, 15 Feb. (2002).
26) * **G. Namkoong**, W. Alan Doolittle, A. S. Brown, M. Losurdo, P. Capezzuto, and G. Bruno, "The Role of Low Temperature (200 °C) Nitridation in the Growth of GaN by Plasma-Assisted Molecular Beam Epitaxy," **J. Vac. Sci. Technol. B**, Vol. 20, No. 3, pp. 1221-1228, May/June (2002).

27) * W. Alan Doolittle, **A. Carver, G. Namkoong**, and A. S. Brown, “Challenges and Potential Payoff for Crystalline Oxides in Wide Bandgap Semiconductor Technology,” **Solid-State Electronics,** Vol. 47, No. 12, pp. 2143-2147, Dec. (2003).
28) ***** **G. Namkoong**, W. Alan Doolittle, A. S. Brown, M. Losurdo, M. M. Giangregorio, and G. Bruno, “The impact of substrate nitridation temperature and buffer design and synthesis on the polarity of GaN epitaxial films,” **J. of Cryst. Growth**, Vol. 252, No. 1-3, p. 159, May (2003).
29) * M. Losurdo, M. M. Giangregorio, P. Capezzuto, G. Bruno, **G. Namkoong**, W. Alan Doolittle, and A. S. Brown, “Interplay Between GaN Polarity and Surface Reactivity Towards Atomic Hydrogen,” **J. Appl. Phys.**, Vol. 95, No. 12, pp. 8408-8418, 15 June (2004).
30) * M. Losurdo, M. M. Giangregorio, P. Capezzuto, G. Bruno, **G. Namkoong**, W. Alan Doolittle, and A. S. Brown, “Interaction of GaN epitaxial layers with atomic hydrogen,” **Appl. Surf. Sci.**, Vol. 235, No. 3, pp. 267–273 (2004).
31) * S. E. Ralph and W. Alan Doolittle, “Epitaxial integration of III-Nitride devices with Lithium Niobate Optical Waveguides,” **IEEE LEOS Hot Topics**, Vol. 18, No. 3, pp. 1, June 2004.
32) * G. Bu, D. Ciplys, M. S. Shur, **G. Namkoong**, W. Alan Doolittle, and W. D. Hunt, “Leaky surface acoustic waves in Z-$LiNbO_3$ substrates with epitaxial AIN overlays,” **Appl. Phys. Lett.**, Vol. 85, No. 15, pp. 3313-3315, 11 Oct. (2004).
33) ***** **E. Trybus, G. Namkoong**, W. Henderson, W. Alan Doolittle, R. Liu, J. Mei, F. Ponce, M. Cheung, F. Chen, M. Furis, and A. Cartwright, “Growth of InN on Germanium by Molecular Beam Epitaxy,” **J. of Cryst. Growth**, Vol. 279, No. 3/4, pp. 311–315, 2005.
34) ***** **S. D. Burnham**, W. Alan Doolittle, **G. Namkoong**, and W. Henderson, “Mg Doped GaN Using a Valved, Thermally Energetic Source: Enhanced Incorporation, and Control,” **J. of Cryst. Growth**, Vol. 279, No. 1/2, pp. 26–30, 2005.
35) * M.C. Cheung, **G. Namkoong**, F. Chen, M. Furis, H. E. Pudavar, A. N. Cartwright, and W. Alan Doolittle, "Photoluminescence Study of MBE Grown InGaN with Intentional Indium Segregation," **Phys. Stat. Sol. (c)** Vol. 2, No. 7 , pp. 2779-2782, 2005.
36) ***** **G. Namkoong**, W. Alan Doolittle, M. Losurdo, P. Capezzuto, G. Bruno, B. Nemeth and J. Nause, “III-nitrides on O and Zn face ZnO substrates,” **Appl. Phys. Lett**., Vol. 87, 184104, 2005.
37) ***** **G. Namkoong, K. K. Lee, S. M. Madison**, W. Henderson, W. Alan Doolittle, and S. E. Ralph, “III-Nitride Integration on Ferroelectric Materials of Lithium Niobate by Molecular Beam Epitaxy,” **Appl. Phys. Lett.,** Vol. 87, 171107, Oct. 2005
38) * E. Trybus, G. Namkoong, W. Henderson, S. Burnham, W. Alan Doolittle, M. Cheung and A. Cartwright “InN: A material with Photovoltaic Promise and Challenges,” **J. of Cryst. Growth**, Vol 288, pp. 218, 2005.
39) * N. Takeuchi, A. Selloni, T. H. Myers, and W. Alan Doolittle, “Adsorption and diffusion of Ga and N adatoms on GaN surfaces: comparing the effects of Ga-coverage and electronic excitation”, **Phys. Rev. B**, Vol. 72, 115307, 2005.
40) ***** **G. Namkoong**, **S. D. Burnham, K.-K. Lee, E. Trybus**, W. Alan Doolittle, M. Losurdo, P. Capezzuto, G. Bruno, B. Nemeth, and J. Nause, "III-nitrides on oxygen- and zinc-face ZnO substrates," **Appl. Phys. Lett.**, Vol. 87, pp. 184104-3, 2005.

41) * **E. Trybus, G. Namkoong**, W. Henderson, **S. Burnham**, W. Alan Doolittle, M. Cheung, and A. Cartwright, "InN: A material with Photovoltaic Promise and Challenges", **Journal of Crystal Growth, V**ol. 288, pp 218, (2006).
42) * **D. Pritchett**, W. Henderson, **S. D. Burnham**, W. Alan Doolittle, "Influence of growth conditions and surface reaction byproducts on GaN grown via metal organic molecular beam epitaxy: toward an understanding of surface reaction chemistry", **Journal of Electronic Materials**, Vol. 35, No. 4, p 562-7, April 2006
43) * Q. Sun, A. Selloni, T. H. Myers, W. Alan Doolittle, "Energetics of Mg incorporation at GaN(0001) and GaN(000$\bar{1}$) surfaces", **Physical Review B** (Condensed Matter and Materials Physics), Vol. 73, No. 15, p 155337-1-9, 15 April 2006
44) Q. Sun, A. Selloni, T.H. Myers, W. Alan Doolittle, "Oxygen adsorption and incorporation at irradiated GaN (0001) and GaN (000-1) surfaces: First-principles density-functional calculations", J. Phys. Rev. B, V 74, No. 19, pp. 195317, (2006)
45) * **K.-K. Lee, G. Namkoong**, W. Alan Doolittle, M. Losurdo, G. Bruno, and D. Jundit, "III-nitride growth and characteristics on ferroelectric materials using plasma-assisted MBE," **Journal of Vacuum Science Technology B**, Vol. 24, no. 4, pp. 2093-9, July 2006.
46) * T. Chen, A. K. Sutton, B. M. Haugerud, **W. Henderson**, A.P.G. Prakash, J. D. Cressler, W. Alan Doolittle, X.Liu; A. Joseph, P. W. Marshall "An investigation of the effects of radiation exposure on stability constraints in epitaxial SiGe strained layers", **Solid-State Electronics**, Vol. 50, No. 7-8, p 1194-200, July-Aug. 2006
47) * **S. D. Burnham**, E. W. Thomas, W. Alan Doolittle, "Resistivity analysis of epitaxially grown, doped semiconductors using energy dependent secondary ion mass spectroscopy", **Journal of Applied Physics**, Vol. 100, No. 11, p 113719-1-6 , 1 Dec. 2006
48) * **S. D. Burnham** and W. Alan Doolittle, " In situ growth regime characterization of AlN using reflection high energy electron diffraction", **Journal of Vacuum Science & Technology B**, Vol 24, pp 2100-2104, 2006.
49) * **S. D. Burnham, G. Namkoong, K.-K. Lee**, and W. Alan Doolittle, "Reproducible RHEED signatures for improvement of AlN using *in situ* growth regime characterization," **Journal of Vacuum Science and Technology B**, Vol. 25, no. 3, pp. 1009-13, May/June 2007.
50) * **K.-K. Lee, G. Namkoong, S. M. Madison**, S. E. Ralph, W. Alan Doolittle, M. Losurdo, G. Bruno, and H. K. Choi, "III-nitride growth and AlGaN/GaN heterostructures on ferroelectric materials," **Material Science Engineering B**, Vol. 140, pp.203, June 2007.
51) * **G. Namkoong, E. Trybus, K. K. Lee, M. Moseley**, W. Alan Doolittle, D. C. Look, "Metal modulation epitaxy growth for extremely high hole concentrations above 10^{19} cm^{-3}in GaN", **Appl. Phys. Lett.**, Vol. 93, No. 17, p 172112 (3 pp.), 27 Oct. 2008
52) * **D. Pritchett**, W. Henderson, **D. Billingsley**, W. Alan Doolittle, "Mixed alkyl exchange and exploitable surface interactions in InGaN by NH_3-based metal organic molecular beam epitaxy", **J. Crys. Growth**, Vol. 310, No. 24, p 5297-5302, 1 Dec. 2008
53) * **A. G. Carver**, W. Henderson, W. Alan Doolittle, "Reclamation of a molecular beam epitaxy system and conversion for oxide epitaxy", **J. Vac. Sci. & Tech. A**, Vol. 26, No. 6, pp. 1501-6, Nov.-Dec. 2008

54) * **S. D. Burnham, G. Namkoong**, D. C. Look, B. Clafin, W. Alan Doolittle,, “Reproducible increased Mg incorporation and large hole concentration in GaN using metal modulated epitaxy”, **J. Appl. Phys.**, Vol. 104, No. 2, pp. 024902-7, 15 July 2008
55) * **E. Trybus**, O. Jani, **S. D. Burnham**, I. Ferguson, C. Honsberg, M. Steiner, and W. Alan Doolittle, “Characteristics of InGaN Designed for Photovoltaic Applications”, **Phys. Stat. Sol. C**, Vol. 5, No. 6, p 1843-5, May 2008.
56) * **S. D. Burnham**, **W. Henderson**, W. Alan Doolittle, "Closed-loop MBE growth of droplet-free GaN with very metal rich conditions using metal modulated epitaxy with Mg and In", **Phys. Stat. Sol. C**, Vol. 5, No. 6, pp. 1855-8, May 2008
57) * **D. Pritchett**, **W. Henderson**, **D. Billingsley**, W.A. Doolittle, “InGaN compositional patterning by ultraviolet photoexcitation during NH_3-based MOMBE: a pathway to 3D epitaxy”, **Phys. Stat. Sol. C**, Vol. 5, No. 6, pp. 1726-9, May 2008
58) * **D. Billingsley**, **D. Pritchett**, **W. Henderson**, **A. G. Carver, S. D. Burnham**, W. Alan Doolittle, “Investigation into the use of molecular hydrogen on the growth of gallium nitride via metal-organic molecular beam epitaxy”, **Phys. Stat. Sol. C**, Vol. 5, No. 6, pp. 1723-5, May 2008
59) * A. Barnett, A. D. Kirkpatrick, C. Honsberg, D. Moore, M. Wanlass, K. Emery, R. Schwartz, D. Carlson, S. Bowden, D. Aiken, A. Gray, S. Kurtz, L. Kazmerski, M. Steiner, J. Gray, T. Davenport, R. Buelow, L. Takacs, N. Shatz, J. Bortz, O. Jani, K. Goossen, F. Kiamilev, A. Doolittle, I. Ferguson, B. Unger, G. Schmidt, E. Christensen, D. Salzman, "Very high efficiency solar cell modules", **Progress in Photovoltaics: Research and Applications**, Vol. 17, No. 1, p 75-83, Jan. 2009.
60) * **D. Billingsley**, **W. Henderson**, **D. Pritchett**,W. Alan Doolittle, “Growth and characterization of $Al_xGa_{1-x}N$ via NH_3-based metal-organic molecular beam epitaxy”, **J. Cryst. Growth**, Vol. 311, No. 5, pp. 1328-32, 15 Feb. 2009
61) * **M. Moseley, D. Billingsley**, **W. Henderson**, **E. Trybus**, W. Alan Doolittle, “Transient atomic behavior and surface kinetics of GaN”, **J. Appl. Phys.**, Vol. 106, No. 1, pp. 014905-12, 1 July 2009
62) * **G. Namkoong, S. Huang, M. Moseley**, and W. Alan Doolittle, “In-plane anisotropic strain of elastically and plastically deformed III-nitrides on lithium gallate”, **Thin Solid Films**, Vol. 517, p. 6508 (2009).
63) * J. F. Ihlefeld, T. Wei; L. Z.-Kui; W. Alan Doolittle, M. Bernhagen, P. Reiche, R. Uecker, R. Ramesh, D. G. Schlom, “Adsorption-controlled growth of $BiFeO_3$ by MBE and integration with wide band gap semiconductors”, **IEEE Trans. Ultrasonics, Ferroelectrics and Frequency Control**, Vol. 56, No. 8, p 1528-33, Aug. 2009
64) * **K. K. Lee**, Z. Cai, K. Ziemer, W. Alan Doolittle, “The origin of the residual conductivity of GaN films on ferroelectric materials”, **J. Cryst. Growth**, Vol. 311, No. 16, p. 4001-6, 1 Aug. 2009
65) * **E. Trybus**, W. Alan Doolittle, **M. Moseley**, W. Henderson, **D. Billingsley, G. Namkoong**, and D. C. Look, “Extremely High Hole Concentrations in c-Plane GaN”, **Phys. Stat. Sol. C**, Vol. 6, p. S788, (2009).
66) * **M. Moseley, D. Billingsley**, W. Henderson, **E. Trybus**, and W. Alan Doolittle, “Transient Atomic Behavior and Surface Kinetics of GaN,” J. Appl. Phys. 106, 014905 (2009).
67) * **G. Namkoong**, S. Huang, **M. Moseley**, and W. Alan Doolittle, “In-plane anisotropic strain of elastically and plastically deformed III-nitrides on lithium gallate,” Thin Solid Films, 517, 6508 (2009).

68) * **E. Trybus**, W. Alan Doolittle, **M. Moseley**, **W. Henderson**, **D. Billingsley**, G. Namkoong, and D. C. Look, “Extremely High Hole Concentrations in c-Plane GaN,” Phys. Status Solidi C, 6, S788 (2009).
69) * **D. Billingsley**, **W. Henderson**, **D. Pritchett**, and W. Alan Doolittle, “Growth Kinetics of $Al_xGa_{1-x}N$ Grown via Ammonia-Based Metal-Organic Molecular Beam Epitaxy,” **J. Cryst. Growth,** Vol. 312, p. 209, (2010).
70) * **D. Billingsley**, **W. Henderson**, and W. Alan Doolittle, “High-temperature Growth of GaN and $Al_xGa_{1-x}N$ via Ammonia-Based Metal-Organic Molecular Beam Epitaxy,” **J. Electron. Mater**., V. 39, No 5, pp. 473-7, 2010
71) * **G. Namkoong, E. Trybus**.; M.C. Cheung, W. A. Doolittle, A. N. Cartwright, I. Ferguson, T. Y. Seong, J. Nause, “Dual-Color Emission in Hybrid III-Nitride/ZnO Light Emitting Diodes”, **Appl. Phys. Express**, V. 3, No 2, p 022101-4, Feb. 2010
72) * **M. Moseley, J. Lowder, D. Billingsley**, W. Alan Doolittle, “Control of surface adatom kinetics for the growth of high-indium content InGaN throughout the miscibility gap”, **Appl. Phys. Lett.**, Vol. 97, No 19, p 191902-5, 8 Nov. 2010
73) * **W. E. Henderson**, **W. L. Calley**, **A. G. Carver**, **H. Chen**, and W. Alan Doolittle, “A versatile metal-halide vapor chemistry for the epitaxial growth of metallic, insulating and semiconducting films”, **J. Cryst. Growth**, Vol. 324, Issue 1, pp134-141, 1 June, (2011)
74) * M. E. Zvanut, Y. Uprety, J. Dashdorj, **M. Moseley**, and W. Alan Doolittle, “Passivation and Activation of Mg acceptors in heavily doped GaN,” **J. Appl. Phys.**, 110, 044508 (2011).
75) * **G. Namkoong**, P. Boland, Si-Young Bae, Jae-Phil Shim, Dong-Seon Lee, Seong-Ran Jeon, K. Foe, K. Latimer, W. Alan Doolittle, “Effect of III-nitride polarization on VOC in p-i-n and MQW solar cells”, **Physica Status Solidi (RRL) - Rapid Research Letters**, V5, n 2, p 86-8, Feb. 2011
76) * **J. D. Greenlee**, **W. L. Calley, W. Henderson**, and W. Alan Doolittle, "Halide based MBE of Crystalline Metals and Oxides," **Phys. Status Solidi C**, vol. 9, no. 2, pp. 155-160, 2011.
77) * **J. Greenlee**, **W. Calley**, **M. Moseley**, W. Alan Doolittle, "Comparison of Interfacial and Bulk Ionic Motion in Analog Memristors," **IEEE Trans. Electron Dev.**, 60, 427 (2012).
78) * **B. Gunning**, **J. Lowder**, **M. Moseley**, W. Alan Doolittle, “Negligible carrier freeze-out facilitated by impurity band conduction in highly p-type GaN,” **Appl. Phys. Lett.**, 101, 082106 (2012).
79) * **J. D. Greenlee**, C. F. Petersburg, **W. L. Calley**, C. Jaye, D. A. Fischer, F. M. Alamgir, and W. Alan Doolittle, "In-situ oxygen x-ray absorption spectroscopy investigation of the resistance modulation mechanism in $LiNbO_2$ memristors," **Appl. Phys. Lett.**, vol. 100, no. 18, pp. 182106 - 182106-4, (2012).
80) * **M. Moseley, B. Gunning, J. Greenlee, J. Lowder**, **G. Namkoong**, W. Alan Doolittle, “Observation and Control of the Surface Kinetics of InGaN for the Elimination of Phase Separation,” **J. Appl. Phys.**, V112, 014909 (2012).
81) * **M. Moseley, B. Gunning, J. Lowder**, W. Alan Doolittle, **G. Namkoong** “Structural and electrical characterization of InN, InGaN, and p-InGaN grown by metal-modulated epitaxy**”, J. Vac. Sci. & Tech. B**, V31, no 3, p 03C104 (6 pp.), May 2013
82) * **W. Laws Calley, J. D. Greenlee, W. E. Henderson**, **J. Lowder, M. W. Moseley**, W. Alan Doolittle, P. G. Staib, “In situ Auger probe enabling epitaxy composition

control of alloys by elemental surface analysis", **J. Vac. Sci. & Tech. B**, V31, n 3, p 03C126 (5 pp.), May 2013

83) * **J. D. Greenlee** , C. F. Petersburg , **W. G. Daly** , F. M. Alamgir, W. Alan Doolittle, " In-situ investigation of the channel conductance of a $Li_{1-x}CoO_2$ (0 < x < 0.5) ionic-electronic transistor," **Appl. Phys. Lett.**, V102, No 21, p 213502 (4 pp.), 27 May (2013)

84) * A. M. Fischer, Y. O. Wei, F. A. Ponce, **M. Moseley, B. Gunning** and W. Alan Doolittle, "Highly luminescent, high-indium-content InGaN film with uniform composition and full misfit-strain relaxation", **Appl. Phys. Lett.**, 103, 131101 (2013).

85) * **M. Moseley, B. Gunning, J. Lowder**, W. Alan Doolittle and **G. Namkoong**, "Structural and electrical characterization of InN, InGaN, and p-InGaN grown by metal-modulated epitaxy**", J. Vac. Sci. Technol. B**, 31, 01C104-1 (2013).

86) * **C. A. M. Fabien**, **M. Moseley, B. Gunning**, W. Alan Doolittle, "Simulations, Practical Limitations, and Novel Growth Technologies for InGaN-based Solar Cells," ***IEEE J. Photovoltaics***, vol. PP, no. 99, pp.1-6, 2013.

87) * **J. D. Greenlee, J. C. Shank, M. B. Tellekamp**, and W. Alan Doolittle, "Spatiotemporal drift-diffusion simulations of analog ionic memristors," **J. Appl. Phys.**, vol. 114, p. 034504, 2013.

88) * **Jordan D. Greenlee, Joshua C. Shank, M. Brooks Tellekamp**, Enxia Zhang, Jinshun Bi, Daniel M. Fleetwood, Michael L. Alles, Ronald D. Schrimpf, and W. Alan Doolittle, "Radiation Effects on $LiNbO_2$ Memristors for Neuromorphic Computing Applications", **IEEE Transactions on Nuclear Science**, v 60, n 6, pt.1, p 4555-62, Dec. 2013

89) * **C. A. M. Fabien**, W. Alan Doolittle, "Guidelines and limitations for the design of high-efficiency InGaN single-junction solar cells", **Solar Energy Materials and Solar Cells**, v 130, p 354-63, Nov. 2014

90) * **C.A.M. Fabien, M. Moseley, B. Gunning**, W. Alan Doolittle, A. M. Fischer, Y. O. Wei, F. A. Ponce, "Simulations, Practical Limitations, and Novel Growth Technology for InGaN-Based Solar Cells", **IEEE J. of Photovoltaics**, v 4, n 2, p 601-6, March 2014

91) * **J. D. Greenlee, J. C. Shank, M. B. Tellekamp, B. Gunning, C. A. Fabien**, and W. Alan Doolittle, "Liquid Phase Electro-Epitaxy of Memristive $LiNbO_2$ Crystals," **Crystal Growth & Design**, vol. 14, pp. 2218-2222, 2014.

92) * **B. P. Gunning, C.A.M. Fabien, J. J. Merola, E. A. Clinton**, W. Alan Doolittle, S. Wang; A. M. Fischer, and F. A. Ponce, "Comprehensive study of the electronic and optical behavior of highly degenerate p-type Mg-doped GaN and AlGaN", **J. Appl. Phys.**, v 117, n 4, p 045710 (11 pp.), 28 Jan. 2015

93) * **J. C. Shank, M. B. Tellekamp**, and W. Alan Doolittle, "Evidence of ion intercalation mediated band structure modification and opto-ionic coupling in lithium niobite", **J. Appl. Phys.**, v 117, n 3, p 035704 (6 pp.), 21 Jan. 2015

94) * **J. C. Shank, M. B. Tellekamp**, E. X. Zhang, W. G. Bennett, M. W. McCurdy, D. M. Fleetwood, M. L. Alles, R. D. Schrimpf, and W. Alan Doolittle, "Self-Healing of Proton Damage in Lithium Niobite ($LiNbO_2$)," ***IEEE Trans. Nucl. Sci.,*** 2015.

95) * **M.B. Tellekamp, J.D. Greenlee, J.C. Shank**, W.A. Doolittle, "Molecular beam epitaxy growth of niobium oxides by solid/liquid state oxygen source and lithium assisted metal-halide chemistry", **Journal of Crystal Growth**, v 425, p 225-9, 1 Sept. 2015

96) * **C.A.M. Fabien, B. P. Gunning**, W. Alan Doolittle, A. M. Fischer, Y.O. Wei, X. Hongen, F. A. Ponce, “Low-temperature growth of InGaN films over the entire composition range by MBE”, **Journal of Crystal Growth**, v 425, p 115-18, 1 Sept. 2015
97) * **B. P. Gunning, E. A. Clinton, J. J. Merola**, W. Alan Doolittle, R. C. Bresnahan, “Control of ion content and nitrogen species using a mixed chemistry plasma for GaN grown at extremely high growth rates >9 µm/h by plasma-assisted molecular beam epitaxy”, **J. Appl. Phys.**, v 118, n 15, p 155302 (8 pp.), 21 Oct. 2015
98) * **Jordan D. Greenlee, Brendan Gunning**, Boris N. Feigelson, Travis J. Anderson, Andrew D. Koehler, Karl D. Hobart, Francis J. Kub, and W. Alan Doolittle, “Defect Reduction in MBE-Grown AlN by Multicycle Rapid Thermal Annealing”, **Electronic Materials Letters**, V12, Issue 1, pp133-138, Jan 2016
99) * **C.A.M. Fabien**, A. Maros, C. B. Honsberg, W. Alan Doolittle, “III-Nitride Double-Heterojunction Solar Cells With High In-Content InGaN Absorbing Layers: Comparison of Large-Area and Small-Area Devices”, **IEEE Journal of Photovoltaics**, v 6, n 2, p 460-4, March 2016
100) * **J. C. Shank, M. B. Tellekamp**, and W. Alan Doolittle, ”The Crystallization and Properties of Sputter Deposited Lithium Niobite”, Thin Solid Films, Volume 609, 30 June 2016, Pages 6-11
101) J. D. Greenlee, **B. P. Gunning**, B. N. Feigelson, T. J. Anderson, A. D. Koehler, K. D. Hobart, F. J. Kub, W. Alan Doolittle, “Defect reduction in MBE-grown AlN by multicycle rapid thermal annealing”, Source: Electronic Materials Letters, v 12, n 1, p 133-8, Jan. 2016
102) ***M. B. Tellekamp**, **J. C. Shank**, M. S. Goorsky, W. Alan Doolittle, “Molecular Beam Epitaxy Growth of High Crystalline Quality $LiNbO_3$”, Journal of Electronic Materials, v 45, n 12, p 6292-9, Dec. 2016
103) ***M. B. Tellekamp**, **J. C. Shank**, W. Alan Doolittle, “Molecular beam epitaxy of lithium niobium oxide multifunctional materials”, Journal of Crystal Growth, v 463, p 156-61, 1 April 2017
104) * A.M.Fischer, S. Wang, F. A. Ponce, **B. P. Gunning**, **C. A. M. Fabien**, W. Alan Doolittle,” Origin of high hole concentrations in Mg-doped GaN films”, Physica Status Solidi B - Basic Solid State Physics, v 254, n 8, p 1600668 (6 pp.), Aug. 2017
105) ***E. A. Clinton**, **E. Vadiee**, **C. A. M. Fabien**, **M. W. Moseley**, **B. P. Gunning**, W. Alan Doolittle, A. M. Fischer, Y. O. Wei, Xie Hongen, F. A. Ponce, “A review of the synthesis of reduced defect density $In_xGa_{1-x}N$ for all indium compositions”, Solid-State Electronics, v 136, p 3-11, Oct. 2017
106) *Rong Jiang, En Xia Zhang, S. E. Zhao, D. M. Fleetwood, R. D. Schrimpf, R. A. Reed, M. L. Alles, **J. C. Shank**, **M. B. Tellekamp**, W. Alan Doolittle, “Total-Ionizing-Dose Response of Nb_2O_5-Based MIM Diodes for Neuromorphic Computing Applications”, IEEE Transactions on Nuclear Science, v 65, n 1, pt.1, p 78-83, Jan. 2018
107) ***J. C. Shank**, **M. B. Tellekamp**, M. J. Wahila, S. Howard, **A. S. Weidenbach**, **B. Zivasatienraj**, L. F. J. Piper, W. Alan Doolittle, “Scalable Memdiodes Exhibiting Rectification and Hysteresis for Neuromorphic Computing”, Scientific reports, Vol 8, Article number: 12935, August 8, 2018; https://doi.org/10.1038/s41598-018-30727-9
108) ***E. A. Clinton**, **E. Vadiee**, Shyh-Chiang Shen; K. Mehta, P. D. Yoder, W. Alan Doolittle, “Negative differential resistance in GaN homojunction tunnel diodes and

low voltage loss tunnel contacts", Applied Physics Letters, v 112, n 25, p 252103 (5 pp.), 18 June 2018

109) ***E. Vadiee**, **E. A. Clinton**, H. McFavilen, **A. S. Weidenbach**, **Z. Engel**, **C. Matthews**, Chaomin Zhang, C. Arena, R. R. King, C. B. Honsberg, W. Alan Doolittle, "InGaN solar cells with regrown GaN homojunction tunnel contacts", Applied Physics Express, v 11, n 8, p 082304 (5 pp.), Aug. 2018

110) * Zhe Cheng, **A. S. Weidenbach**, Tianli Feng, **M. B. Tellekamp**, S. Howard, M. J. Wahila, **B. Zivasatienraj**, B. Foley, S. T. Pantelides, L. F. J. Piper, W. Alan Doolittle, S. Graham, "Diffuson-driven ultralow thermal conductivity in amorphous Nb_2O_5 thin films", Physical Review Materials, v 3, n 2, p 025002 (7 pp.), arXiv:1807.05483 [cond-mat.mes-hall] , Feb. 2019

111) * **E. A. Clinton**, **E. Vadiee**, **M. B. Tellekamp**, and W. Alan Doolittle, "Observation and mitigation of RF-plasma-induced damage to III-nitrides grown by molecular beam epitaxy", J. Applied Physics, 126, 015705 (2019); https://doi.org/10.1063/1.5097557

112) * **E. A. Clinton**, **Z. Engel**, **E. Vadiee**, J. V. Carpenter, Z. C. Holman, and W. Alan Doolittle, "Ultra-Wide-Bandgap AlGaN Homojunction Tunnel Diodes with Negative Differential Resistance", Appl. Phys. Lett. 115, 082104 (2019); https://doi.org/10.1063/1.5113503

113) * Matthew J. Wahila, Galo Paez, Christopher N. Singh, Anna Regoutz, Shawn Sallis, Mateusz J. Zuba, Jatinkumar Rana, **M. Brooks Tellekamp**, Jos E. Boschker, Toni Markurt, Jack E. N. Swallow, Leanne A. H. Jones, Tim D. Veal, Wanli Yang, Tien-Lin Lee, Fanny Rodolakis, Jerzy T. Sadowski, David Prendergast, Wei-Cheng Lee, W. Alan Doolittle, and Louis F. J. Piper, "Evidence of a second-order Peierls-driven metal-insulator transition in crystalline NbO_2", Phys. Rev. Materials 3, 074602 – Published 16 July 2019, https://doi.org/10.1103/PhysRevMaterials.3.074602

114) * Sebastian A. Howard, Christopher N. Singh, Galo J. Paez, Matthew J. Wahila, Linda W. Wangoh, Shawn Sallis, Keith Tirpak, Yufeng Liang, David Prendergast, Mateusz Zuba, Jatinkumar Rana, **Alex Weidenbach, Timothy M. McCrone**, Wanli Yang, Tien-Lin Lee, Fanny Rodolakis, William Alan Doolittle, Wei-Cheng Lee, and Louis F. J. Piper, "Direct observation of delithiation as the origin of analog memristance in $LixNbO_2$", APL Materials 7, 071103 (2019); https://doi.org/10.1063/1.5108525

115) * Zhe Cheng, **Alex Weidenbach**, Tianli Feng, **M. Brooks Tellekamp**, Sebastian Howard, Matthew J. Wahila, **Bill Zivasatienraj**, Brian Foley, Sokrates T. Pantelides, Louis F. J. Piper, William Alan Doolittle, and Samuel Graham, "Diffuson-driven ultralow thermal conductivity in amorphous Nb_2O_5 thin films", Phys. Rev. Materials 3, 025002 – Published 21 February 2019; https://doi.org/10.1103/PhysRevMaterials.3.025002

116) * **E. Vadiee, E. A. Clinton**, J. V. Carpenter, H. McFavilen, C. Arena, Z. C. Holman, C. B. Honsberg, W. Alan Doolittle, "The role of Mg bulk hyper-doping and delta-doping in low-resistance GaN homojunction tunnel diodes with negative differential resistance", Journal of Applied Physics 126 (8), 083110, Aug. (2019)

117) * **E. Vadiee,** A. M. Fischer**, E. A. Clinton**, H. McFavilen, A. Patadia, C. Arena, F. A. Ponce, R. R. King, C. B. Honsberg, W. Alan Doolittle "Evaluating the performance of InGaN/GaN multi-quantum-well solar cells operated at elevated temperatures via DC and small-signal AC analysis" Japanese Journal of Applied Physics 58 (10), 101003, Sept. (2019).

118) * D. C. Lee, J. C. Shank, M. B. Tellekamp, W. Alan Doolittle, F. M. Alamgir, "Thin-film lithium niobites and their chemical properties for lithium-ion storage and diffusion", ChemElectroChem 6 (19), 5109-5115, Sept. (2019)
119) * **Habib Ahmad**, Travis J. Anderson, James C. Gallagher, **Evan A. Clinton**, **Zachary Engel, Christopher M. Matthews**, and W. Alan Doolittle, "Beryllium Doped Semi-insulating GaN without Surface Accumulation for Homoepitaxial High Power Devices," Journal of Applied Physics 127, 215703 (2020).
120) * **B. Zivasatienraj, M. B. Tellekamp, A. S. Weidenbach, A. Ghosh, T. M. McCrone**, W. Alan Doolittle, "Temporal versatility from intercalation-based neuromorphic devices exhibiting 150 mV non-volatile operation", Journal of Applied Physics 127 (8), 084501, Feb. 2020.
121) * D. G. Pahinkar, P. Basnet, M. P. West, **B. Zivasatienraj, A. Weidenbach**, W. Alan Doolittle, E. Vogel, S. Graham "Experimental and computational analysis of thermal environment in the operation of HfO_2 memristors", AIP Advances 10 (3), 035127, March 2020.
122) * G. P. Fajardo, M. Wahila, J. Rana, **M. B. Tellekamp**, W. Doolittle, L. Piper, "Investigating the metal to insulator transition in crystalline NbO_2 for neuromorphic computing applications", Bulletin of the American Physical Society 65. March 2020.
123) * S. Howard, L. Piper, M. Wahila, C. Singh, W.-C. Lee, **T. McCrone**, W. Doolittle, A. Weidenbach, G. Paez, "Investigation of the Resistive Switching Mechanism in Li_xNbO_2 Memristors", Bulletin of the American Physical Society 65, March 2020.
124) * **Z. Engel, E. A. Clinton, C. M. Matthews**, W. Alan Doolittle, "Controlling surface adatom kinetics for improved structural and optical properties of high indium content aluminum indium nitride", Journal of Applied Physics 127 (12), 125301, March 2020.
125) * Y. R. Koh, J. Shi, B. Wang, R. Hu, **H. Ahmad**, S. Kerdsongpanya, E. Milosevic, W. Alan Doolittle, D.Gall, Z. Tian, S. Graham, P. E. Hopkins, "Thermal boundary conductance across epitaxial metal/sapphire interfaces", Physical Review B 102 (20), 205304. Nov. 2020.
126) * **H. Ahmad, K. Motoki, E. A. Clinton, C. M. Matthews, Z. Engel**, W. Alan Doolittle, "Comprehensive Analysis of Metal Modulated Epitaxial GaN", ACS Applied Materials & Interfaces 12 (33), 37693-377122, July 2020.
127) * **A. Ghosh, B. Zivasatienraj, A. S. Weidenbach, T. M. McCrone**, W. Alan Doolittle, "Communication—Impact of Electrode Chemistry on the Non-Volatile Performance of Lithium Niobite Memristors for Neuromorphic Computing", ECS Journal of Solid State Science and Technology 9 (5), 055018, June 2020.
128) * Z. Cheng, Y. R. Koh, H. Ahmad, R. Hu, J. Shi, M. E. Liao, Y. Wang, T. Bai, R. Li, E. Lee, **E. A. Clinton, C. M. Matthews, Z. Engel**, L. Yates, T. Luo, M. S. Goorsky, W. Alan Doolittle, Z. Tian, P. E. Hopkins and S. Graham, "Thermal Conductance across Harmonic-Matched Epitaxial Al-Sapphire Heterointerfaces," Communication Physics 3, 115 (2020).
129) * M. S. B. K. Hoque , Y. Rui, K. Aryana, E. R. Hoglund, J. L. Braun, D. H. Olson, J. T. Gaskins, **H. Ahmad**, M. Mohammad, M. Elahi, J. K. Hite, Z. C. Leseman, W. Alan Doolittle, P. E. Hopkins, "Thermal conductivity measurements of sub-surface buried substrates by steady-state thermoreflectance", Review of Scientific Instruments, v 92, n 6, 064906 June 1, (2021)

130) * Christopher N. Singh, Brian A. Crafton, Mathew P. West, **Alex S. Weidenbach**, Keith T. Butler, Allan H. MacDonald, Arijit Raychowdhury, Eric M. Vogel, W. Alan Doolittle, L.F.J. Piper, Wei-Cheng Lee, "Quantum Statistical Transport Phenomena in Memristive Computing Architectures", Physical Review Applied, v 15, n 5, May (2021)
131) * **B. Zivasatienraj, M. B. Tellekamp**, W. Alan Doolittle, "Epitaxy of $LiNbO_3$: Historical Challenges and Recent Success", Crystals 2021, 11(4), 397, April 2021.
132) * **Z. Engel, E. A. Clinton, K. Motoki, H. Ahmad, C. M. Matthews**, W. Alan Doolittle, "Adlayer control for tunable AlGaN self-assembled superlattices," Journal of Applied Physics 130, 165304, October 2021.
133) * **H. Ahmad, Z. Engel**, M. Zia, **A. S. Weidenbach, C. M. Matthews, B. Zivasatienraj**, M. S. Bakir, W. Alan Doolittle, "Cascaded Ni hard mask to create chlorine-based ICP dry etched deep mesas for high-power devices," Semiconductor Science and Technology, October 2021.
134) * **H. Ahmad, Z. Engel, C. M. Matthews**, W. Alan Doolittle, "p-type AlN Based Heteroepitaxial Diodes with Schottky, PIN and Junction Barrier Schottky Character Achieving Significant Breakdown Performance," Journal of Applied Physics 130 (19), (2021).
135) * Y. R. Koh, M. S. B. Hoque, **H. Ahmad**, D. H. Olson, Z. Liu, J. Shi, W. Steven, K. Huynh, E. R. Hoglund, J. M. Howe, M. S. Goorsky, S. Graham, T. Luo, J. K. Hite, W. Alan Doolittle, P. E. Hopkins, "High thermal conductivity and thermal boundary conductance of homoepitaxially grown gallium nitride (GaN) films with thicknesses ranging from 0.25 to 2.1 mm," Physical Review Materials 5, 104604, October 2021.
136) * **H. Ahmad**, J. Lindemuth, **Z. Engel, C. M. Matthews, K. Motoki**, W. Alan Doolittle, "Substantial P-type Conductivity of AlN Achieved via Beryllium Doping," Advanced Materials 33 (42), 2104497, September 2021.
137) **H. Ahmad, Z. Engel, A. Ghosh, C. M. Matthews** and W. A. Doolittle, "GaN:Be I-Layer-Based High-Power p-i-n Diodes Achieving Large Quasi-Vertical MBE Breakdown Performance," in IEEE Transactions on Electron Devices, vol. 69, no. 5, pp. 2566-2572, May 2022, doi: 10.1109/TED.2022.3156951.
138) **H. Ahmad, Z. Engel, C. M. Matthews, S. Lee,** and W. Alan Doolittle, "Realization of homojunction PN AlN diodes", J. Appl. Phys. 131, 175701 (2022)
139) **K. Motoki, Z. Engel, C. M. Matthews, H. Ahmad, T. M. McCrone, K. Harada**, and W. A. Doolittle, "Observation of interfacial strain relaxation and electron beam damage thresholds in $Al_{0.3}In_{0.7}N$/GaN heterostructures by transmission electron microscopy," Journal of Vacuum Science & Technology B, vol. 40, no. 5, pp. 052210, Sep. 2022. doi: 10.1116/6.0001974.
140) **Z. Engel, K. Motoki, C. M. Matthews,** and W. A. Doolittle, "Overcoming metal-rich surface chemistry limitations of ScAlN for high electrical performance heterostructures," Journal of Applied Physics vol. 132, no. 18, pp. 185302, Nov. 2022. doi: 10.1063/5.0121621
141) **B. Zivasatienraj** and W. A. Doolittle, "Dynamical memristive neural networks and associative self-learning architectures using biomimetic devices", Front. Neurosci. 17:1153183, (2023)
142) P. -C. Shih, G. Rughoobur, **Z. Engel, H. Ahmad**, William Alan Doolittle, A. Akinwande, and T. Palacios, "Stable and High Performance AlGaN Self-Aligned-Gate Field Emitter Arrays," in IEEE Electron Device Letters, vol. 43, no. 8, pp. 1351-1354, Aug. 2022, doi: 10.1109/LED.2022.3184996.

143) P. -C. Shih, **Z. Engel, H. Ahmad**, William Alan Doolittle, and T. Palacios, "Wet-based digital etching on GaN and AlGaN", Appl. Phys. Lett. 120, 022101 (2022); https://doi.org/10.1063/5.0074443

144) **A. Ghosh, A. S. Weidenbach, B. Zivasatienraj, T. M. McCrone** and W. A. Doolittle, "Ion Intercalation Enabled Tunable Frequency Response in Lithium Niobite Memristors," in IEEE Transactions on Electron Devices, vol. 70, no. 2, pp. 776-781, Feb. 2023. doi: 10.1109/TED.2022.3227498.

145) C**. M. Matthews, Z. Engel, K. Motoki**, and W. A. Doolittle, "A Kinetic Model for Ternary III-Nitride Epitaxy: The Role of Vertical Segregation on Phase Separation," Crystal Growth & Design, vol. 23, no. 12, p. 8856, Oct. 2023, doi: 10.1021/acs.cgd.3c00946.

146) S. Cho, O. Barrera, P. Simeoni, E. N. Marshall, J. Kramer, K. Motoki, T.-H. Hsu, V. Chulukhadze, M. Rinaldi, W. A. Doolittle, R. Lu, "Millimeter Wave Thin-Film Bulk Acoustic Resonator in Sputtered Scandium Aluminum Nitride", Journal of Microelectromechanical Systems, p 529-32, 2023

147) **C. M. Matthews, H. Ahmad**, K. Hussain, MVS Chandrashekhar, A. Khan, and W. A. Doolittle, "Cathodoluminescence investigation of defect states in n- and p-type AlN," Applied Physics Letters (Accepted).

B2. CONFERENCE PRESENTATION WITH PROCEEDINGS (REFEREED)

No Data

B2A INVITED CONFERENCE PROCEEDINGS (REFEREED)

1) * **Invited**: W. Alan Doolittle and A. S. Brown, "Compliant Substrate Processes," Proceedings of Materials Research Society, Epitaxial Growth-Principles and Applications Symposium, San Francisco, CA, April 5-8, (1999).

B2B CONFERENCE PROCEEDINGS (REFEREED)

2) * A. Rohatgi, W. Alan Doolittle, A. W. Smith, F. V. Wald, R. O. Bell, and C. E. Dube, "Doping and Oxygen Dependence of Efficiency of EFG Silicon Solar Cells," Proceedings of the 21st Photovoltaic Specialists Conference, Kissimmee, FL, , p. 581, May 21-25 (1990).

3) * W. Alan Doolittle, A. Rohatgi, and R. Brenneman, "Correlation between Impurities, Defects, and Cell Performance in Semicrystalline Silicon," Proceedings of the 21st Photovoltaic Specialists Conference, Kissimmee, FL, p. 681, May 21-25 (1990).

4) * B. L. Sopori, K.M. Jones, X.R. Matson, M. Al-Jassim, S. Tsuo, W. Alan Doolittle, and A. Rohatgi, "Hydrogen in Silicon: Diffusion and Defect Passivation," Proceedings of the 22nd Photovoltaic Specialists Conference, Las Vegas, NV, Vol. 2, pp. 833-841, Oct., (1991).

5) * A. Rohatgi, Z. Chen, P. Sana, N. Evers, R. Ramanachalam, and W. Alan Doolittle, "Gettering and Passivation Techniques for Quality Enhancement of Multicrystalline Silicon," American Institute of Physics Conference Proceedings, Proceedings of 1994 12th NREL Photovoltaic Review, Denver, CO, Vol. 303, pp. 505-518. Oct. 13-15 (1993).

6) * A. Rohatgi, P. Doshi, M. Ropp, L. Cai, W. Alan Doolittle, S. Narashima, T. Krygowski, J. Rand, D. Ruby, and D.L. Meier, "Improved understanding and optimization of RTP and PECVD processes for high efficiency silicon solar cells," Proc. 13th European Photovoltaic Solar Energy Conference and Exhibition, Oct. (1995).
7) * A. Rohatgi, P. Sana, L. Cai, W. Alan Doolittle, S. Kamra, P. Doshi, T. Krygowski, and G. Crotty, "Fabrication and analysis of high efficiency multicrystalline silicon solar cells," American Institute of Physics Conference Proceedings, 1996, Proceedings of 13th NREL Photovoltaics Review, Lakewood, CO, Vol. 353, pp. 126-34, , May 16-19 (1995).
8) * J. Cowles, R.A. Metzger, A. Gutierrez-Aitken, A. S. Brown, D. Streit, A. Oki, T. Kim, and W. Alan Doolittle, "Double heterojunction bipolar transistors with InP epitaxial layers grown by solid-source MBE," 1997 International Conference on Indium Phosphide and Related Materials, Cape Cod, MA, pp. 548-50, , May 11-15 (1997).
9) * T. Ciszek, T. Wang, W. Alan Doolittle, and A. Rohatgi, "Minority Carrier Lifetime Degradation in Silicon Co-Doped with Iron and Gallium," Proceedings of the 26th Photovoltaic Specialists Conference, Anaheim, CA, pp. 59-62, Sept. 29-Oct. 3 (1997).
10) * W. Alan Doolittle, T. Kropewnicki, C. Carter-Coman, S. Stock, P. Kohl, N. M. Jokerst, R. A. Metzger, S. Kang, K. Lee, G. May, and A. S. Brown, "Growth of GaN on lithium gallate substrates for development of a GaN thin compliant substrate," Proceedings of the Materials Research Society, Nitride Semiconductors Symposium, Boston, MA, pp. 283-288, Fall (1997).
11) * G. Augustine, H. McD. Hobgood, V. Balakrishna, G. T. Dunne, R. H. Hopkins, R. N. Thomas, W. Alan Doolittle, and A. Rohatgi, "High purity and semi-insulating 4H-SiC crystals grown by physical vapor transport," Proceedings of the Silicon Carbide, III-Nitrides and Related Materials. 7th International Conference, Stockholm, Sweden, Materials Science Forum, Vol. 264-268, pt.1, pp. 9-12, Aug. 31-Sept. 5, (1997) .
12) * W. Alan Doolittle, A. Rohatgi, R. Ahrenkiel, D. Levi, G. Augustine, and R. H. Hopkins, "Understanding the Role of Defects in Limiting the Minority Carrier Lifetime in SiC," Proceedings of the Materials Research Society, Power Semiconductor Materials and Devices Symposium, Boston, MA, pp. 197-202, Fall (1997).
13) * T. F. Ciszek, T. H. Wang, W. Alan Doolittle, A. Rohatgi, C. L. Claeys, P. Rai-Choudhury, M. Watanbabe, P. Stallhofer, and H. J. Dawson, "Iron-gallium pair defects in float-zoned silicon," Proceedings of the Fifth International Symposium on High Purity Silicon V, Boston, MA, pp. 230-237, Nov. 2-6 (1998).
14) * K. Lee, S. Seo, S. Huang, Y. Joo, W. Alan Doolittle, S. Fike, N. Jokerst, M. Brooke, and A. S. Brown, "Design of a smart pixel multispectral imaging array using 3D stacked thin film detectors on Si CMOS circuits," 2000 Digest of the IEEE Lasers and Electro-Optic Society (LEOS) Summer Topical Meetings, Cat. No.00TH8497, pp. I57-8, Nov. (2000).
15) * S. Seo, K. Lee, S. Huang, Y. Joo, W. Alan Doolittle, N. Jokerst, A. S. Brown, and M. Brooke, "GaN Thin Film Material Bonded to Host Substrates Using Selective Chemical Etching," 2000 Digest of the IEEE Lasers and Electro-Optic Society (LEOS) Summer Topical Meetings, Cat. No.00CH37080, Vol. 2, pp. 559-560, Nov. (2000).

16) * S. Kang, W. Alan Doolittle, A. S. Brown, and S. R. Stock, "Comparison of AlGaN and GaN grown on various substrates; step flow growth on LiGaO2 at low growth temperature," Proceedings of the International Conference on Silicon Carbide and Related Materials, Raleigh, NC, Materials Science Forum, Vol. 338-342, part 2, pp. 1499-1502, Oct. 10-15, (2000).
17) * **G. Namkoong**, W. Alan Doolittle, S. Kang, S. Huang, A. S. Brown, and S. R. Stock, "Low temperature nitridation combined with high temperature buffer annealing for high quality GaN grown by plasma-assisted MBE," MRS Internet Journal of Nitride Semiconductor Research, Vol. 5S1, 2000.
18) * M. Losurdo, M. Giangregorio, P. Capezzuto, G. Bruno, **G. Namkoong**, W. Alan Doolittle, and A. S. Brown, "A Chemical Perspective of GaN Polarity: The Use of Hydrogen Plasma Dry Etching Versus NaOH Wet Etching to Determine Polarity," Materials and Devices for Optoelectronics and Microphotonics Symposia (Materials Research Society Symposium Proceedings, Vol. 722, pp. 103-108 (2002)
19) * M. Cheung, F. Chan, M. Furis, A. Cartwright, **G. Namkoong**, and W. Alan Doolittle, "Time-Resolved Optical Studies of InGaN Layers Grown on LGO substrates," GaN and Related Alloys - 2002 Symposium (Mater. Res. Soc. Symposium Proceedings), Boston, MA, Vol. 743, L11.6, pp. 659-664, Dec. 2-6, (2002).
20) * W. Alan Doolittle, **G. Namkoong, A. Carver, W. Henderson**, and A. S. Brown, "III-Nitride Growth on Lithium Niobate: A new substrate material for Polarity Engineering in III-Nitride Heteroepitaxy," GaN and Related Alloys - 2002 Symposium (Mater. Res. Soc. Symposium Proceedings), Boston, MA, Vol. 743, L1.4, pp. 9-14, Dec. 2-6, (2002).
21) * H. Wu, W. J. Schaff, M. Furis, A. Cartwright, **W. Henderson**, W. Alan Doolittle, and A. V. Osinsky, "Molecular Beam Epitaxial Growth of AlN/GaN Multiple Quantum Wells", GaN and Related Alloys - 2002 Symposium (Mater. Res. Soc. Symposium Proceedings), Boston, MA, Vol. 743, L6.2, pp. 375-380, Dec. 2-6, (2002).
22) * W. Alan Doolittle, **G. Namkoong, A. G. Carver, and W. Henderson**, "Crystalline Functional Oxides Integrated with Wide Bandgap Semiconductors via Epitaxy: A Novel Platform for Multifunctional Materials Integration and Devices", Advanced Research Workshop: Future Trends in Microelectronics-4: The Nano, the Giga, the Ultra, and the Bio, Corsica, France, June 23-27 (2003).
23) * **G. Namkoong**, W. Alan Doolittle, **A. G. Carver, W. Henderson**, D. Jundt, and A.S. Brown, "III-Nitride Growth on a Ferro/Pyro/Piezoelectric/Nonlinear Optical Substrate for Advanced Functionality", Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), Atlanta, GA., Feb. (2003).
24) * **S. Burnham, G. Namkoong**, and W. Alan Doolittle, "Mg Doped GaN using a thermally energetic source: Enhanced incorporation, control and quantitative optimization," GaN and Related Alloys - 2003 Symposium (Mater. Res. Soc. Symposium Proceedings, Vol. 798), 2004, pp. 479-484, Dec. (2003).
25) * S. E. Ralph, M. King, **G. Namkoong**, and W. Alan Doolittle, "Monolithic Integration of GaN Electronic Amplifiers with $LiNbO_3$ Optical Modulators," 2003 IEEE LEOS Annual Meeting Conference Proceedings, (IEEE Cat. No.03CH37460), pt. 2, pp. 652-653, Vol. 2, (2003).
26) * **A. G. Carver, W. Henderson**, W. Alan Doolittle, "Novel chlorine based chemistry for growth of ferroelectric materials by molecular beam epitaxy", Materials Research Society Fall 2003 Meeting, December (2003).

27) * **S. D. Burnham**, W. Alan Doolittle, **G. Namkoong, W. Henderson**, "Mg doped GaN using a valved, thermally energetic source: enhanced incorporation, control and quantitative optimization," Mater. Res. Soc. 2003 Symposium Proceedings – GaN and Related Alloys, Vol. 798, pp. 479-484, (2004).
28) * S. Madison, **W. Henderson, G. Namkoong**, K. M. Patel, W. Alan Doolittle, S. Ralph, "Monolithic integration of AlGaN/GaN-$LiNbO_3$ optical-electronic-structures," 2004 IEEE LEOS Annual Meeting Conference Proceedings, Vol. 1, pp. 232-233, (2004).
29) * M. Losurdo, M. Giangregorio, G. Bruno, A. Brown, W. Alan Doolittle, **G. Namkoong**, and T. Meyers, "Surface potential measurements of doping and defects of p-GaN," GaN and Related Alloys - 2003 Symposium (Mater. Res. Soc. Symposium Proceedings), Boston, MA, Dec. 1-5, 2003, Vol. 798, pp. 805-810, (2004).
30) * **G. Namkoong**, W. Alan Doolittle, A. S. Brown, M. Losurdo, M. M. Giangregorio, and G. Bruno, "Effect of buffer design on AlGaN/AlN/GaN heterostructures by MBE," GaN and Related Alloys - 2003 Symposium (Mater. Res. Soc. Symposium Proceedings), Boston, MA, Dec. 1-5, 2003, Vol. 798, pp. 359-364, (2004).
31) * M. Losurdo, M. M. Giangregorio, G. Bruno, A. S. Brown, W. Alan Doolittle, A. J. Ptak, T. H. Myers, "Surface potential measurements of doping and defects in p-GaN", GaN and Related Alloys - 2003 Symposium (Mater. Res. Soc. Symposium Proceedings Vol.798), p 805-10, (2004).
32) * S. M. Madison, **W. Henderson, G. Namkoong, K. K. Lee**, K. M. Patel, W. Alan Doolittle, and S. E. Ralph, "Monolithic Integration of Electronic and Electro-Optical Devices Exploiting the AlGaN/GaN-LiNbO3 Material System," 2004 IEEE LEOS Annual Meeting Conference Proceedings (IEEE Cat. No.04CH37581), pt. 1, pp. 232-3, Vol. 1, (2004).
33) * C. Honsberg, O. Jani, W. Alan Doolittle, **E. Trybus, G. Namkoong**, I. Ferguson, D. Nicole, and A. Payne, "InGaN– A New Solar Cell Material," Proceedings of the 19th European Photovoltaic Solar Energy Conference, Paris, 2004.
34) * O. Jani, C. Honsberg, A. Asghar, D. Nicol, I. Ferguson, W. Alan Doolittle, and S. Kurtz, "Characterization and analysis of InGaN photovoltaic devices", Conference Record of the Thirty-First IEEE Photovoltaic Specialist Conference, (IEEE Cat. No. 05CH37608), 3-7 Jan. 2005, Lake Buena Vista, FL, pp. 37-42, (2005).
35) * **S. M. Madison**, **W. Henderson, G. Namkoong, K. K. Lee**, K. M. Patel, W. Alan Doolittle, S. E. Ralph, S. E., "Monolithic integration of electronic and electro-optical devices exploiting the AlGaN/GaN-LiNbO3 material system," 2005 Conference on Lasers and Electro-Optics, Vol. 3, part 3, pp. 1605-1607, 2005.
36) * O. Jani, C. Honsberg, S. Y. Huang, I. Ferguson**, G. Namkoong, E. Trybus**, W. Alan Doolittle, S. Kurtz, "Design, growth, fabrication and characterization of high-band gap InGaN/GaN solar cells", Conference Record of the 2006 IEEE 4th World Conference on Photovoltaic Energy Conversion (IEEE Cat. No. 06CH37747), p. 6, 2006.
37) * O. Jani, H. Yu**, E. Trybus**, B. Jampana, I. Ferguson, W. Alan Doolittle, and C. Honsberg, " Effect of Phase Separation on Performance of III-V Nitride Solar Cells", Conference Proceedings of the 22nd European Photovoltaic Solar Energy Conference, Milan, Italy, September, 2007.
38) * **C.A.M. Fabien, B. P. Gunning, J. J. Merola, E. A. Clinton**, W. Alan Doolittle, "Large-area III-nitride double-heterojunction solar cells with record-high in-content

InGaN absorbing layers", 2015 IEEE 42nd Photovoltaic Specialist Conference (PVSC) Proceedings, p 1-3, 2015

39) * **J. C. Shank, M. B. Tellekamp**, W. Alan Doolittle, "A scalable non-electroformed memdiode for neuromorphic circuitry", 2016 74th Annual Device Research Conference (DRC), p 1-2, 2016
40) * **E. Vadiee, E. A. Clinton**, H. McFavilen, A. M. Fischer, Yi Fang, J. J. Williams, C. B. Honsberg, W. Alan Doolittle, S. M. Goodnick, "Progress towards double-junction InGaN solar cell ", 2017 IEEE 44th Photovoltaic Specialist Conference (PVSC), p 0305-8, 2017 (appeared in print in 2018).
41) * **E. Vadiee, E.A. Clinton**, A.M. Fischer, H. McFavilen, C. Arena, C.B. Honsberg, S.M. Goodnick, and W.A. Doolittle, "DC and Small Signal AC Performance Analysis of InGaN/GaN Multi-Quantum-Well Solar Cells Operated at Elevated Temperatures", in 2018 IEEE 7th World Conf. Photovolt. Energy Convers (IEEE, 2018), pp. 3861–3864.
42) * **E. Vadiee, E.A. Clinton**, H. McFavilen, Z. Engel, C. Matthews, C. Arena, C.B. Honsberg, S.M. Goodnick, and W. Alan Doolittle, "InGaN based solar cells with GaN tunnel junction contacts", in 2018 IEEE 7th World Conf. Photovolt. Energy Convers. (IEEE, 2018), pp. 0965–0968.
43) * D. G. Pahinkar, P. Basnet, **B. Zivasatienraj, A. Weidenbach**, M. West, W. Alan Doolittle, E. Vogel, S. Graham, "Computational Investigation of Nanoscale Memristor Devices for Neuromorphic Computing", 2019 18th IEEE Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm), 2019.
44) * J. Shi, A. Krishnan, A. F. M. A. U. Bhuiyan, Y. R. Koh, K. Huynh, A. Mauze, S. Mu, B. Foley, **H. Ahmad**, T. Itoh, Y. Zhang, Z. Feng, C. Yuan, S. Kim, W. Alan Doolittle, C. V. Walle, J. S. Speck, M. Goorsky, P. Hopkins, H. Zhao, S. Graham, "Thermal transport across Al-(AlxGa1-x)2O3 and Al-Ga2O3 interfaces," ASME 2021 International Technical Conference and Exhibition on Packaging and Integration of Electronic and Photonic Microsystems InterPACK2021, (2021).
45) **B. Zivasatienraj** and W. A. Doolittle, "An Experimentally Validated, Universal Memristor Model Enabling Temporal Neuromorphic Computation," 2022 Device Research Conference (DRC), Columbus, OH, USA, 2022, pp. 1-2, doi: 10.1109/DRC55272.2022.9855650.

B3. Other Refereed Material
No Data

B4. Submitted Journal Articles (with date of submission)
No Data

B5. Submitted Conference Papers (with date of submission)
No Data

C. Other Publications and Creative Products

C1. NON-REFEREED CONFERENCE PRESENTATIONS WITH PROCEEDINGS

1) *P. Gunning and W. Alan Doolittle, "Improving p-type nitrides", Compound Semiconductor Magazine, 11th May 2015
2) C. M. Matthews, H. Ahmad, K. Motoki, S. Lee, A. Ghosh, E. N. Marshall, A. L. Tang and, W. A. Doolittle, "AlN: Opening doors with low temperature epitaxy," Compound Semiconductor, vol. 9, no. 29, pp. 40-44, Dec. 2023.

C2. PATENTS

C2A. US PATENTS

a. *US Patent #5,521,839 for a Deep Level Transient Spectroscopy System and Method, May 28, 1996.
b. *US Patent #7,173,286 for Semiconductor devices formed of III-nitride compounds, lithium-niobate-tantalate, and silicon carbide, February 6, 2007.
c. *US Patent Applied for, High Efficiency Solar Cell, application number 60/833-994 filed July 28, 2006
d. *US Patent #7,888,669 B2, "Nitride/Zinc Oxide Based Light-Emitting Diodes" , February 15, 2011
e. *U.S. Patent No. 8,261,690 B2 "In-Situ Flux Measurement Devices, Methods, And Systems" W. Alan Doolittle and Alexander G. Carver, September 11, 2012
f. *U.S. Patent No. 8,360,002 B2 "In-Situ Flux Measurement Devices, Methods, And Systems" W. Alan Doolittle and Alexander G Carver, January 29, 2013
g. *U.S. Patent No. 8,377,518 "In-Situ Flux Measurement Devices, Methods, And Systems", W. Alan Doolittle and Alexander G Carver, February 19, 2013
h. *International Patent Applied for, PCT/US10/40108, Metal Oxide Structures, Devices and Fabrication Methods
i. *U. S. Patent No. 9,142,413 US10000381B2, "Methods for growing a non-phase separated group-III nitride semiconductor alloy", M. Moseley and W. Alan Doolittle, September 22, 2015
j. *U. S. Patent No. 10,329,688, "Effusion cells, deposition systems including effusion cells, and related methods"
k. *U. S. Patent No. 10,266,962, "Deposition systems including effusion sources, and related methods"
l. *U. S. Patent No. 10,526,723 for, System and method for increasing III-nitride semiconductor growth rate and reducing damaging ion flux

C2B. PROVISIONAL PATENTS

m. *Integrated Transistors and Circuitry with Lithium Niobate Optical Modulator. Filed with Dr. Stephen Ralph on Oct. 11, 2002. (GT Disclosure 2776) Provisional Patent Application #60/512,157.
n. *Lithium Niobate Based Optical Modulators and Waveguides on SiC and III-Nitrides. Filed with Dr. Stephen Ralph on Oct. 11, 2002. (GT Disclosure 2777) Provisional Patent Application #60/512,156.

o. *Low-Cost Nitride Power Electronics with Integrated Active Cooling. Filed with Samuel Graham (ME), Ari Glezer (ME), Ian Ferguson (ECE) on Jan. 12, 2005 (GT Disclosure 3358).
p. *Dynamically Tunable Terahertz Radiation Emission Through Standing Wave Acoustical Poling of Ferroelectric Thin Films. Filed with W. Hunt (ECE), and David Citrin (ECE) on Feb. 21, 2005. (GT Disclosure 3396).
q. *W. Alan Doolittle, D. Pritchett, W. Henderson, "Maskless and Dynamic AlInGaN Compositional and Doping Patterning for Three Dimensional Epitaxy," U. S. Patent Pending, February 19, 2007 (GT Disclosure 4122). Refiled as GTRC ID No. 4122
r. *W. Alan Doolittle, "Novel Epitaxial Metal Interconnects to the III-Nitride Material System for Advanced Photovoltaic Devices", US Patent Pending filed on (GT Disclosure 3890).
s. *W. Alan Doolittle, “Lithium Metal Oxide Memristor and Related Constrictive Current Flow Device” , US Patent Pending filed on June 25, 2009, (GT Disclosure 4910), serial number 61/220,366
t. *W. Alan Doolittle, “Photo-electrolytic Water Splitting for Hydrogen Generation” US Patent Pending filed on June 16, 2009 (GTRC ID No. 4900).
u. *W. Alan Doolittle, “Integrated Solar Cell and Battery” US Patent Pending filed on June 16, 2009 (GTRC ID No. 4901)
v. *W. Alan Doolittle and M. Moseley, “Non-Phase Separated InGaN for use in Light-Emitting Diodes, LASERs, and Solar Cells” (GTRC ID 5459).
w. *J. D. Greenlee, W. Alan Doolittle, M. B. Tellekamp, J. C. Shank, B. P. Gunning, and C. A. M. Fabien. Method of $LiNbO_2$ synthesis. Georgia Tech Research Corporation, assignee. Provisional 61/946,998. US Patent Pending filed on 17 February 2014
x. “Systems and methods for growing a non-phase separated group-III nitride semiconductor alloy”, Michael William Moseley, William Alan Doolittle, Publication date, 2018/6/19, Patent office, US, Application number10000381
y. “System and Method for Increasing III-Nitride Semiconductor Growth Rate and Reducing Damaging Ion Flux”, William Alan Doolittle, Evan A Clinton, Chloe AM Fabien, Brendan Patrick Gunning, Joseph J Merola, Publication date 2018/5/17, Patent office US, Application number, 15738458
z. PCT Patent Application, “Aluminum Nitride-Based High-Power Devices and Methods of Making the Same”, 11 January 2023 GTRC Reference No.: 8666-WO1, including GTRC8810/8666/8786/8789/8790) Our Reference No.: GTRC8666/8810PCT
aa. U.S. Patent Application No. 63/494,793, “Disappearing Polarization Hetero-Superjunction Acoustic Switch (DiPHASP”, Filed: April 7, 2023, GTRC Reference No.: 9206, Our Reference No.: GTRC9206PRV

C4. Invention Disclosures

a. 1249 Pseudo-logarithmic Transient Capacitance/Conductance, 3/13/1992
b. 2497 Automatically Tunable RF Impedance Matching System for the Applied EPI Unibulb Plasma Source, 5/21/2001
c. 2582 Increased Acceptor Doping in Aluminum-Gallium-Indium Nitride Alloys by Be Doping, 11/26/2001

d. 2583 Doping of III-Nitride Substrate Materials to Facilitate Broad Wavelength Range Luminescence, 11/26/2001
e. 2584 Increased Acceptor Doping by Pre-cracking and Exciting Dopants, 11/26/2001
f. 2585 Novel Approach to Design and Fabrication of Power Field Effect Transistors Using Metal-Oxide Ferroelectric Materials to Enhance their Performance, 11/26/2001
g. 2586 Novel Approach to Growth of Lithium Metal Oxides Using Metal Chloride Salts, 11/26/2001
h. 2587 Deposition of Lithium Salts on Wide Bandgap Semiconductors Including but not limited to Alloys of Aluminum Nitride, Gallium Nitride, Indium Nitride and Polytypes of Silicon Carbide 4H and 6H, 11/26/2001
i. 2624 Silicon Carbide and III-Nitride Substrate Technology Based on Lithium Niobate and Lithium Tantalate, 2/13/2002
j. 2776 Integrated Transistors and Circuitry with Lithium Niobate Optical Modulator, 10/14/2002
k. 2777 Lithium Niobate Based Optical Modulators and Waveguides on SiC and III-Nitrides, 10/14/2002
l. 3133 III-Nitride Phase Modulators, 3/16/2004
m. 3358 Low-Cost Nitride Power Electronics with Integrated Active Cooling, 1/7/2005
n. 3396 Tunable Terahertz Emitters Through Standing Wave Acoustical Poling of Ferroelectric Thin Films, 2/22/2005
o. 3556 In-Situ Molecular Flux Measurement Device and Method, 7/18/2005
p. 3797 Phosphor-Free White LED using Self-Fluorescent Substrates, 3/29/2006
q. 3890 Novel Epitaxial Metal Interconnects to the III-Nitride Material System for Advanced Photovoltaic Devices, 6/5/2006
r. 4122 3D Epitaxy, 2/19/2007
s. 4811 High Efficiency Solar Cell, 4/3/2009
t. 4900 Photo-Electrolytic Water Splitting for Hydrogen Generation, 6/9/2009
u. 4901 Integrated Solar Cell & Battery, 6/9/2009
v. 4910 Metal Oxide Structures, Devices, and Fabrication Methods, 6/25/2009
w. 5459 Non-Phase Separated InGaN for use in Light-Emitting Diodes, Lasers, and Solar Cells, 11/8/2010
x. 6083 Improved Ohmic Contact to p-type InAlGaN Devices, 5/31/2012
y. 6617 Method of LiNbO2 synthesis, 2/17/2014
z. 7009 Method of Increasing III-Nitride Semiconductor Growth Rate and Reduced Damaging Ion Flux Content, 5/29/2015
aa. 7200 A Scalable Memdiode - Rectification and Hysteresis in Metal - Nb2O5 - Metal Diodes Without Electroforming, 2/2/2016
bb. 7561 Non-volatile LiNbO2 memristors
cc. 8435 Surface Protection Technique for MBE-MOCVD Hybrid Growths, 4/6/2020
dd. 8666 First Experimental Demonstration of P-type AlN Grown by MME, 1/31/2021
ee. 8790 Cascaded Ni Hard Mask to Create ICP Dry Etched Deep Mesas for High-Power Devices, 8/12/2021

ff. 8789 Improved Breakdown Performance in High-Power Devices via Thin Current Spreading Layers, 8/12/2021

gg. 8786 First-time Experimental Achievement of Junction Barrier Schottky Diodes via Relaxed p-AlN on n-GaN Films, 8/12/2021

hh. 8810 High Breakdown High-Power Be Doped AlN Schottky Diode, 9/15/2021

D. Presentations

D1. Keynote Addresses and Plenary Lectures

1) * **Invited Plenary:** W. Alan Doolittle and A. S. Brown, "GaN Growth on Sapphire and Lithium Gallate," Seventeenth Conference on Crystal Growth, June 4-7, 2000, (AACG/WEST), Fallen Leaf Lake, CA.

D2. Invited Conference and Workshop Presentations

2) * **Invited**: W. Alan Doolittle and A. S. Brown, "Growth of GaN on LGO for Compliant Substrates," TMS Workshop on Bonding and Compliant Substrates, Feb. 1998, San Juan, Puerto Rico.
3) * **Invited**: W. Alan Doolittle, A. S. Brown, and A. Rohatgi, "Characterization of SiC and GaN for Minority Carrier Devices," TMS Workshop on Minority Carrier Wide Bandgap Devices, Feb. 1999, Panama City, FL.
4) * **Invited**: W. Alan Doolittle and A. S. Brown, "High Quality Gallium Nitride on Lithium Gallate for High Frequency Power Devices," TMS Workshop on Minority Carrier Wide Bandgap Devices, Feb. 1999, Panama City, FL.
5) * **Invited**: W. Alan Doolittle and A. S. Brown, "Compliant Substrate Processes," Materials Research Society Meeting, Epitaxial Growth-Principles and Applications Symposium, April 5-8, 1999, San Francisco, CA.
6) * **Invited**: A. S. Brown and W. Alan Doolittle, "Compliant Substrates," International Conference on Compliant and Bonded Substrates, Sept. 1999, Orlando, FL.
7) * **Invited**: A. S. Brown and W. Alan Doolittle, "Status and Promise of Compliant Substrate Technology," International Conference of Semiconductor Interface Science and Technology, June 1999, Gothenberg, Sweden.
8) ***Invited**: W. Alan Doolittle, **G. Namkoong**, S.S. Stock, and A. S. Brown, "Workshop on Polarization Effects on Semiconductors," Aug. 27-31, 2000, Glacier National Park, Montana.
9) * **Invited**: W. Alan Doolittle, A. S. Brown, **G. Namkoong**, S. Huang, and C. Wood, "How much can we get in and where can we put it?" Doping, Dopants, and Carrier Dynamics on Wide Gap Semiconductors Workshop, April 2-6, 2000, Copper Mountain Resort, Copper Mountain, CO.
10) * Invited: A. S. Brown and W. Alan Doolittle, "Molecular Beam Epitaxial GaN," Frontiers in Science Meeting, April 4, 2000, La Jolla, CA.
11) * **Invited**: W. Alan Doolittle, "The Role of Innovative Materials Research in the Wide Bandgap Electronics and Optoelectronics," University of Buffalo-The Institute for Lasers, Photonics, and Biophotonics Colloquium, Oct. 26, 2001.
12) * **Invited**: W. Alan Doolittle, A. S. Brown, and S. Kang, "The Critical Role of Surface Finish and Crystallinity on the Performance of AlGaN/GaN 2DEGs and UV Metal Semiconductor Metal Photodetectors Grown on LiGaO2," Office of Naval Research

Workshop on Near-surface effects in semiconductor substrates, Aug. 5-10, 2001, Kodiak Island, Alaska.

13) * **Invited**: W. Alan Doolittle, "The Role of Innovative Materials Research in the Wide Bandgap Electronics and Optoelectronics," Ohio State University Electronic Nanostructures Seminar, May 28, 2002.
14) * **Invited**: W. Alan Doolittle, "The Role of Innovative Materials Research in the Wide Bandgap Electronics and Optoelectronics," North Carolina State University, School of Materials Science and Engineering Colloquium, Aug. 30, 2002.
15) * **Invited**: W. Alan Doolittle, "The Role of Innovative Materials Research in the Wide Bandgap Electronics and Optoelectronics," Auburn University, School of Physics Colloquium, Sept. 6, 2002.
16) * **Invited**: W. Alan Doolittle and **A. G. Carver**, "Crystalline Oxides on Wide Bandgap Semiconductors: A Novel Platform for Multifunctional Materials Integration and Devices," Office of Naval Research Workshop on Multifunctional Materials, Oct. 27-31, Pucon, Chile (2002).
17) * **Invited**: W. Alan Doolittle, **G. Namkoong, A. Carver**, S. Huang, S. Kang, **W. Henderson** and A. S. Brown, "Lithium –(Niobate, Gallate and Aluminate) Alternative Substrates for III-Nitride Epitaxy: New Technology and Devices," International Conference on Alternative Substrate Technologies, Sept. 15-19, 2002, Cancun, Mexico.
18) * **Invited**: W. Alan Doolittle and **G. Namkoong**, "III-Nitride epitaxy on oxide substrates: new understanding and novel device alternatives," 50th anniversary meeting of the American Vacuum Society, Nov. 3, 2003, Baltimore, MD.
19) * **Invited:** W. Alan Doolittle, **G. Namkoong, A. Carver, W. Henderson**, and A. S. Brown, "III-Nitride Alternative Substrates SiC, ZnO and ???: Filling in the ??? with Lithium Oxides: Lithium Gallate, Lithium Aluminate, Lithium Niobate and Lithium Tantalate as Substrates for III-Nitrides," Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), 2002, Austin, Texas.
20) * **Invited: G. Namkoong**, W. Alan Doolittle, **A. Carver, W. Henderson**, D. Jundt, and A. S. Brown, "III-Nitride Growth on a Ferro/Pyro/Piezoelectric/Nonlinear Optical Substrate for Advanced Functionality," Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), 2003, Atlanta, GA.
21) * **Invited:** S. Huang, W. Alan Doolittle, and A. S. Brown, "Asymmetric Strain in III-N Resulting from the Substrate with Direction-Dependent Thermal Expansion Coefficient," Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), 2003, Atlanta, GA.
22) * **Invited**: W. Alan Doolittle, **G. Namkoong, A. Carver, and W. Henderson**, "Crystalline Functional Oxides Integrated with Wide Bandgap Semiconductors via Epitaxy: A Novel Platform for Multifunctional Materials Integration and Devices," Advanced Research Workshop: Future Trends in Microelectronics-4: The Nano, the Giga, the Ultra, and the Bio, June 23-27, 2003, Corsica, France.
23) * **Invited**: W. Alan Doolittle, "Electrostatic Boundary Conditions in Epitaxy: New strength for an old problem," ONR Workshop on Epitaxial Heterogeneous Interfaces – Formation and Stability, May 4-8, 2003, Yosemite, CA.
24) * **Invited**: W. Alan Doolittle, "Process-induced changes in and elimination/creation of SiC surface and bulk defects for $LiNbO_3$ and III-V Nitride Epitaxy," Tri-Services/DARPA Workshop on Process Induced Defects in Wide Gap Semiconductors, Aug. 17-21, 2003, Grants Pass, OR.

25) * **Invited**: W. Alan Doolittle, **E. Trybus, and G. Namkoong**, “Alternative Substrates For InN Epitaxy: Choices to Enable Novel Device Opportunities,” International Indium Nitride Workshop, Nov. 16-20, 2003, Freemantle, Australia.
26) * **Invited**: W. Alan Doolittle, “The Role of Innovative Materials Research in the Wide Bandgap Electronics and Optoelectronics,” University of Alabama Birmingham, School of Physics Colloquium, Sept. 10, 2004.
27) * **Invited**: W. Alan Doolittle, **A. G. Carver, and W. Henderson**, “MBE of Complex Metal-Oxides: Where have we come, where are we going and how are we going to get there?” North American MBE Conference, Oct. 11-14, 2004, Banff, Alberta, Canada.
28) * **Invited**: W. Alan Doolittle, “Heteroepitaxy in the Lithium Oxide (niobate, tantalate, aluminate and gallate)/III-Nitride/SiC Wide Bandgap Family,” ONR Workshop on Frontiers of Epitaxial Engineering, May 2-6, 2004, Sorrel River Ranch, Moab, Utah.
29) * **Invited**: W. Alan Doolittle, “Lithium Niobate and Tantalate - a naturally multifunctional material,” ONR Workshop on International Workshop on Multifunctional Materials II, Oct. 17-21, 2004, Huatulco, Mexico.
30) * **Invited**: W. Alan Doolittle, “Lithium Niobate/Tantalate Epitaxial Integration With Wide Bandgap Semiconductors: Could This Be The Next "Great" Platform For Advanced Optoelectronic Devices?” WOFE-04 (Workshop on Future Electronics), Dec. 18-22, 2004, Aruba.
31) * **Invited:** W. Alan Doolittle, **S. D. Burnham, G. Namkoong, and W. Henderson**, “Mg Doped GaN Using A Valved, Thermally Energetic Source: Enhanced Incorporation, Control and Quantitative Optimization,” Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), Jan. 2004, Pasadena, CA.
32) * **Invited**: W. Alan Doolittle**, E. Trybus, W. Henderson, G. Namkoong, S. Burnham, K. K. Lee**, I. Ferguson, and C. Honsberg, “InN: A Material with Photovoltaic Promise and Challenges,” AFOSR Indium Nitride Workshop 2, Jan. 9-13, 2005, Kailua-Kona, Hawaii.
33) * **Invited**: **W. Henderson, A. Carver**, W. Alan Doolittle, and D. Citrin, “New Device Possibilities for Tunable THz Emitters and Detectors,” Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD) , Miami, FL., Jan. 2005
34) * **Invited**: **A. G. Carver, W. Henderson**, and W. Alan Doolittle, “Lithium Niobate and Related Oxides Using Chlorine Based Chemistries,” Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), Miami FL., Jan. 2005.
35) * **Invited**: S. M. Madison, **W. Henderson**, K. M. Patel, **G. Namkoong, K.-K. Lee**, S. E. Ralph, and W. Alan Doolittle, “III-Nitride HEMTs on LiNbO3 for Integrated Electro-Optic Applications,” Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), Miami FL., Jan. 2005.
36) * **Invited**: **E. Trybus**, W. Alan Doolittle, **W. Henderson, G. Namkoong, S. Burnham, K. Lee**, I. Ferguson, and C. Honsberg “InN: Revolutionary Photovoltaic Material or Just a Revolting Material,” Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), Miami FL., Jan. 2005.
37) * **Invited**: **S. D. Burnham, G. Namkoong**, and W. Alan Doolittle, “New Physical Understanding of the Nature of Sublimed Mg and Mg Doped GaN,” Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), Miami FL., Jan. 2005.

38) * **Invited:** W. Alan Doolittle, **A. Carver, W. Henderson, G. Namkoong**, S. Madison, K. Lee, and S. E. Ralph, "MBE of Complex Metal-Oxides: What is in the toolbox and how can we use these tools to construct devices?", University of Iowa's Workshop on Materials and Devices Incorporating Functional Interfaces, April 11-14, 2005, Palm Springs, CA.
39) * **Invited:** W. Alan Doolittle, **A. Carver, W. Henderson, and W. L. Calley**, "In-situ Flux Measurement of Individual Effusion Cells for Stoichiometry Control of Multifunctional Oxides," West Virginia University Workshop on Multifunctional Material Stoichiometry, Jackson Hole, WY, July 17-21, (2005).
40) * **Invited:** W. Alan Doolittle, **A. G. Carver, W. Henderson**, "Molecular Beam Epitaxy of complex metal-oxides: where have we come, where are we going, and how are we going to get there?," 22nd North American Conference on Molecular Beam Epitaxy (2004).
41) * **Invited: E. Trybus, G.Namkoong, W. Henderson**, W. Alan Doolittle, "Interesting Anomaly in InGaN Growth by Molecular Beam Epitaxy," Workshop on Compound Semiconductor Materials and Devices (WOCSEMADD), Savannah, GA, February, 2007.
42) * **Invited: D. Pritchett, D. Billingsley, W. Henderson**, and W. Alan Doolittle, "Influence of Ultraviolet Photoexcitation on the Growth of InGaN via NH3-based MOMBE", 2007 Workshop on Compound Semiconductor Materials and Devices, February 19, 2007.
43) * **Invited:** W. Alan Doolittle, **M. Moseley, E. Trybus**, "Deeply degenerate p-type GaN grown by metal modulated epitaxy", 2009 International Semiconductor Device Research Symposium (ISDRS 2009), December (2009)
44) * **Invited:** Christiana Honsberg, **M. Moseley**, and W. Alan Doolittle, "Progress and Future Prospects for InGaN Solar Cells", 6th International Workshop on Nitride Semiconductors, Tampa, Florida, USA, September 2010.
45) *** Invited: W. L. Calley, W. Henderson, A. Carver**, and W. Alan Doolittle "New Complementary (n & p-type) Oxide Memristor Technology For Potential Neuromorphic Computing Applications", 2010 Workshop on Compound Semiconductor Materials and Devices, Newport Beach, CA, February 16, 2010.
46) * **Invited: W. Laws Calley, Jordan Greenlee**, and W. Alan Doolittle, "Halide Based MBE of Epitaxial Metals and Epitaxial Oxides", International Symposium on Compound Semiconductors, Berlin, May 22 to 27, (2011)
47) * **Invited:** W. Alan Doolittle , **Chloe A. Fabien, Michael Moseley, Brendan Gunning**, Alec M. Fisher, Yong Wei, Fernando A. Ponce, "New Advances in III-Nitride Optoelectronic Materials", Symposium on Compound Semiconductors, 2013 Materials Research Society Fall Meeting, December 1-6, 2013, Boston, Massachusetts
48) *** Invited: J. D. Greenlee, J. C. Shank, J. L. Compagnoni, B. Tellekamp**, and W. Alan Doolittle. "New Ways to Make a Synthetic Brain: Material Synthesis Pathways Toward Neuromorphic Computing," Workshop on Compound Semiconductor Materials and Devices, New Orleans, LA 2013.
49) *** Invited:** W. Alan Doolittle, **B. Gunning, C. Fabien**, A. Fischer, Y. Wei, and F. Ponce, "New advances in III-Nitride epitaxy", Workshop on Compound Semiconductor Materials and Devices, San Antonio, Texas, USA, Feb. 2014.

50) * **Invited: B. Gunning, C. Fabien, and W. Alan Doolittle**, "Breaching the perceived upper bounds of p-type doping in GaN and InGaN", Workshop on Compound Semiconductor Materials and Devices, San Antonio, Texas, USA, Feb. 2014.
51) * **Invited:** W. Alan Doolittle, **B. Gunning, C. Fabien**, A. Fischer, S. Wang, Y. Wei, and F. Ponce, "Extremely high hole concentrations in III-Nitrides", International Workshop on Nitride Semiconductors, Wrocław, Poland, August 2014
52) * **Invited:** W. Alan Doolittle, "Brains For All: How to compute with new devices", Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD) 2015, Isle of Palms, South Carolina, February 2015
53) * **Invited: B. Gunning, C. Fabien, J. Merola, E. Clinton**, W. Alan Doolittle, A. Fischer, S. Wang, Y. Wei, and F. Ponce, "Electronic and Optical Behavior of Highly p-type GaN and AlGaN, and High Growth Rate GaN by MBE", Workshop on Compound Semiconductor Materials and Devices, Isle of Palms, South Carolina, USA, February 2015.
54) * **Invited:** W. Alan Doolittle, **J. Shank, M. B. Tellekamp, E. Clinton, J. Merola, B. Gunning, C. A. M. Fabien**, A. Fischer and F. Ponce, "An Overview of Materials Innovation Research at Georgia Tech Enabling Oxide Memristors, Neuromorphic Circuitry, and III-Nitride Devices", Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), San Diego, February 3, 2016
55) * **Invited:** W. Alan Doolittle, **E. Clinton, E. Vadiee**, "High Temperature III-Nitride Solar Cells", Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD) 2017, Clearwater FL Feb 20 2017
56) * **Invited:** W. Alan Doolittle, **E. Clinton, E. Vadiee, B. Gunning, C. A. M. Fabien**, A. Fischer and F. Ponce, "The Beauty and New Utility of and Dirty Secrets Behind Plasma Assisted MBE of III-Nitrides", Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD) 2018, Feb 21, 2018
57) * **Invited:** W. Alan Doolittle, **E. Clinton, E. Vadiee, Z. Engle, and C. Matthews**, "MBE of III-Nitrides in an Era Dominated by CVD: Opportunities and Challenges", International Conference on Molecular Beam Epitaxy, Shanghai China, Sept 3 2018
58) * **Invited: E. Clinton, Z. Engel, E. Vadiee**, W. Alan Doolittle, "Synthesis and Performance of AlGaN Tunnel Diodes", Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD) 2019, Jacksonville Beach FL, February 2019
59) * **Invited: E. Clinton, Z. Engel, E. Vadiee**, W. Alan Doolittle, "Synthesis and Performance of AlGaN Tunnel Diodes", Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD) 2019, Jacksonville Beach FL, February 2019
60) * **Invited:** W. Alan Doolittle "III-Nitrides Semiconductor Fundamentals, Opportunities and Challenges", NASA Doolittle Center Innovation Funded Workshop on III-Nitrides JPL June 17 2019
61) * **Invited:** W. Alan Doolittle**, H. Ahmad, Z. Engel, C. M. Matthews, and K. Motoki**, "Chemical and Kinetic Mechanisms to Overcome Perceived Limitations in III-Nitride Epitaxy", 21st International Conference on Molecular Beam Epitaxy, Virtual Conference Sept 6-9, 2021.
62) * **Invited:** W. Alan Doolittle**, H. Ahmad, Z. Engel, C. M. Matthews, and K. Motoki**, "Chemical and Kinetic Mechanisms to Overcome Perceived Limitations in III-Nitride Epitaxy", Symposium EQ13-Nitride Materials—Synthesis, Characterization and Modeling at the Fall 2021 Materials Research Society, Boston, December 1, 2021.
63) * **Invited:** W. Alan Doolittle, **Aheli Ghosh, Bill Zivasatienraj, Alex Weidenbach, Timothy McCrone**, "Realization and Modelling of Li-Intercalation Based Memristive

Devices and Integrated Systems For Neuromorphic Computing", University of Utah Virtual Seminar, Spring 2022

64) * **Invited:** W. Alan Doolittle, **Aheli Ghosh, Bill Zivasatienraj, Alex Weidenbach, Timothy McCrone**, "Lithium Intercalation as a Pathway to Diverse Biomimetic Functionality—Beyond Merely Changing Resistance", MRS 23rd Solid State Ionics (SSI) Conference, Poster Session, Boston, MA, USA, July 17–22, 2022
65) * **Invited:** W. Alan Doolittle, "Creative Epitaxy: Finding Ways to Violate Assumptions that Breach Material Barriers", National Nanotechnology Infrastructure Network (NNIN) Virtual Seminar, January 11, 2022
66) * **Invited:** W. Alan Doolittle, "Creative Epitaxy: Finding Ways to Violate Assumptions that Breach Material Barriers", Kennesaw State University Dean's Seminar, September 14, 2022
67) * **Invited:** W. Alan Doolittle, Habib Ahmad, Christopher M. Matthews, Keisuke Motoki, Zachary Engel, and Sangho Lee, "Substantial p-type, n-type and Homojunction Diode Functionality using the Highest Bandgap Semiconductor Ever Demonstrated ", 3rd International Workshop on Materials Science and Advanced Electronics Created by Singularity (IWSingularity 2022) as a hybrid (Nagoya Congress Center and online), January 12, 2022
68) * **Invited:** W. Alan Doolittle, Habib Ahmad, Christopher M. Matthews, Keisuke Motoki, Zachary Engel, and Sangho Lee, "New Surface Chemistry and Adatom Kinetics Results in Novel Extreme Bandgap Semiconductor Device Opportunities", American Physical Society Meeting, Session S51.00004, March Meeting 2023, Archived in Volume 68, Number 3, Las Vegas, Nevada (March 5-10)
69) * **Invited:** W. Alan Doolittle, Habib Ahmad, Zachary Engel, Christopher M. Matthews, and Sangho Lee, "Realization of Homojunction pn AlN Diodes for Deep UV Optoelectronics", Photonics North 2022, Niagara Falls, Canada, May 26, 2022
70) * **Invited:** W. Alan Doolittle, C. M. Matthews, H. Ahmad, Z. Engel, K. Motoki, S. Lee, "Surface Chemistry and Adatom Kinetics for Hyper Doping and Phase Purity in Nitride Semiconductors," International Workshop on Nitride Semiconductors (IWN) 2022, Berlin, Germany, Oct. 9–14, 2022.
71) * **Invited:** W. Alan Doolittle, Habib Ahmad, Zachary Engel, Christopher M. Matthews, and Sangho Lee, "Semiconducting AlN: Materials and Devices Advances", Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD) 2019, February 21, 2023, San Antonio Tx
72) * **Invited:** W. Alan Doolittle, Habib Ahmad, Christopher M. Matthews, Keisuke Motoki, Zachary Engel, and Sangho Lee, "Semiconducting AlN: A New Pathway to High Voltage, Power and Temperature Extreme Bandgap Power Electronic Components", Les Eastman Conference, Chicago August 9th, 2023
73) * **Invited:** W. Alan Doolittle, Habib Ahmad, Christopher M. Matthews, Keisuke Motoki, Zachary Engel, and Sangho Lee, "Semiconducting AlN: A New Pathway to High Voltage, Power and Temperature Extreme Bandgap Power Electronic Components", Georgia Tech Research Institute Seminar, Sept 5th 2023
74) * **Invited:** W. Alan Doolittle, Habib Ahmad, Christopher M. Matthews, Keisuke Motoki, Zachary Engel, and Sangho Lee, "Challenges and Approaches for p-type and n-type Doping of AlN", DARPA Ultra-Wide Band Gap (UWBG) Industry Day, October 5th, 2023
75) * **Invited:** W. Alan Doolittle, Habib Ahmad, Christopher M. Matthews, Keisuke Motoki, Zachary Engel, and Sangho Lee, "Semiconducting AlN: A New Pathway to

High Voltage, Power and Temperature Extreme Bandgap Power Electronic Components", Case Western University Seminar, October 9th 2023

76) * **Invited:** W. Alan Doolittle, Habib Ahmad, Christopher M. Matthews, Keisuke Motoki, Zachary Engel, and Sangho Lee, "Semiconducting AlN Electrical Devices", International Conference on Nitride Semiconductors 14, Fukuoka Japan, November 13th, 2023
77) * **Invited:** W. Alan Doolittle, Habib Ahmad, Christopher M. Matthews, Keisuke Motoki, Zachary Engel, Sangho Lee and Samuel Graham, "MRS Fall Meeting, November 27, 2023", Materials Research Society Fall Meeting, November 27, 2023
78) * **Invited:** W. Alan Doolittle, "Quest for the Ideal Epitaxy Materials Discovery Tool", DARPA MTO Killing Giants Workshop, Washington DC, July 20, 2023.

D3. CONFERENCE AND WORKSHOP PRESENTATIONS

1) * W. Alan Doolittle, S. Kang, T. Kropewnicki, K. Lee, S. Stock, P. Kohl, G. May, and A. S. Brown, "High Quality GaN on $LiGaO_2$," 40th Electronic Materials Conference, 1998, Charlottesville, VA.
2) * A. S. Brown and W. Alan Doolittle, "Status of Compliant Substrates," Advanced Heterostructures Workshop 98, Dec. 1998, Hawaii.
3) * W. Alan Doolittle and A. S. Brown, "Comparison of AlGaN and GaN Grown on Various Substrates: Benefits and Limitations of Growth on LGO at Low Substrate Temperature," First GaN Electronic Device Workshop, Aug. 1999, Cornell University, Ithaca, NY.
4) * S. Kang, W. Alan Doolittle, S. R. Stock, A. S. Brown, Z. R. Dai, and Z. L. Wang, "Characterization of AlGaN/GaN Heterojunctions Grown by MBE," 42nd Electronic Materials Conference, 2000, Denver, CO.
5) * **G. Namkoong**, W. Alan Doolittle, S.R. Stock, and A. S. Brown, "Growth, Characterization and Optimization of Magnesium Doped GaN," 42nd Electronic Materials Conference, 2000, Denver, CO.
6) * M. Losurdo, P. Capezzuto, G. Bruno, **G. Namkoong**, W. Alan Doolittle, and A. S. Brown, "The Chemistry of Sapphire Nitridation in Relation to the GaN Structural Quality- Why Low Temperature 200°C Nitridation," The Fourth International Conference on III-Nitride Semiconductors, July 16-20, 2001, Denver, CO.
7) * W. Alan Doolittle, A. S. Brown, S. Kang, S. W. Seo, S. Huang, and N. M. Jokerst, "Recent Advances in III-Nitride Devices Grown on Lithium Gallate," The Fourth International Conference on III-Nitride Semiconductors, July 16-20, 2001, Denver, CO.
8) * M. Losurdo, P. Capezzuto, G. Bruno, **G. Namkoong**, W. Alan Doolittle, and A. S. Brown, "Plasma for the low-temperature growth of high-quality GaN films by MBE and remote plasma MOCVD," International Workshop on the Physics of Light-Matter Coupling in Nitrides (PLMCN-1), Sept. 2001, Rome, Italy.
9) * **G. Namkoong**, W. Alan Doolittle, and A. S. Brown, "InN nanowires grown by Molecular Beam Epitaxy," The Second Georgia Tech Conference on Nanoscience and Nanotechnology, Sept. 2001, Georgia Tech, Atlanta, GA.
10) * A. S. Brown, N. M. Jokerst, W. Alan Doolittle, M. Brooke, T. F. Kuech, S.W. Seo, S. Kang, S. Huang, and J.J. Shen, "Heterogeneous Integration: From Substrate Technology to Active Packaging," International Electron Device Meeting, Dec. 2001, Washington, DC.

11) **G. Namkoong**, W. Alan Doolittle, A. S. Brown, M. Losurdo, P. Capezzuto, and G. Bruno, "The Role of Low Temperature (200 °C) Nitridation in the Growth of GaN by Plasma-Assisted Molecular Beam Epitaxy," 20th North American Conference on Molecular Beam Epitaxy, Oct. 2001, Providence, RI.
12) * W. Alan Doolittle, **A. Carver, G. Namkoong**, and A. S. Brown, "Challenges and Potential Payoff for Crystalline Oxides in Wide Bandgap Semiconductor Technology," International Workshop on Oxide Electronics, Oct. 20-23, 2002, St. Petersburg, FL.
13) * W. Alan Doolittle, **G. Namkoong, A. Carver, W. Henderson**, and A. S. Brown, "III-Nitride Growth on Lithium Niobate: A new substrate material for Polarity Engineering in III-Nitride Heteroepitaxy," Materials Research Society Fall Meeting, Dec. 2-6 2002, Boston, MA.
14) * **G. Namkoong**, W. Alan Doolittle, A. S. Brown, M. Losurdo, M. M. Giangregorio, and G. Bruno, "Characteristics of GaN Epitaxial Layers Grown on GaN and AlN Buffers by RF Molecular Beam Epitaxy," 44th Electronic Materials Conference, June 2002, Santa Barbara, CA.
15) * M. Losurdo, M. M. Giangregorio, P. Capezzuto, and G. Bruno, **G. Namkoong**, W. Alan Doolittle, and A. S. Brown, "Determination of GaN polarity by interaction with H2 remote plasmas," 44th Electronic Materials Conference, June 2002, Santa Barbara, CA.
16) * **G. Namkoong**, W. Alan Doolittle, **A. Carver, W. Henderson**, D. Jundt, and A. S. Brown, "III-Nitride Growth on Lithium Niobate: Polarity Control by Electrostatic Boundary Condition," 45th Electronic Materials Conference, June 2003, Salt Lake, UT.
17) * M. Losurdo, G. Bruno, A. S. Brown, S. Kang, T. Kim, and W. Alan Doolittle, "The Chemistry and Kinetics of $LiGaO_2$ Substrate Nitridation for the Optimization of GaN Epitaxial Growth," 45th Electronic Materials Conference, June 2003, Salt Lake, UT.
18) * S. Huang, S. Kang, W. Alan Doolittle, A. S. Brown, "Asymmetric Strain in III-N Resulting from the Substrate with Direction-Dependent Thermal Expansion Coefficients," 45th Electronic Materials Conference, June 2003, Salt Lake, UT.
19) * M.C. Cheung, **G. Namkoong**, F. Chen, M. Furis, H. E. Pudavar, A. N. Cartwright, and W. Alan Doolittle, "Photoluminescence Study of MBE Grown InGaN with Intentional Indium Segregation," International Workshop on Nitride Semiconductors, Pittsburgh, PA, July 19-23 2004.
20) *** S. Burnham, G. Namkoong**, and W. Alan Doolittle, "Mg Doped GaN using a thermally energetic source: Enhanced incorporation, control and quantitative optimization," Materials Research Society Fall Meeting, Dec. 1-5, 2003, Y8.11, Boston, MA.
21) *** A. Carver, W. Henderson**, and W. Alan Doolittle, "Novel chlorine based chemistry for growth of ferroelectric materials by molecular beam epitaxy," Materials Research Society Fall Meeting, Boston, MA, C3.28, Dec. 1-5 (2003).
22) * **K.-K. Lee, G. Namkoong**, S. M. Madison, **W. Henderson**, S. E. Ralph, and W. Alan Doolittle, "Prospects for, problems with and practical implementation strategies for heteroepitaxy integrated electronics-optoelectronics utilizing the III-nitride /lithium niobate material system," IEEE Lester Eastman Conference on High-Performance Devices, Troy, NY, Aug. 4-6, 2004.

23) * **K.-K. Lee, G. Namkoong, W. Henderson**, and W. Alan Doolittle, "III-Nitrides on Ferroelectric Lithium Niobate: Impact of the Electrostatic Boundary Condition," American Physical Society (APS) Meeting, Los Angeles, CA, March 2005.
24) * **D. C. Pritchett, S. Burnham, W. Henderson**, and W. Alan Doolittle, "Metalorganic Molecular Beam Epitaxy (MOMBE) of GaN: Towards an Understanding of Surface Reaction Chemistry" 47th Electronic Materials Conference, June 22-24, 2005, Santa Barbara, CA.
25) * S. M. Madison, **W. Henderson, G. Namkoong, K.-K. Lee**, K. M. Patel, W. Alan Doolittle, and S. E. Ralph, "Monolithic Integration of Electronic and Electro-Optical Devices Exploiting the AlGaN/GaN-$LiNbO_3$ Material System," Presented at CLEO/QELS Annual Meeting, May 2005.
26) * **G. Namkoong, K.-K. Lee**, S. M. Madison, S. E. Ralph, W. Alan Doolittle, M. Losurdo, G. Bruno, and D. Jundit, "Crystalline stability of congruent and Li-rich lithium niobate for III-nitride optoelectronic-acoustic-electronic applications," presented at 23rd North American Conference on Molecular Beam Epitaxy, Santa Barbara, CA, Sept. 11th-14th, 2005.
27) * **D. Pritchett, W. Henderson, S. D. Burnham**, W. Alan Doolittle, "Influence of Intense Ultraviolet Photoexcitation on Surface Reactions during Gallium Nitride Growth via Metal Organic Molecular Beam Epitaxy," 33rd Physics and Chemistry of Semiconductor Interfaces Conference, January 17, 2006.
28) * **E. Trybus, G. Namkoong, W. Henderson, A. Carver**, W. Alan Doolittle, and H. J. Lee, "High-Energy Electron Beam Interactions with Indium Nitride During Growth via MBE," 33rd Conference on the Physics and Chemistry of Semiconductor Interfaces, Cocoa Beach, FL, February, 2006.
29) * **K.-K. Lee, G. Namkoong**, W. Alan Doolittle, M. Losurdo, and G. Bruno, "III-nitride growth and characteristics on ferroelectric materials using plasma-assisted MBE, presented at 33rd Conference on the Physics and Chemistry of Semiconductor Interfaces, Cocoa Beach, FL, 2006.
30) * **D. Billingsley, D. Pritchett, W. Henderson, E. Trybus, K.K. Lee**, and W. Alan Doolittle, "Influence of Surface Nitridation on Gallium Nitride Grown via Ammonia based Metal Organic Molecular Beam Epitaxy," 2006 North American Molecular Beam Epitaxy Conference, October 9, 2006.
31) * **D. Billingsley, D. Pritchett, W. Henderson, E. Trybus, K. K. Lee**, W. Alan Doolittle, "Influence of Surface Nitridation on Gallium Nitride Grown via Ammonia based Metal Organic Molecular Beam Epitaxy, " 24th North American Conference on Molecular Beam Epitaxy, Durham, NC, October, 2006.
32) * **S. D. Burnham, G. Namkoong, K.-K. Lee**, and W. Alan Doolittle, "Reproducible RHEED signatures for in situ growth regime characterization of AlN," presented at 24th North American Conference on Molecular Beam Epitaxy, Durham, NC, 2006.
33) * **E. Trybus**, O. Jani, **S. Burnham**, J. Bai, D. Citrin, I. Ferguson, C. Honsberg, M. Steiner, and W. Alan Doolittle, "Characteristics of InGaN Designed for Photovoltaic Applications", 7th International Conference of Nitride Semiconductors, Las Vegas, NV, September, 2007.
34) * **D. Pritchett, W. Henderson, D. Billingsley**, W. Alan Doolittle, "InGaN Compositional Control by Ultraviolet Photoexcitation during NH3-based MOMBE - A Pathway to 3D Epitaxy", 7th International Conference of Nitride Semiconductors, September 18, 2007.

35) * **D. Billingsley, D. Pritchett, S. D. Burnham, W. Henderson**, W. Alan Doolittle, "Investigation into the Use of Molecular Hydrogen on the Growth of Gallium Nitride via Metal-Organic Molecular Beam Epitaxy", 7th International Conference of Nitride Semiconductors, September 18, 2007.
36) * **K.-K. Lee, G. Namkoong**, W. Alan Doolittle, M. Losurdo, G. Bruno, and H. K. Choi, "Interface Property Study of III-Nitrides on Lithium-Niobate to Improve the Device Performance of Optoelectronic-Acoustic-Electronic Applications", 7th International Conference of Nitride Semiconductor, Las Vegas, NV, 2007.
37) * **E. Trybus, S. Burnham, G. Namkoong**, D. C. Look, **D. Billingsley, M. Moseley, W. Henderson,** and W. Alan Doolittle, "Systematic Study of High Hole Concentration, Low Temperature Grown GaN Approaching the Compensated Region," 50th Electronic Materials Conference, Santa Barbara, CA, June 2008.
38) * **E. Trybus**, W. Alan Doolittle, **M. Moseley, W. Henderson, D. Billingsley, G. Namkoong**, and D. C. Look, "Extremely High Hole Concentrations in c-Plane GaN," 7th International Workshop on Nitride Semiconductors, Montreux Switzerland, October 6-10, 2008.
39) * **D. Billingsley, W. Henderson**, and W. Alan Doolittle, "Study of Growth Kinetics and Characterization of AlxGa1-xN Grown by Ammonia-Based Metal-Organic Molecular Beam Epitaxy", 51st Electronic Materials Conference, June 24-26, 2009.
40) * **E. Trybus, W. Henderson, M. Moseley, G. Namkoong**, D. Look, J. Freitas, and W. Alan Doolittle, "Analysis of Degenerate p-type GaN by Metal-Modulated Epitaxy", 51st Electronic Materials Conference, University Park, PA, June 2009.
41) * **E. Trybus, W. Henderson, M.l Moseley, G. Namkoong**, David Look, Jaime Freitas, and W. Alan Doolittle, "Analysis of Degenerate p-type GaN by Metal-Modulated Epitaxy," 51st Electronic Materials Conference, University Park, PA, June 2009.
42) * **M. Moseley, E. Trybus, D. Billingsley, W. Henderson, G. Namkoong**, D. Look, and W. Alan Doolittle, "Deeply Degenerate p-GaN Grown by Metal-Modulated Epitaxy", 26th North American Molecular Beam Epitaxy Conference, Princeton, VA, August 2009. – Won Best student Presentation Award
43) * W. Alan Doolittle, **M. Moseley, E. Trybus, D. Billingsley, W. Henderson**, David Look, M. E. Zvanut, and J. Dashdorj, "Deeply Degenerate p-GaN Grown by Metal-Modulated Epitaxy," 8th International Conference on Nitride Semiconductors, Jeju, Korea, October 2009.
44) * J. A. Freitas Jr., D. Look, P. Klein, **M. Moseley, E. Trybus, W. Henderson**, and W. Alan Doolittle, "Compensation and Activation Mechanism in Metal Modulated Epitaxy p-GaN," 8th International Conference on Nitride Semiconductors, Jeju, Korea, October 2009.
45) * J. A. Freitas Jr., D. Look, P. Klein, **M. Moseley, E. Trybus, W. Henderson**, and W. Alan Doolittle, "Compensation and Activation Mechanism in Metal Modulated Epitaxy p-GaN," 8th International Conference on Nitride Semiconductors, Jeju, Korea, October 2009.
46) * W. Alan Doolittle, **M. Moseley, E. Trybus, D. Billingsley, W. Henderson**, David Look, M. E. Zvanut, and J. Dashdorj, "Deeply Degenerate p-GaN Grown by Metal-Modulated Epitaxy," 8th International Conference on Nitride Semiconductors, Jeju, Korea, October 2009.
47) * W. Alan Doolittle, **W. L. Calley, W. Henderson**, "Complementary oxide memristor technology facilitating both inhibitory and excitatory synapses for

potential neuromorphic computing applications", 2009 International Semiconductor Device Research Symposium (ISDRS 2009), University of Maryland, December 2009.

48) * W. Alan Doolittle, **M. Moseley, and E. Trybus**, "Deeply-degenerate p-type GaN grown by metal modulated epitaxy," International Semiconductor Device Research Symposium 2009, College Park, Maryland, USA, December 2009.

49) *** J. Lowder, M. Moseley, E. Trybus, D. Billingsley, W. Henderson, G. Namkoong**, D. Look, and W. Alan Doolittle, "Deeply Degenerate p-GaN with Hole Concentrations Exceeding 7×10^{19} cm^{-3} Grown by Metal-Modulated Epitaxy", 6th International Workshop on Nitride Semiconductors, Tampa, Florida USA, September 19-24, 2010

50) *** M. Moseley, J. Lowder, D. Billingsley, G. Namkoong** and W. Alan Doolittle, "Control of Adlayer Kinetics for the Growth of High Quality InGaN Throughout the Miscibility Gap", 6th International Workshop on Nitride Semiconductors, Tampa, Florida USA, September 19-24, 2010

51) * M. E. Zvanut, J. Dashdorj, **M. Moseley**, and W. Alan Doolittle, "The Local Environment of the Mg Impurity in High Hole Density p-type GaN:Mg", 6th International Workshop on Nitride Semiconductors, Tampa, Florida, USA, September 2010.

52) *** M. Moseley, J. Lowder, D. Billingsley, G. Namkoong** and W. Alan Doolittle, "Control of Adlayer Kinetics for the Growth of High Quality InGaN Throughout the Miscibility Gap", 27th North American Molecular Beam Epitaxy Conference, Breckenridge Colorado, Sept. 26-29th 2010 - Won Best student Presentation Award

53) *** W. L. Calley**, P. Staib, **J. Lowder, W. Henderson**, and W. Alan Doolittle, "An Auger Electron Analyzer System for In Situ MBE Stoichiometry Control", 27th North American Molecular Beam Epitaxy Conference, Breckenridge Colorado, Sept. 26-29th 2010

54) *** W. L. Calley, J. Greenlee, W. Henderson**, W. Alan Doolittle, "Advances in Metal-Halide MBE Thin Film Growth", 27th North American Molecular Beam Epitaxy Conference, Breckenridge Colorado, Sept. 26-29th 2010

55) *** J. Greenlee, W. L. Calley**, and W. Alan Doolittle, "MBE Growth of Metal Oxides for Complementary Memristive Applications", 27th North American Molecular Beam Epitaxy Conference, Breckenridge Colorado, Sept. 26-29th 2010 – Won Best Student Abstract Award

56) * W. Alan Doolittle, "InGaN Solar – Role for MBE in Photovoltaics?", 27th North American Molecular Beam Epitaxy Conference, Breckenridge Colorado, Sept. 26-29th 2010

57) * C. Honsberg, **M. Moseley**, and W. Alan Doolittle, "Progress and Future Prospects for InGaN Solar Cells," 6th International Workshop on Nitride Semiconductors, Tampa, Florida, USA, September 2010.

58) *** W. L. Calley**, P. Staib**, J. D. Greenlee, W. Henderson**, and W. Alan Doolittle. "An Auger Electron Analyzer System for In-situ MBE Stoichiometry Control," 27th North American Molecular Beam Epitaxy Conference, Breckenridge, CO 2010.

59) *** M. Moseley, J. Lowder, B. Gunning, E. Trybus, D. Billingsley, W. Henderson, G. Namkoong**, W. Alan Doolittle, "Deeply Degenerate p-type Doping in III-Nitrides: Critical Milestones Achieved for High Power Electronics," Poster presented at Air Force Office of Scientific Research Joint Electronics Program Review, Arlington, VA, USA, May 2011.

60) * **M. Moseley, J. Lowder, B. Gunning, D. Billingsley, G. Namkoong**, W. Alan Doolittle, “Observation and Elimination of Indium Surface Segregation,” Presented at Electronic Materials Conference 2011, Santa Barbara, CA, USA, June 2011.
61) * **B. Gunning, M. Moseley, J. Lowder**, W. Alan Doolittle, J. Wierer, S. Lee, D. Koleske, and Q. Li, “InGaN/GaN p-i-n solar cells grown by metal-modulated epitaxy,” Poster presented at 9th International Conference on Nitride Semiconductors, Glasgow, Scotland, UK, July 2011.
62) * **M. Moseley, B. Gunning, J. Lowder**, W. Alan Doolittle, “Elimination of Indium Surface Segregation in InGaN Grown Throughout the Miscibility Gap,” Presented at 9th International Conference on Nitride Semiconductors, Glasgow, Scotland, UK, July 2011.
63) * **J. Lowder, M. Moseley, B. Gunning**, W. Alan Doolittle, M. E. Zvanut, J. Dashdorj, “Characterization of Mg Acceptors in GaN:Mg grown by Metal Modulated Epitaxy and MOCVD,” Presented at 9th International Conference on Nitride Semiconductors, Glasgow, Scotland, UK, July 2011.
64) * **B. Gunning, M. Moseley, J. Lowder**, W. Alan Doolittle, J. Wierer, S. Lee, D. Koleske, and Q. Li, “Metal-modulated epitaxy growth of InGaN/GaN p-i-n solar cells,” Presented at American Vacuum Society 58th International Symposium & Exhibition, Nashville, TN, USA, October 2011.
65) * **M. Moseley, J. Lowder, B. Gunning**, M. E. Zvanut, J. Dashdorj, W. Alan Doolittle, “Characterization of Mg Acceptors in GaN:Mg Grown by Metal Modulated Epitaxy and MOCVD,” Presented at American Vacuum Society 58th International Symposium and Exhibition, Nashville, TN, USA, October 2011.
66) * **M. Moseley, B. Gunning, J. Lowder, G. Namkoong**, W. Alan Doolittle, “Elimination of Indium Surface Segregation in InGaN Grown Throughout the Miscibility Gap,” Presented at American Vacuum Society 58th International Symposium and Exhibition, Nashville, TN, USA, October 2011.
67) * **W. Laws Calley**, P. G. Staib, Jonathan Lowder, **Jordan Greenlee, Michael Moseley, Walter Henderson**, W. Alan Doolittle, “An Auger Electron Analyzer System for In Situ MBE Growth Monitoring” American Vacuum Society 58th International Symposium and Exhibition, Nashville, Tennessee, USA, October 2011.
68) * F. Zaman, M. Rubio-Roy, **M. Moseley, J. Lowder**, W. Alan Doolittle, C. Berger, R. Dong, J. Meindl, W. de Heer, “Selective Epitaxial Graphene Growth on SiC via AlN Capping,” APS March Meeting 2011, Dallas, Texas, USA, March 2011.
69) * M. E. Zvanut, Y. Uprety, J. Dashdorj, **M. Moseley**, W. Alan Doolittle, “Hydrogen incorporation in high hole density GaN:Mg,” APS March Meeting 2011, Dallas, Texas, USA, March 2011.
70) * **J. D. Greenlee, W. L. Calley**, C. F. Petersburg, C. Jaye, D. A. Fischer, F. M. Alamgir, and W. Alan Doolittle. “Advances in the Growth of Metal Oxides for Neuromorphic Computing Applications,” AVS 58th International Symposium and Exhibition, Nashville, TN 2011.
71) * **W. L. Calley, J. D. Greenlee, W. Henderson**, W. Alan Doolittle. “Halide Based MBE of Epitaxial Metals and Epitaxial Oxides,” 38th International Symposium on Compound Semiconductors, Berlin, Germany 2011.
72) * **W. L. Calley**, P. Staib, **W. Henderson, J. Greenlee**, and W. Alan Doolittle. “An In situ Auger Electron Analyzer System for Harsh Environment MBE,” 29th North American Molecular Beam Epitaxy Conference, Atlanta, GA 2012.

73) * **J.C. Shank, J.D. Greenlee, J.L. Compagnoni**, and W.A. Doolittle. "Neuromorphic Computing Applications of $LiNbO_2$ Grown by Molecular Beam Epitaxy," 29th North American Molecular Beam Epitaxy Conference, Atlanta, GA 2012.
74) * **J. L. Compagnoni, W. Laws Calley, J.D. Greenlee, J.C. Shank**, and W.A. Doolittle. "Molecular Beam Epitaxy of Complex Transition-Metal Oxides by a Versatile Metal-Chloride Growth Chemistry," 29th North American Molecular Beam Epitaxy Conference, Atlanta, GA 2012.
75) * **C. A. M. Fabien, M. Moseley, B. Gunning**, W. Alan Doolittle, A. M. Fisher, Y. Wei, F. A. Ponce, "Characterization of MBE-Grown, Low Threading-Dislocation Density, High-Indium InGaN without Phase Separation," 29th North American Molecular Beam Epitaxy Conference, Stone Mountain Park, GA, USA, Oct. 2012.
76) * **J. D. Greenlee, W. L. Calley, J. L. Compagnoni, J. C. Shank**, and W. Alan Doolittle. "MBE-Grown Analog Memristor Characterization by Electrochemical Impedance Spectroscopy," 29th North American Molecular Beam Epitaxy Conference, Atlanta, GA 2012.
77) * **B. Gunning, M. Moseley**, and W. Alan Doolittle, "Impurity Band Conduction in Highly p-type GaN and InGaN", 29th North American Molecular Beam Epitaxy Conference, Atlanta, Georgia, USA, October 2012.
78) * **J. D. Greenlee, J. C. Shank, J. L. Compagnoni, B. Tellekamp**, E. Zhang, J. Bi, M. L. Alles, R. D. Schrimpf, and W. Alan Doolittle. "Radiation Effects on Lithium Metal Oxide Analog Memristors for Neuromorphic Computing," GOMACTech 13, Las Vegas, NV 2013.
79) * **J. D. Greenlee, J. C. Shank, M. B. Tellekamp**, E. Zhang, J. Bi, D. M. Fleetwood, M. L. Alles, R. D. Schrimpf, and W. Alan Doolittle, "Radiation Effects on LiNbO2 Memristors for Neuromorphic Computing Applications," NSREC 2013, San Francisco, CA 2013.
80) * **C. A. M. Fabien, B. Gunning, M. Moseley**, W. Alan Doolittle, A. M. Fischer, Y. Wei and F. A. Ponce, "Advances in Nitride Growth Technology for InGaN-Based Solar Cells," 10th International Conference on Nitride Semiconductors, Washington, D.C., USA, Aug. 2013.
81) * **B. Gunning, J. Lowder, M. Moseley, C. Fabien, G. Namkoong**, W. Alan Doolittle, "Optimization of Growth and Electrical Transport Properties of Highly p-type GaN and InGaN", 10th International Conference on Nitride Semiconductors, Washington, D.C., USA, Aug. 2013.
82) * F. A. Ponce, A. M. Fischer, Y. Wei, **M. Moseley, B. Gunning** and W. Alan Doolittle, "High-Indium-Content InGaN Layers with Uniform Composition, Full Misfit-Strain Relaxation, and High Light-Emission Efficiency," 10th International Conference on Nitride Semiconductors, Washington, D.C., USA, Aug. 2013.
83) * W. Alan Doolittle, **B. Gunning, C. A. M. Fabien, M. Moseley**, "Growth methodologies for overcoming the perceived limitations of phase separation and p-type doping in InGaN," 17th International Conference on Crystal Growth and Epitaxy, Warsaw, Poland, Aug. 2013.
84) * **C. A. M. Fabien, M. Moseley, B. Gunning**, W. Alan Doolittle, "Simulations, Practical Limitations, and Novel Growth Technologies for InGaN-based Solar Cells," 39th IEEE Photovoltaic Specialists Conference, Tampa, FL, USA, June 2013.
85) * W. Alan Doolittle, **B. Gunning, C. A. M. Fabien, M. Moseley**, "Growth Methodologies for Overcoming the Challenges of Phase Separation and p-type

Doping in InGaN," Collaborative Conference on Crystal Growth, Cancun, Mexico, June 2013.

86) * W. Alan Doolittle , **Chloe A. Fabien, Michael Moseley, Brendan Gunning**, Alec M. Fisher, Yong Wei, Fernando A. Ponce, "MBE Growth Methodologies for Overcoming the Perceived Limitations of Phase Separation and p-type Doping in InGaN," 30th North American Molecular Beam Epitaxy Conference, Banff, CA, Oct. 2013.

87) * **J. C. Shank, J. D. Greenlee, M. B. Tellekamp**, W. Alan Doolittle, "Building a Brain without Transistors", WOCSEMMAD 2014, San Antonio, TX Feb. 2014.

88) * **C. Fabien, B. Gunning, M. Moseley**, W. Alan Doolittle, A. Fischer, Y. Wei, and F. Ponce, "Prospects of InGaN-Based Solar Cells by Metal-Modulated Epitaxy", 5th International Symposium on Growth of III-Nitrides, Atlanta, Georgia, USA, May 2014.

89) * **B. Gunning, C. Fabien, J. Merola, E. Clinton**, and W. Alan Doolittle, "Highly Conductive P-Type GaN and AlGaN Using Both Bulk and 2-Dimensional Heavily Mg-Doped Layers", 5th International Symposium on Growth of III-Nitrides, Atlanta, Georgia, USA, May 2014.

90) * **C. Fabien, B. Gunning, M. Moseley**, W. Alan Doolittle, A. Fischer, Y. Wei, and F. Ponce, "Comparison of N-rich and MME-grown InGaN Throughout the Miscibility Gap", 18th International Conference on Molecular Beam Epitaxy, Flagstaff, Arizona, USA, September 2014.

91) * **B. Gunning, C. Fabien, J. Merola, E. Clinton**, W. Alan Doolittle, A. Fischer, S. Wang, Y. Wei, and F. Ponce, "Highly Conductive P-type III-Nitrides Using Both Bulk and 2-Dimensional Heavily Mg-doped Layers", 18th International Conference on Molecular Beam Epitaxy, Flagstaff, Arizona, USA, September 2014.

92) * **M. B. Tellekamp, J. D. Greenlee, J. C. Shank**, W. Alan Doolittle, "New Equipment for Oxide Epitaxy: A Solid State Oxygen Source and Stable Two Zone Effusion Cell," ICMBE 2014, Flagstaff, AZ 2014.

93) * **M. B. Tellekamp, J. D. Greenlee, J. C. Shank**, W. Alan Doolittle, "MBE Oxide Growth Rate Limitations Quantified by in situ Auger Electron Spectroscopy," ICMBE 2014, Flagstaff, AZ 2014.

94) * **B. Gunning, C. Fabien, J. Merola, E. Clinton**, and W. Alan Doolittle, "III-Nitride Optoelectronic Devices Using Highly Mg-doped p-type Layers Grown by Metal-Modulated Epitaxy", 18th International Conference on Molecular Beam Epitaxy, Flagstaff, Arizona, USA, September 2014.

95) * **J. C. Shank, M. B. Tellekamp, J. D. Greenlee**, W. Alan Doolittle, "Evidence of Optically-Induced Band Structure Modifications in Lithium Niobite", EMC 2014, Santa Barbara, CA 2014.

96) * **J. C. Shank, M. B. Tellekamp**, W. Alan Doolittle, "New Pathways to Multi-functionality: Ionic Intercalation into Metal Oxides", International Workshop on Oxide Electronics 2014, Bolton Landing, New York 2014.

97) * T. Smyth, H. Xia, Y. Feng, M. Dvorak, M. Tayebjee, S. Shrestha, S. Bremner, S. Huang, G.J. Conibeer, S. Yagi, **C. A. M. Fabien, B. Gunning**, W.A. Doolittle, C. Tessarek, M. Latzel, T.W. Schmidt, and M. Sugiyama, "Hot Carrier Relaxation and Phonon Dispersion in III-V Alloys," 29th European Photovoltaic Solar Energy Conference and Exhibition, Amsterdam, the Netherlands, Sept. 2014.

98) * **C. M. Matthews, E. Clinton**, W. Alan Doolittle, "Conduction in GaN-Si Heterojunctions", Jacksonville Beach FL, February, 2019

99) ***B. Zivasatienraj**, **A. S. Weidenbach**, and W. Alan Doolittle, "Understanding Intercalation Enabling Device Structures Resulting in Non-Volatile Behavior of Lithium Niobite Memristors", The 60th Electronic Materials Conference 2018 (EMC 2018), Santa Barbara, CA, June 27-29, 2018

100) ***J. C. Shank**, **M. B. Tellekamp**, M. J. Wahila, S. Howard, **A. S. Weidenbach**, **B. Zivasatienraj**, L. F. J. Piper, and W. Alan Doolittle, "Correlation of Oxygen Vacancies to Niobium Pentoxide Memdiode Electrical Responses", The 60th Electronic Materials Conference 2018 (EMC 2018), Santa Barbara, CA, June 27-29, 2018

101) ***B. Zivasatienraj**, **A. S. Weidenbach**, **A. Ghosh**, **T. McCrone**, and W. Alan Doolittle, "Scalability of Non-Volatile Lithium Niobite Memristors: Potential for millivolt Operation of Neuromorphic Devices", The 61st Electronic Materials Conference 2019 (EMC 2019), Ann Arbor, MI, June 26-28, 2019

102) ***A. Ghosh**, **B. Zivasatienraj**, **A. Weidenbach**, **T. McCrone**, W. Alan Doolittle; "Impact of Alloying Contact Metal on Non-Volatile performance of Lithium Niobite Memristors for Neuromorphic Computing", The 61st Electronics Materials Conference (EMC 2019), Ann Arbor Michigan, June 26-28, 2019.

103) * **Z. Engel, E. Clinton, C. Matthews**, W. Alan Doolittle, "Demonstration of High Quality Aluminum Indium Nitride with High Indium Content Grown via Metal Modulated Epitaxy", The 61st Electronics Materials Conference (EMC 2019), Ann Arbor Michigan, June 26-28, 2019.

104) * **Z. Engel, E. Clinton, C. Matthews**, W. Alan Doolittle, "Demonstration of High-Quality Aluminum Indium Nitride Grown Via Metal Modulated Epitaxy and Application Towards Polar/Non-Polar Optical Devices", The International Conference on Nitride Semiconductors 2019, Bellevue Washington, July 7-13 2019

105) * **Z. Engel, E. Clinton, C. Matthews**, W. Alan Doolittle, "Advancements in High Indium Content AlInN Grown Via Metal Modulated Epitaxy and Application Towards Polar/Non-Polar Optical Devices", The North American Molecular Beam Epitaxy Conference (NAMBE) 2019, Ketchum Idaho, September 22-25, 2019

106) * **H. Ahmad , E. A Clinton , C. M. Matthews , Z. Engel**, W. Alan Doolittle, "Dramatic Improvement in the Surface Quality of High Temperature Annealed c-plane (0001) Sapphire Substrates and its Impact on the Quality of AlN Films from 1 nm to 2 µm," The International Conference on Nitride Semiconductors 2019, Bellevue Washington, July 7-13 2019

107) Yee Rui Koh, J. T. Gaskins, J. L. Braun, **H. Ahmad**, J. Tomko, W. Alan Doolittle, and Patrick E. Hopkins, "Size effects of the AlN on the Thermal Transport across Metal/semiconductor Interface," The International Conference on Nitride Semiconductors 2019, Bellevue Washington, July 7-13 2019

108) * **C. M. Matthews, E. Clinton, Z. Engel, H. Ahmad, K. Motoki**, W. Alan Doolittle, "Rectification in Vertically Conducting Power GaN-on-Si Heterojunctions", The 61st Electronics Materials Conference (EMC 2019), Ann Arbor Michigan, June 26-28, 2019.

109) * **T. McCrone, A. Ghosh, B. Zivasatienraj, A. Weidenbach**, W. Alan Doolittle "High Quality Lithium Niobite grown by Liquid Phase Electroepitaxy for use as a

Memristor." The 61st Electronics Materials Conference (EMC 2019), Ann Arbor Michigan, June 26-28, 2019.

110) * **C. M. Matthews, E. Clinton, Z. Engel, H. Ahmad, K. Motoki**, "Electrical Characterization of Vertically Conducting GaN-on-Si Heterojunctions", The International Conference on Nitride Semiconductors 2019, Bellevue Washington, July 7-13 2019

111) **E. A. Clinton, E. Vadiee, B. Tellekamp, Z. E. Engel, C. M. Matthews**, and W. Alan Doolittle, "Engineering the Nitrogen Plasma to Reduce Defects in InN Resulting in a 0.12 eV Moss-Burstein Shift Towards the Fundamental Bandgap," 13th International Conference on Nitride Semiconductors, Bellevue, Washington, USA, July 2019.

112) **E. A. Clinton, E. Vadiee, Z. E. Engel, C. M. Matthews**, and W. Alan Doolittle, "First Demonstration of Negative Differential Resistance in AlxGa1-xN Homojunction Tunnel Diodes up to x=0.19 and High Reverse Bias Tunneling up to x=0.58 to Enable Ultraviolet Optoelectronics," 13th International Conference on Nitride Semiconductors, Bellevue, Washington, USA, July 2019.

113) **E. A. Clinton, E. Vadiee, B. Tellekamp, Z. E. Engel, C. M. Matthews**, and W. Alan Doolittle, "Plasma Control of Defects in InN: Correlation to Residual Electron Concentration and Moss-Burstein Effect," 61st Electronic Materials Conference, Ann Arbor, Michigan, USA, June 2019.

114) **E. A. Clinton, E. Vadiee, Z. E. Engel, C. M. Matthews**, and W. Alan Doolittle, "AlxGa1-xN (0<x<0.6) Homojunction Tunnel Diodes Exhibiting Low Voltage Negative Differential Resistance: Progress towards Tunnel Contacts Compatible with Ultraviolet Optoelectronics," 61st Electronic Materials Conference, Ann Arbor, Michigan, USA, June 2019.

115) **E. A. Clinton, E. Vadiee, Z. E. Engel, C. M. Matthews**, and W. Alan Doolittle, "Plasma Considerations for Growth of High In Content III-Nitrides," International Workshop on Nitride Semiconductors, Kanazawa, Japan, November 2018.

116) **E. A. Clinton, E. Vadiee**, K. Mehta, P. D. Yoder, **Z. E. Engel, C. M. Matthews, A. S. Weidenbach**, H. McFavilen, C. Arena, and W. Alan Doolittle, "GaN Homojunction Tunnel Diodes Exhibiting Negative Differential Resistance and their Application as Tunnel Contacts," International Workshop on Nitride Semiconductors, Kanazawa, Japan, November 2018.

117) D. C. Lee**, J. C. Shank**, W. Alan Doolittle, F. M. Alamgir, "Thin Film Lithium Niobites with Intrinsic High-Rate Performance for Lithium-Ion Batteries", ECS Meeting Abstracts, 386 (Aug. 2019).

118) **Z. Engel, E. A. Clinton, C. M. Matthews**, W. Alan Doolittle, "Advancements in High Indium Content Alinn Grown Via Metal Modulated Epitaxy and Application Towards Polar/Non-Polar Optical Devices", ECS Meeting Abstracts, 1271 (Aug 2019).

119) **H. Ahmad, K. Motoki, E. A. Clinton, C. M. Matthews, Z. Engel**, W. Alan Doolittle, "Impact of Substrate Temperature for High Quality Regrown GaN Homoepitaxial

Films Grown by Metal Modulated Epitaxy," Oral presentation-62nd Electronic Materials Conference, Ohio, Jun 24-Jun 26 2020.

120) **H. Ahmad, K. Motoki, E. A. Clinton, C. M. Matthews, Z. Engel**, W. Alan Doolittle, "Extensive Study of Ga-coverage in UID Regrown GaN by MBE," Poster presentation-62nd Electronic Materials Conference, Ohio, Jun 24-26 2020.

121) **H. Ahmad**, T. J. Anderson, J. C. Gallagher, **E. A. Clinton, Z. Engel, C. M. Matthews**, and W. A. Doolittle, "Be Doping of Semi-Insulating GaN without Surface Accumulation using MME," Poster presentation-62nd Electronic Materials Conference, Ohio, Jun 24-26 2020.

122) **Z. Engel, C. M. Matthews, E. A. Clinton, H. Ahmad**, and W. Alan Doolittle, "Advancements in Aluminum Indium Nitride Growth over a Wide Compositional Range— Towards Long Wavelength III-Nitride Optoelectronics," Oral Presentation, 62nd Electronic Materials Conference, Columbus, Ohio, Jun 24-26, 2020.

123) **E. Clinton, Z. Engel, E. Vadiee, C. M. Matthews**, R. Floyd, M. K. Hussain, M. Gaevski, A. Mamun, A. Khan and W. Alan Doolittle, "AlxGa1-xN Homojunction Tunnel Diodes with 0≤x≤58% —First Demonstration of Negative Differential Resistance in AlxGa1-xN Homojunction Tunnel Diodes and 110% Improvement in 275 nm UV-LED Output Power", Oral Presentation, 62nd Electronic Materials Conference, Columbus, Ohio, Jun 24-26, 2020.

124) **A. Ghosh, B. Zivasatienraj, A. Weidenbach, T. McCrone**, W. Alan Doolittle; "Understanding the Origin of Non-Volatile Programming in LiNbO2 Memristors via Electrochemical Impedance Spectroscopy (EIS)", Oral Presentation, 62nd Electronic Materials Conference, Columbus, Ohio, Jun 24-26, 2020.

125) **T. McCrone, A. Ghosh, B. Zivasatienraj, A. Weidenbach**, W. Alan Doolittle; "Heteroepitaxial Thin Film Growth of LiNbO2 for Rapid Charge Battery, Neuromorphic, and Photosynthesis Applications", Oral Presentation, 62nd Electronic Materials Conference, Columbus, Ohio, Jun 24-26, 2020.

126) S. Graham, P. E. Hopkins, M. S. Goorsky, A. Khan, A. Henry, W A. Doolittle, T. Luo, T. Suga, F. Mu, "Characterization of Thermal Effects in Wide Bandgap Semiconductor Materials and Devices", ECS Meeting Abstracts, 1331 (2020).

127) M. S. Goorsky, S. Graham, P. Hopkins, A. Henry, T. Luo, W. Alan Doolittle, A. Khan, "Defect and Impurity Characterization in Wide Bandgap Materials and Interfaces: Impact on Thermal Transport", ECS Meeting Abstracts, 1332 (2020).

128) A. Payne, **A. H. Rao, Z. Engel, C. M. Matthews, H. Ahmad**, T. Brown, W. Alan Doolittle, "Machine Learning for Evaluation of RHEED Spectra on III-Nitride Films Grown Using Molecular Beam Epitaxy," 63rd Electronic Materials Conference, Virtual Conference, June 23-25, 2021.

129) **C. M. Matthews**, W. Alan Doolittle, "Kinetic Model of Vertical Indium Segregation During InGaN Epitaxy," 63rd Electronic Materials Conference, Virtual, June 23-25, 2021.

130) **H. Ahmad, Z. Engel, C. M. Matthews, K. Motoki**, W. Alan Doolittle, "First Experimental Demonstration of P-type AlN Grown by MME," 63rd Electronic Materials Conference, Virtual Conference, June 23-25, 2021.
131) **K. Motoki, Z. Engel, C. M. Matthews, H. Ahmad**, W. Alan Doolittle, "Observation of Interfacial Strain Relaxation in High Indium, AlInN/GaN Heterostructures by Transmission Electron Microscope" 63rd Electronic Materials Conference, Virtual Conference, June 23-25, 2021.
132) **Z. Engel, H. Ahmad**, W. Alan Doolittle, "Novel Approach for Growth of High-Quality Aluminum Indium Nitride Covering the Entire Composition Range," MRS Cambridge, UK 2021.
133) **C. M. Matthews**, W. Alan Doolittle, "Kinetic Model of Vertical Indium Segregation During InGaN Epitaxy," 21st International Conference on Molecular Beam Epitaxy (ICMBE), Virtual Poster, Sept. 6-9, 2021
134) **H. Ahmad**, J. Lindemuth**, Z. Engel, C. M. Matthews, T. M. McCrone**, W. Alan Doolittle, "First Time Achievement of MME Grown P-type AlN:Be Films," 21st ICMBE, Puerto Vallarta, Virtual Poster, September 6-9, 2021.
135) **Z. Engel, H. Ahmad, C. M. Matthews, K. Motoki**, W. Alan Doolittle, "Metal Rich, Low Temperature MME Growth of Aluminum Indium Nitride in the Entire Composition Range," 21st ICMBE, Puerto Vallarta, Mexico September 6-9, 2021.
136) **Z. Engel, E. A. Clinton, K. Motoki, H. Ahmad, C. M. Matthews**, W. Alan Doolittle, "Self-Assembled AlGaN Superlattices Grown Via Metal Modulated Epitaxy," 21st ICMBE, Puerto Vallarta, Mexico September 6-9, 2021.
137) J. Shi, A. Krishnan, AFMAU,Bhuiyan, YR. Koh, K. Huynh, A. Mauze, S. Mu, BM. Foley, **H. Ahmad,** T. Itoh, Y. Zhang, C. Yuan, S. Kim, **W.A. Doolittle,** C. Van de Walle, J. S. Speck, M. Goorsky, P. Hopkins, H. Zhao, and S. Graham, "Thermal Transport Across Al-(AlxGa1-x)2O3 and Al-Ga2O3 Interfaces." Proceedings of the ASME 2021 International Technical Conference and Exhibition on Packaging and Integration of Electronic and Photonic Microsystems. ASME 2021 International Technical Conference and Exhibition on Packaging and Integration of Electronic and Photonic Microsystems. Virtual, Online. October 26–28, 2021. V001T08A005. ASME. https://doi.org/10.1115/IPACK2021-74116
138) **C. M. Matthews, Z. Engel**, and W. A. Doolittle, "Kinetic Modeling of Vertical Cation Segregation During AxB1-xN Epitaxy;" 2022 MRS Spring Meeting & Exhibit, Oral session, Honolulu, Hawai'i, USA, May 8–13, 2022.
139) **T. Pfeifer, H. Aller, E. Hoglund, E. Scott, J. Tomko, H. Ahmad, A. Giri**, W. A. Doolittle, K. Hattar, A. McGaughey, P. Hopkins, "Nanoscale Mechanisms for Reducing Thermal Boundary Resistance via Ion Bombardment," 2022 MRS Fall Meeting & Exhibit, Oral session, Boston, Massachusetts, USA, Nov. 6–8, 2022.
140) **C. M. Matthews, H. Ahmad, Z. Engel, K. Motoki, S. Lee**, and W. A. Doolittle, "AlN Homojunction PN Diodes: The Highest Bandgap Semiconductor Diodes Ever Demonstrated," 64th Electronic Materials Conference, Oral session, Columbus OH, USA, June 28-July 1, 2022.

141) **K. Motoki, Z. Engel, C. M. Matthews**, W. A. Doolittle, “Observation of Compositional Modulation in AlGaN Self-Assembled Superlattices by Transmission Electron Microscopy,” 64th Electronic Materials Conference, Oral session, Columbus OH, USA, June 28-July 1, 2022.
142) **A. Ghosh, A. S. Weidenbach, B. Zivasatienraj, T. M. McCrone**, and W. A. Doolittle, “Understanding non-volatile programming in LiNbO2 memristors via Electrochemical Impedance Spectroscopy (EIS),” MRS 23rd Solid State Ionics (SSI) Conference, Poster Session, Boston, MA, USA, July 17–22, 2022.
143) **Z. Engel, K. Motoki, C. M. Matthews**, and W. A. Doolittle, “Demonstration of Sc0.2Al0.8N HEMT Structures with a Sheet Resistance of 150 Ω/□ and a Sheet Charge of 5.9x1013 cm-2 with Phase Pure, Metal Rich Growth,” The International Conference on Molecular Beam Epitaxy (ICMBE) 2022, Oral session, Sheffield, UK, Sep. 4–9th, 2022.
144) **C. M. Matthews, H. Ahmad, Z. Engel, K. Motoki, S. Lee**, W. A. Doolittle, “Demonstration of AlN Homojunction PN Diodes,” The International Conference on Molecular Beam Epitaxy (ICMBE) 2022, Oral session, Sheffield, UK, Sep. 4–9th, 2022.
145) **C. M. Matthews, H. Ahmad, Z. Engel, A. Ghosh, S. Lee**, and W. A. Doolittle, “High Breakdown Performance in GaN Quasi-Vertical PIN Diodes with Beryllium Doped I-Layer and Current Spreading Layer,” The International Conference on Molecular Beam Epitaxy (ICMBE) 2022, Oral session, Sheffield, UK, Sep. 4–9th, 2022.
146) **C. M. Matthews, Z. Engel**, and W. A. Doolittle, “Vertical Cation Segregation in Ternary III-Nitrides,” The International Conference on Molecular Beam Epitaxy (ICMBE) 2022, Oral session, Sheffield, UK, Sep. 4–9th, 2022.
147) **Z. Engel, K. Motoki**, and W. A. Doolittle, “Demonstration of Sc0.2Al0.8N HEMT Structures with a Sheet Resistance of 150 Ω/□ and a Sheet Charge of 5.9x1013 cm-2 with Phase Pure, Metal Rich Growth,” 36th North American Molecular Beam Epitaxy Conference (NAMBE), Oral session, Rehoboth Beach, Delaware, USA, Sep. 18–21, 2022.
148) **C. M. Matthews, H. Ahmad, Z. Engel, K. Motoki, S. Lee,** and W. A. Doolittle, “Realization of AlN Homojunction PN Diodes,” 36th North American Molecular Beam Epitaxy Conference (NAMBE), Oral session, Rehoboth Beach, Delaware, USA, Sep. 18–21, 2022.
149) **C. M. Matthews, Z. Engel**, and W. A. Doolittle, “Vertical Cation Segregation During AxB1-xN Epitaxy,” 36th North American Molecular Beam Epitaxy Conference (NAMBE), Poster session, Rehoboth Beach, Delaware, USA, Sep. 18–21, 2022.
150) **C. M. Matthews, H. Ahmad, Z. Engel, K. Motoki, S. Lee**, and W. A. Doolittle, “Realization of AlN Homojunction PN Diodes,” International Workshop on Nitride Semiconductors (IWN) 2022, Oral session, Berlin, Germany, Oct. 9–14, 2022.
151) **C. M. Matthews, Z. Engel**, and W. A. Doolittle, “Vertical Cation Segregation During AxB1-xN Epitaxy,” International Workshop on Nitride Semiconductors (IWN) 2022, Oral session, Berlin, Germany, Oct. 9–14, 2022.

152) **C. M. Matthews, H. Ahmad, Z. Engel, A. Ghosh**, and W. A. Doolittle, "High Breakdown Performance in GaN Quasi-Vertical PIN Diodes with Beryllium Doped I-Layer and Current Spreading Layer," 22nd International Conference on Molecular Beam Epitaxy (ICMBE), Sheffield, United Kingdom (2022).
153) **K. Motoki, Z. Engel, C. M. Matthews**, and W. A. Doolittle, "Observation of compositional modulation variation and reduction in rapidly grown AlGaN self-assembled superlattices by transmission electron microscopy," International Workshop on Nitride Semiconductors (IWN) 2022, Poster session, Berlin, Germany, Oct. 9–14, 2022.
154) **A. Krishnan, C. M. Matthews, H. Ahmad, J. Shi, S. Lee, K. Motoki**, W. A. Doolittle, and S. Graham, "The effect of Be doping concentration on thermal conductivity of p-type AlN thin films," International Workshop on Nitride Semiconductors (IWN) 2022, Poster session, Berlin, Germany, Oct. 9–14, 2022.
155) **Z. Engel, E. Clinton, C. M. Matthews, H. Ahmad, K. Motoki**, and W. A. Doolittle, "Advancements in aluminum indium nitride growth over a wide compositional range – towards long wavelength III-nitride optoelectronics," International Workshop on Nitride Semiconductors (IWN) 2022, Poster session, Berlin, Germany, Oct. 9–14, 2022.
156) **Z. Engel, K. Motoki, C. M. Matthews** and W. A. Doolittle, "Demonstration of $Sc_{0.2}Al_{0.8}N$ HEMT Structures with a Sheet Resistance of 150 Ω/□ and a Sheet Charge of 5.9×10^{13} cm^{-2} with Phase Pure, Metal Rich Growth," International Workshop on Nitride Semiconductors (IWN) 2022, Oral session, Berlin, Germany, Oct. 9–14, 2022.
157) **S. Lee, H. Ahmad, Z. Engel, A. Ghosh, C. M. Matthews**, and W. A. Doolittle, "Quasi-vertical pin diodes achieve high breakdown performance with GaN:Be I-layer and current spreading layer," International Workshop on Nitride Semiconductors (IWN) 2022, Oral session, Berlin, Germany, Oct. 9–14, 2022.
158) **Z. Engel, K. Motoki, C. M. Matthews, T. Stamm**, and W. A. Doolittle, "Improved nucleation of 111 ScN thin films," International Workshop on Nitride Semiconductors (IWN) 2022, Poster session, Berlin, Germany, Oct. 9–14, 2022.
159) **E. N. Marshall, T. Stamm, H. Ahmad, Z. Engel, C. M. Matthews**, and W. A. Doolittle, "p-type AlN based heteroepitaxial diodes with Schottky, PIN and junction barrier Schottky character achieving significant breakdown performance," International Workshop on Nitride Semiconductors (IWN) 2022, Poster session, Berlin, Germany, Oct. 9–14, 2022.
160) **K. Motoki, Z. Engel, C. M. Matthews, H. Ahmad, T. M. McCrone, K. Harada**, and W. A. Doolittle, "Observation of interfacial strain relaxation and electron beam damage thresholds in $Al_{0.3}In_{0.7}N$/GaN heterostructures by transmission electron microscope," International Workshop on Nitride Semiconductors (IWN) 2022, Oral session, Berlin, Germany, Oct. 9–14, 2022.

161) **C. M. Matthews, H. Ahmad, E. N. Marshall, A. Krishnan, K. Motoki, S. Lee, H. Chung**, and W. Alan Doolittle, "Electrical Characterization of AlN PN Diodes," 65th Electronic Materials Conference (EMC), Santa Barbara, CA, USA (2023).

162) **Keisuke Motoki, Amanda L. Tang, Zachary Engel, Timothy M. McCrone, Christopher M. Matthews, Sangho Lee, Emily N. Marshall, Aheli Ghosh** and W. Alan Doolittle, "Structural Analysis and Observation of Tilts, Twists, and Crystallographic Orientation of High-Quality, Metal-Rich MME-Grown ScAlN," 65th Electronic Materials Conference (EMC), Santa Barbara, CA, USA (2023).

163) **C. M. Matthews, H. Ahmad, Z. Engel, K. Motoki, S. Lee, E. N. Marshall, A. Krishnan**, and W. A. Doolittle, "Surface Oxide Removal on AlN Substrates via Low Temperature Aluminum Flashing," 14th International Conference on Nitride Semiconductors (ICNS), Fukuoka, Japan (2023). ***Won Best Student Presentation Award***

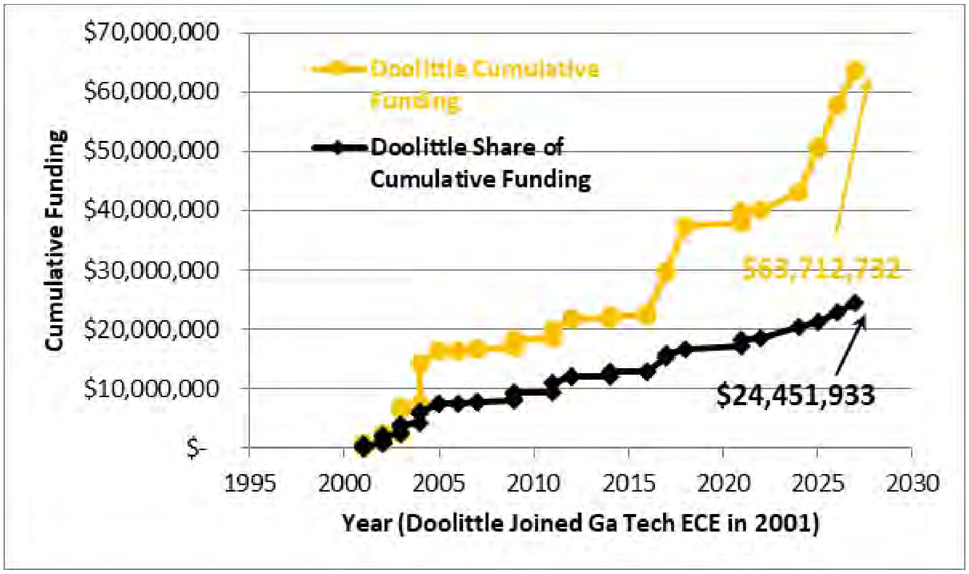
164) **Keisuke Motoki, Amanda L. Tang, Zachary Engel, Timothy M. McCrone, Christopher M. Matthews, Sangho Lee, Emily N. Marshall, Aheli Ghosh** and W. Alan Doolittle, "Structural Analysis and Observation of Tilts, Twists, and Crystallographic Orientation of High-Quality, Metal-Rich MME-Grown ScAlN," 14th International Conference on Nitride Semiconductors (ICNS), Fukuoka, Japan (2023).

165) **Emily N. Marshall Zachary Engel, Keisuke Motoki, Christopher M. Matthews, Sangho Lee, Amanda L. Tang,** and W. Alan Doolittle, "Pushing the Limits of Low-Temperature Growth of High-Quality ScAlN Via Metal-Rich Epitaxy," 14th International Conference on Nitride Semiconductors (ICNS), Fukuoka, Japan (2023). ***Won Best Student Presentation Award***

E. Grants and Contracts

E1. As Principal Investigator

Doolittle share of Total Funding=$20,365,933 of $43,029,732 Total Awarded



(**Additional 2024 Submitted/Pending Funding=$20,683,000 with PI Share = $ 4,086,000**)

1. Title: ADVANCES IN THE EXPLOITATION OF GAN HETEROSTRUCTURES ON LITHIUM GALLATE
   Sponsor: NAVY
   Role: PI
   Collaborators: DOOLITTLE, WILLIAM ALAN; BRENNAN, KEVIN
   Period of the Contract: 01/01/1998 - 09/30/2003
   Doolittle Share: 30% = $91,000 of $300,000 total awarded
2. Title: DEVELOPMENT OF A RAPID THERMAL MOLECULAR BEAM EPITAXY SYSTEM
   Sponsor: NAVY
   Role: PI
   Collaborators: None
   Period of the Contract: 03/02/1998 - 12/12/1999
   Doolittle Share: 100% = $174,298 of $174,298 total awarded
3. Title: FERMI-ENERGY CONTROL DURING SEMICONDUCTOR GROWTH FOR ENHANCED DOPANT ACTIVATION I
   Sponsor: NAVY
   Role: PI
   Collaborators: None
   Period of the Contract: 03/15/1999 - 09/30/2003
   Doolittle Share: 100% = $150,000 of $150,000 total awarded
4. Title: FERMI-ENERGY CONTROL DURING SEMICONDUCTOR GROWTH FOR ENHANCED DOPANT ACTIVATION II
   Sponsor: NAVY

Role: PI
Collaborators: None
Period of the Contract: 03/15/1999 - 09/30/2003
Doolittle Share: 100% = $300,000 of $300,000 total awarded

5. Title: ACQUISITION OF EQUIPMENT TO FACILITATE ENERGY MODIFIED SEMICONDUCTOR EPITAXY
   Sponsor: NAVY
   Role: PI
   Collaborators: None
   Period of the Contract: 04/01/2001 - 03/31/2002
   Doolittle Share: 100% = $172,740 of $172,740 total awarded
6. Title: DEVELOPMENT OF AN AUTOMATICALLY TUNABLE RF IMPEDANCE MATCHING SYSTEM
   Sponsor: APPLIED EPI INC
   Role: PI
   Collaborators: None
   Period of the Contract: 05/01/2001 - 03/31/2004
   Doolittle Share: 100% = $11,290 of $11,290 total awarded
7. Title: DEVELOPMENT OF A TRULY LATTICE-MATCHED III-NITRIDE TECHNOLOGY FOR "NEAR-DISLOCATION FREE" OPTOELECTRONIC AND HIGH FREQUENCY ELECTRONIC APPLICATIONS
   Sponsor: CERMET INC
   Role: PI
   Collaborators: None
   Period of the Contract: 09/05/2001 - 03/04/2002
   Doolittle Share: 100% = $30,000 of $30,000 total awarded
8. Title: MBE GROWTH OF SINGLE CRYSTAL LITHIUM OXIDES FOR ELECTRONIC AND OPTOELECTRONIC APPLICATIONS I
   Sponsor: NAVY
   Role: PI
   Collaborators: None
   Period of the Contract: 02/15/2002 - 09/30/2005
   Doolittle Share: 100% = $193,907 of $193,907 total awarded
9. Title: FERRO-ELECTRICALLY SWITCHED HIGH POWER ELECRONICS
   Sponsor: NAVY/DARPA
   Role: PI
   Collaborators: None
   Period of the Contract: 05/15/2002 - 05/14/2004
   Doolittle Share: 100% = $371,236 of $371,236 total awarded
10. Title: OPTICAL MATERIALS
    Sponsor: GEORGIA TECH BROADBAND INSTITUTE
    Role: PI
    Collaborators: Ralph, Steven
    Period of the Contract: 8/6/02 - 8/5/04
    Doolittle Share: 50% = $40,000 of $80,000 total awarded
11. Title: MBE GROWTH OF SINGLE CRYSTAL LITHIUM OXIDES FOR ELECTRONIC AND OPTOELECTRONIC APPLICATIONS II
    Sponsor: NAVY

Role: PI
Collaborators: None
Period of the Contract: 10/01/2002 - 12/31/2008
Doolittle Share: 100% = $960,000 of $960,000 total awarded

12. Title: DEVELOPMENT OF A LATTICE-MATCHED AIINN OFR UV EMITTERS
    Sponsor: CERMET INC
    Role: PI
    Collaborators: None
    Period of the Contract: 10/11/2002 - 04/11/2003
    Doolittle Share: 100% = $30,600 of $30,600 total awarded
13. Title: DURIP - ACQUISITION OF EQUIPMENT TO FACILITATE NEXT GENERATION INTEGRATED OPTICS: MATERIALS DEVELOPMENT AND PERFORMANCE CHARACTERIZATION EQUIPMENT
    Sponsor: NAVY
    Role: PI
    Collaborators: RALPH, STEPHEN
    Period of the Contract: 05/01/2003 - 07/31/2004
    Doolittle Share: 73% = $95,000 of $130,000 total awarded
14. Title: MURI: LABORATORY INSTRUMENTATION DESIGN RESEARCH FOR SCALEABLE NEXT GENERATION EPITAXY: NON-EQUILIBRIUM WIDE APPLICATION EPITAXIAL PATTERNING BY INTELLIGENT CONTROL
    Sponsor: AIR FORCE
    Role: PI
    Collaborators: FRAZIER, ALBERT + other universities.
    Period of the Contract: 05/15/2003 - 02/14/2009
    Doolittle Share: 30% = $1,065,068 of $3,558,100 total awarded
15. Title: CAREER: NEW DEVICE OPPORTUNITIES ENABLED BY POLAR DIELECTRIC AND SEMICONDUCTOR HETEROEPITAXY
    Sponsor: NATIONAL SCIENCE FOUNDATION
    Role: PI
    Collaborators: None
    Period of the Contract: 04/01/2004 - 03/31/2009
    Doolittle Share: 100% = $398,344 of $398,344 total awarded
16. Title: MURI: EPITAXIAL MULTIFUNCTIONAL MATERIALS AND APPLIATIONS: REVOLUNTIONARY EPITAXIAL SOLUTIONS CREATING A PLATFORM FOR A NEW GENERATION OF MILITARY APPLICATIONS
    Sponsor: NAVY
    Role: PI
    Collaborators: Hunt, Bill; Citrin, David + other universities
    Period of the Contract: 05/01/2004 - 02/28/2010
    Doolittle Share: 25% = $1,696,160 of $6,657,550 total awarded
17. Title: NOVEL HIGH EFFICIENCY PHOTOVOLTAIC DEVICES BASED ON THE III-N MATERIAL SYSTEM
    Sponsor: UNIVERSITY OF DELAWARE
    Role: PI
    Collaborators: DOOLITTLE, WILLIAM ALAN
    Period of the Contract: 06/08/2004 - 01/08/2005
    Doolittle Share: 100% = $73,322 of $73,322 total awarded

18. Title: VERY-HIGH EFFICIENCY SOLAR CELL (VHESC)
    Sponsor: UNIVERSITY OF DELAWARE
    Role: PI
    Collaborators: FERGUSON, IAN;CITRIN, DAVID
    Period of the Contract: 10/01/2005 - 06/30/2007
    Doolittle Share: 65% = $1,347,413 of $2,067,413 total awarded
19. Title: HIGH EFFICIENCY III NITRIDE SOLAR CELLS
    Sponsor: UNIVERSITY OF DELAWARE
    Role: PI
    Collaborators: FERGUSON, IAN
    Period of the Contract: 12/07/2005 - 12/06/2007
    Doolittle Share: 55% = $79,854 of $146,048 total awarded
20. Title: X-RAY DETECTION FOR RAPID DEVELOPMENT OF MOLECULAR BEAM EPITAXY OF LITHIUM.
    Sponsor: NAVY
    Role: PI
    Collaborators: None
    Period of the Contract: 05/26/2006 - 08/25/2007
    Doolittle Share: 100% = $29,300 of $29,300 total awarded
21. Title: WHITE LIGHT EMITTER USING A SELF-LUMINESCENT, LATTICE MATCHED SUBSTRATE
    Sponsor: NATIONAL SCIENCE FOUNDATION
    Role: PI
    Collaborators: None
    Period of the Contract: 05/01/2007 - 04/30/2011
    Doolittle Share: 100% = $270,000 of $270,000 total awarded
22. Title: BME EQUIPMENT REPAIR AT GEORGIA TECH
    Sponsor: NAVY
    Role: PI
    Collaborators: None
    Period of the Contract: 07/17/2007 - 09/30/2008
    Doolittle Share: 100% = $10,760 of $10,760 total awarded
23. Title: DURIP: ULTRA HIGH VACUUM SCANNING PROBE SYSTEM FOR INVESTIGATION OF NOVEL EPITAXIAL MATERIALS
    Sponsor: ARMY
    Role: PI
    Collaborators: None
    Period of the Contract: 05/01/2009 - 10/30/2010
    Doolittle Share: 100% = $125,900 of $125,900 total awarded
24. Title: LITHIUM-SEMICONDUCTOR BASED MIXED IONIC-ELECTRONICS FOR COMPLEMENTARY TWO TERMINAL NEUROMORPHIC BRAIN SIMULANT
    Sponsor: NAVY
    Role: PI
    Collaborators: None
    Period of the Contract: 10/01/2009 - 09/30/2013
    Doolittle Share: 100% = $449,765 of $449,765 total awarded
25. Title: SYSTEMATIC STUDY OF P-TYPE DOPING AND RELATED DEFECTS IN III-NITRIDES: PATHWAY TOWARD A NITRIDE HBT

Sponsor: AIR FORCE
Role: PI
Collaborators: None
Period of the Contract: 10/01/2009 - 09/30/2012
Doolittle Share: 100% = $747,446 of $747,446 total awarded

26. Title: METAL ORGANIC MOLECULAR BEAM EPITAXY CONVERSION FOR FREQUENCY AGILE WAVEGUIDE
    Sponsor: NAVY
    Role: PI
    Collaborators: None
    Period of the Contract: 07/01/2011 - 11/30/2011
    Doolittle Share: 100% = $90,000 of $90,000 total awarded
27. Title: QESST: ERC FOR QUANTUM ENERGY AND SUSTAINABLE SOLAR TECHNOLOGIES
    Sponsor: ARIZONA STATE UNIVERSITY/ NSF/DOE
    Role: PI
    Collaborators: None
    Period of the Contract: 08/15/2011 - 10/31/2016
    Doolittle Share: 100% = $916,249 of $916,249 total awarded
28. Title: RADIATION TOLERANCE OF NEW SELF-HEALING CRYSTALLINE MEMRISTORS FOR NEUROMORPHIC APPLICATIONS
    Sponsor: US DEPT OF DEFENSE
    Role: PI
    Collaborators: University of Vanderbilt
    Period of the Contract: 07/09/2012 - 07/08/2017
    Doolittle Share: 71% = $1,245,721 of $1,745,721 total awarded
29. Title: III-NITRIDE QD SOLAR CELLS
    Sponsor: ADDVENTURE SUPPORT ENTERPRISES INC (ASE INC)
    Role: PI
    Collaborators: None
    Period of the Contract: 12/12/2012 - 12/31/2014
    Doolittle Share: 100% = $50,000 of $50,000 total awarded
30. Title: WORKSHOP ON COMPOUND SEMICONDUCTOR MATERIALS & DEVICES (WOCSEMMAD) 2014
    Sponsor: NATIONAL SCIENCE FOUNDATION
    Role: PI
    Collaborators: None
    Period of the Contract: 02/15/2014 - 07/31/2014
    Doolittle Share: 100% = $15,300 of $15,300 total awarded
31. Title: HIGH TEMPERATURE INGAN THERMIONIC TOPPING CELLS
    Sponsor: ARIZONA STATE UNIVERSITY / ARPA-E
    Role: PI
    Collaborators: None
    Period of the Contract: 06/04/2014 - 06/03/2017
    Doolittle Share: 100% = $677,100 of $677,100 total awarded
32. Title: STIR: BIOLOGICALLY REALISTIC IONIC RETINA (BiRIR)
    Sponsor: ARMY
    Role: PI
    Collaborators: None

Period of the Contract: 05/01/2016 - 01/31/2017
Doolittle Share: 100% = $50,000 of $50,000 total awarded

33. Title: I-CORPS TEAMS: NOVEL ENGINEERED SUBSTRATE TECHNOLOGY FOR LOW-DEFECT, HIGH QUALITY III-NITRIDE OPTOELECTRONICS
    Sponsor: NATIONAL SCIENCE FOUNDATION
    Role: PI
    Collaborators: None
    Period of the Contract: 06/15/2016 - 07/31/2016
    Doolittle Share: 100% = $9,562 of $9,562 total awarded
34. Title: CROSS-DISCIPLINARY ELECTRONIC-IONIC RESEARCH ENABLING BIOLOGICALLY REALISTIC AUTONOMOUS LEARNING (CEREBRAL)
    Sponsor: Department of Defense
    Role: PI
    Collaborators: Doolittle, William Alan; Graham, Samual; Vogel, Eric; Raychowdhury, Arijit; Piper, Louis; and Lee, Wei-Cheng
    Period of the Contract: 11/1/2017 – 10/31/2022
    Doolittle Share: 34% = $2,401,722 of $7,124,304 Total Award
35. Title: TOWARDS UNDERSTANDING ALINGAN/SILICON INTERFACE KINETICS
    Sponsor: National Science Foundation
    Role: PI
    Collaborators: None
    Period of the Contract: 8/1/2017 – 7/30/2020
    Doolittle Share: 100% = $400,000

36. Title: SEMICONDUCTING AlN: A NEW PATHWAY TO HIGH VOLTAGE, POWER AND TEMPERATURE ULTRA-WIDE BANDGAP POWER ELECTRONIC COMPONENTS
    Sponsor: AFOSR
    Role: PI
    Collaborators: None
    Period of the Contract: 7/1/2021 – 6/31/2024
    Doolittle Share: 100% = $550,000

37. Title: MULTILAYER MOLECULAR-BEAM EPITAXY STACKS WITH INTERMETALLIC LAYERS ENABLED BULK ACOUSTIC RESONATORS (MM-BAR)
    Sponsor: DARPA
    Role: PI
    Collaborators: Ruochen Lu, University of Texas, Austin
    Period of the Contract: 2/1/2022 – 11/30/2025
    Doolittle Share: 56% = $939,834 of $1,685,787

38. Title: CONTACT STRATEGIES FOR EXTREME BANDGAP NITRIDE SEMICONDUCTORS
    Sponsor: Office of Naval Research
    Role: PI
    Collaborators: None
    Period of Contract: 11/1/22- 10/31/25
    Doolittle Share: 100% = $420,000 Total Awarded
39. Title: SCALABLE WIDE-BANDGAP III-NITRIDE SWITCH (SWINS)
    Sponsor: ARPA-E

Role: PI
Collaborators: Lukas Graber, Doug Yoder, Jonathon Goldman
Period of Contract: 1/1/2024- 12/31/2027
Doolittle Share: 53% = $1,517,660 of $ 2,854,000 Total Awarded

E2. AS CO-PRINCIPAL INVESTIGATOR

40. Title: LATTICE MATCHED, HIGH EFFICIENCY SOLID STATE EMITTERS ON ZnO SUBSTRATES
    Sponsor: CERMET INC / DEPARTMENT OF ENERGY
    Role: Co-PI
    Collaborators: FERGUSON, IAN
    Period of the Contract: 09/01/2003 - 08/30/2006
    Doolittle Share: 38% = $250,000 of $650,000 total awarded
41. Title: MULTIFERROIC MATERIALS FOR MICROWAVE PARAMETRIC POWER AMPLIFIERS
    Sponsor: AIR FORCE
    Role: Co-PI
    Collaborators: Steven Kenney, William Alan Doolittle, Ioannis Papapolymerou
    Period of the Contract: 09/30/2009 - 05/15/2011
    Doolittle Share: 67% = $200,000 of $298,146 total awarded
42. Title: MURI-LEVERAGING A NEW THEORETICAL PARADIGM TO ENHANCE INTERFACIAL THERMAL TRANSPORT IN WIDE BANDGAP POWER ELECTRONICS
    Sponsor: Office of Naval Research
    Role: Co-PI
    Collaborators: Samuel Graham (PI), W. Alan Doolittle
    Period of Contract: 8/01/18- 7/30/23
    Doolittle Share: 14% = $1,050,00 of $7,500,000 Total Awarded
43. Title: TIME-RESOLVED SPECTROSCOPY OF HOT-CARRIER DYNAMICS
    Sponsor: AFOSR
    Role Co-PI
    Collaborators: Wenshan Cai (PI)
    Period of Contract: 6/15/19- 3/14/20
    Doolittle Share: $0 (Equipment only) of $390,070
    PI Salary: 0 month per year
44. Title: MURI: Nanoscale and Transduction Optimized Pristine Ferroelectric Nitrides (NanoTOP)
    Sponsor: Army Research Office,
    Role: Co-PI
    Proposed Award Amount : $7,500,000
    Subcontract to University of Michigan, Zetian Mi is PI
    Share: $986,000
    Total Award Period Covered: 5/01/24- 4/30/29
    PI Salary: 1 month per year.
45. Title: MURI: Enabling extreme bandgap electronics – (EXBE)
    Sponsor: Air Force Office of Scientific Research
    Proposed Award Amount: $7,500,000
    Subcontract to University of North Carolina, Zlatko Sitar is PI
    Share: $1,450,000
    Total Award Period Covered: 5/01/24- 4/30/29

PI Salary: 1 month per year.

46. Title: A New Nitride Era (ANNE),
    Sponsor: Defense Advanced Research Projects Agency
    Proposed Award Amount: $5,683,000
    PI Share: $1,650,000
    Total Award Period Covered :6/01/24- 5/30/27
    PI Salary: 1 month per year.
47. Title: Scalable Wide Bandgap Nitride Switch (SWiNS)
    Sponsor: Advanced Research Projects Agency - Energy
    Proposed Award Amount: $2,850,544
    PI Share: $ 1,586,755
    Total Award Period Covered :6/01/24- 5/30/27
    PI Salary: 1 month per year.

E3. As Senior Personnel or Contributor

No Data

E4. Pending Proposals

Total Pending Funding=$0 with PI Share = $ 0

E5. Proposals Submitted But Not Funded (last two years):

Total Declined Funding in the Last 3 Years: $ 7,999,999

1. Title: DIRECT OPTICALLY TRIGGERED GAN HETEROJUNCTION BIPOLAR TRANSISTOR
   Sponsor: ARPA-E
   Role: co-PI
   Collaborators: Chirag Gupta, U. Wisconsin
   Proposal Due Date: Spring 2023
   Proposal Amount: Doolittle Share: $298,500 of total $3,000,000
2. Title: MATERIALS ORIGINATED DYNAMICS ENABLING RECURRENT NEURAL NETWORKS - MODERNN
   Sponsor: AFOSR
   Role: PI
   Collaborators: Arijit Raychowdhury, Christopher Rozell, Shimeng Yu, Saibal Mukhopadhyay, Asif Khan and Anthony Zador from Cold Spring Harbor Laboratory
   Proposal Due Date: Spring 2023
   Proposal Amount: Doolittle Share: $1,125,000 of total $ 4,999,999

.

F. OTHER SCHOLARLY AND CREATIVE ACCOMPLISHMENTS

F1 STARTUP COMPANIES

In 2015/16 Dr. Doolittle started two companies that are not related to any Ga Tech Research but for completeness are listed herein:

1) Innovative Advanced Materials Inc. is commercializing Epitaxy Tools and Semiconductor Components for research scale applications.
2) Innovative Advanced Technologies Inc. is commercializing Epitaxy Tools and Semiconductor Components for production scale applications.

F2 INVENTIONS DISCLOSURES FILED (ALL FILED WITH GEORGIA TECH RESEARCH CORP.)

a. 1249 Pseudo-logarithmic Transcient Capacitance/Conductance, 3/13/1992
b. 2497 Automatically Tunable RF Impedance Mathing System for the Applied EPI Unibulb Plasma Source, 5/21/2001
c. 2582 Increased Acceptor Doping in Aluminum-Galllium-Indium NMitride Alloys by Be Doping, 11/26/2001
d. 2583 Doping of III-Nitride Substrate Materials to Facilitate Broad Wavelength Range Luminescence, 11/26/2001
e. 2584 Increased Acceptor Doping by Precracking and Exciting Dopants, 11/26/2001
f. 2585 Novel Approach to Design and Fabrication of Power Field Effect Transistors Using Metal-Oxide Ferroelectric Materials to Enhance their Performance, 11/26/2001
g. 2586 Novel Approach to Growth of Lithium Metal Oxides Using Metal Chloride Salts, 11/26/2001
h. 2587 Deposition of Lithium Salts on Wide Bandgap Semiconductors Including but not limited to Alloys of Aluminum Nitride, Gallium Nitride, Indium Nitride and Polytypes of Silicon Carbide 4H and 6H, 11/26/2001
i. 2624 Silicon Carbide and III-Nitride Substrate Technology Based on Lithium Niobate and Lithium Tantalate, 2/13/2002
j. 2776 Integrated Transistors and Circuitry with Lithium Niobate Optical Modulator, 10/14/2002
k. 2777 Lithium Niobate Based Optical Modulators and Waveguides on SiC and III-Nitrides, 10/14/2002
l. 3133 III-Nitride Phase Modulators, 3/16/2004
m. 3358 Low-Cost Nitride Power Electronics with Integrated Active Cooling, 1/7/2005
n. 3396 Tunable Terahertz Emitters Through Standing Wave Acoustical Poling of Ferroelectric Thin Films, 2/22/2005
o. 3556 In-Situ Molecular Flux Measurement Device and Method, 7/18/2005
p. 3797 Phosphor-Free White LED using Self-Fluorescent Substrates, 3/29/2006
q. 3890 Novel Epitaxial Metal Interconnects to the III-Nitride Material System for Advanced Photovoltaic Devices, 6/5/2006
r. 4122 3D Epitaxy, 2/19/2007
s. 4811 High Efficiency Solar Cell, 4/3/2009
t. 4900 Photo-Electrolytic Water Splitting for Hydrogen Generation, 6/9/2009
u. 4901 Integrated Solar Cell & Battery, 6/9/2009

v. 4910 Metal Oxide Structures, Devices, and Fabrication Methods, 6/25/2009
w. 5459 Non-Phase Separated InGaN for use in Light-Emitting Diodes, Lasers, and Solar Cells, 11/8/2010
x. 6083 Improved Ohmic Contact to p-type InAlGaN Devices, 5/31/2012
y. 6617 Method of $LiNbO_2$ synthesis, 2/17/2014
z. 7009 Method of Increasing III-Nitride Semiconductor Growth Rate and Reduced Damaging Ion Flux Content, 5/29/2015
aa. 7200 A Scalable Memdiode - Rectification and Hysteresis in Metal - Nb_2O_5 - Metal Diodes Without Electroforming, 2/2/2016
bb. 7561 Non-volatile $LiNbO_2$ memristors
cc. 8435 Surface Protection Technique for MBE-MOCVD Hybrid Growths, 4/6/2020
dd. 8666 First Experimental Demonstration of P-type AlN Grown by MME, 1/31/2021
ee. 8790 Cascaded Ni Hard Mask to Create ICP Dry Etched Deep Mesas for High-Power Devices, 8/12/2021
ff. 8789 Improved Breakdown Performance in High-Power Devices via Thin Current Spreading Layers, 8/12/2021
gg. 8786 First-time Experimental Achievement of Junction Barrier Schottky Diodes via Relaxed p-AlN on n-GaN Films, 8/12/2021
hh. 8810 High Breakdown High-Power Be Doped AlN Schottky Diode, 9/15/2021

G. Societal and Policy Impacts

For the first time in nearly 80 years of research we have the ability to convert an insulator, AlN, to a semiconductor via p and n-type "doping". From this core science result, we have made early devices that suggest revolution in high power/voltage/temperature electronics, deep UV light emitters (LEDs and Lasers), Deep UV photodetectors and radiation sensors. The devices can tolerate higher voltage, temperature, and power than any other semiconductor known. Additionally, they can emit and absorb light at phenomenally high energies approaching 200 nm wavelength. This has direct applications in viral sterilization, photolithography, polymer synthesis, and a host of other areas.

The work published on high p-type doping of III-Nitride semiconductors was so revolutionary, initially it was not widely accepted. After years of effort and others now having duplicated the results, the industry is just now realizing new devices utilizing these features including tunnel junctions useful for improved energy efficiency, both consumed and produced. It is anticipated that new solar cells, power diodes and transistors will be forthcoming.

The work published on neuromorphic computational devices has a much further horizon of impact. As such, future low power computational alternatives are expected but have only just begun to be realized. A seminal paper on low voltage memristive computation was published in 2020 showing 150 mV operation. We currently have data showing operation as low as 100 mV (not a lower limit).

H. Other Professional Activities

Dr. Doolittle has consulted with numerous law, government and industrial organizations including, Orrick, Herrington & Sutcliffe, Baker Botts, Latham & Watkins, Allwood and Associates, Ryan Owens and Associates LLC, The USA securities and exchange commission, Holland and Knight LLC and Brilliant Light Inc.

V. TEACHING

A. Courses Taught

List course taught at Georgia Tech. (Most recent first and include the last six years. Do not include CIOS scores here.)

Undergraduate Courses:				
		Mean Score		
Term/Year	Course Number/Name	# of Students	# of Responses	Teaching Effectiveness
Fall/2001*	**ECE 3040 / Microelectronic Circuits/ 3 sections**	**51**	**29**	**4.65**
Spr./2002	**ECE 3040 / Microelectronic Circuits**	**57**	**23**	**4.40**
Sum./2002	**ECE 3040 / Microelectronic Circuits**	**25**	**5**	**5.00**
Spr./2003	**ECE 3040 / Microelectronic Circuits**	**39**	**14**	**4.80**
Fall/2003**	**ECE 4000 / Proj. Eng. & Prof. Practice/2 sections**	**35**	**14**	**4.45**
Spr./2004	**ECE 3040 / Microelectronic Circuits**	**29**	**14**	**4.90**
Spr./2004	**ECE 3040 / Microelectronic Circuits**	**30**	**12**	**4.50**
Fall/2004	**ECE 3080 / Semiconductor Devices**	**16**	**7**	**4.60**
Spr./2006**	**ECE 3040 / Microelectronic Circuits**	**78**	**31**	**4.04**
Spr./2007**	**ECE 3040 / Microelectronic Circuits**	**61**	**26**	**4.80**
Spring/2008	**ECE3080 / Semiconductor Devices**	**18**	**0**	**n/a**
Spring/2008	**ECE 3040 / Microelectronic Circuits**	**30**	**11**	**4.80**
Fall/2009**	**ECE 3040 / Microelectronic Circuits**	**45**	**20**	**4.50**
Spring 2010	**ECE 4833/ Renewable Energy Devices**	**12**	**5**	**4.90**
Spring /2011	**ECE 3040 / Microelectronic Circuits**	**36**	**9**	**4.90**
Spring /2012	**ECE 3080 / Semiconductor Devices**	**20**	**12**	**4.60**
Spring /2012	**ECE 3040 / Microelectronic Circuits**	**42**	**14**	**4.00**
Spring /2013	**ECE 3040 / Microelectronic Circuits**	**51**	**16**	**4.77**
Spring /2013	**ECE 4833 / Materials and Device Characterization**	**7**	**3**	**4.75**
Spring /2014	**ECE 3040 / Microelectronic Circuits**	**56**	**20**	**4.79**
Spring /2015	**ECE 4803 A/ Renewable Energy Devices**	**10**	**7**	**4.80**
Fall /2015	**ECE 3040 / Microelectronic Circuits**	**41**	**16**	**4.70**
Fall /2015	**ECE 4803 B/ Renewable Energy Devices**	**26**	**5**	**4.00**
Spring /2015	**ECE 3450 A / Semiconductor Devices**	**8**	**4**	**4.80**
Spring /2015	**ECE 4803 A/ Renewable Energy Devices**	**27**	**15**	**4.70**
Spring /2017	**ECE 3040 / Microelectronic Circuits**	**34**	**11**	**4.95**
Spring /2017	**ECE 4803 B/ Renewable Energy Devices**	**15**	**1**	**5.00**
Spring /2018	**ECE 3040 / Microelectronic Circuits**	**38**	**18**	**4.80**
Spring /2019	**ECE 3040 / Microelectronic Circuits**	**32**	**12**	**4.80**
Spring /2019	**ECE 4823 A/ Renewable Energy Devices**	**21**	**10**	**4.90**
Fall / 2019	**ECE 3040 / Microelectronic Circuits**	**15**	**7**	**4.90**
Spring /2021	**ECE 3040 / Microelectronic Circuits**	**24**	**7**	**4.00**
Spring /2021	**ECE 4823 A/ Renewable Energy Devices**	**26**	**6**	**4.90**
Fall /2022	**ECE 3040 / Microelectronic Circuits**	**37**	**6**	**4.90**
Spring /2022	**ECE 4470 A/ Renewable Energy Devices**	**30**	**11**	**4.80**
Fall /2022	**ECE 3040 / Microelectronic Circuits**	**42**	**15**	**4.80**
Spring /2022	**ECE 4470 A/ Renewable Energy Devices**	**30**	**11**	**4.80**
Totals (Students/Responses) and Averages (Means)		**1194**	**447**	**4.69**

***Represents the averages of three sections (1 Atlanta, and 2 GTREP) weighted by the number of responses**

**** Two sections weighted averages based on number of responses**

Graduate Courses:

Term/Year	Course Number/Name	# of Students	# of Responses	Teaching Effectiveness
		Mean Score		
Fall/2002	**ECE6450A / Introduction to Microelectronic Device Fabrication**	**47**	**21**	**4.80**
Fall/2004	**ECE6450A / Introduction to Microelectronic Device Fabrication**	**43**	**26**	**4.50**
Fall/2005	**ECE6451A / Microelectronic Theory**	**13**	**5**	**4.90**
Fall/2008	**ECE6450A / Introduction to Microelectronic Device Fabrication**	**36**	**19**	**4.60**
Fall/2017	**ECE6450A / Introduction to Microelectronic Device Fabrication**	**39**	**17**	**4.90**
Fall /2021	**ECE6450A / Introduction to Microelectronic Device Fabrication**	**36**	**15**	**4.80**
Totals (Students/Responses) and Averages (Medians)		**214.00**	**103.00**	**4.75**

B. INDIVIDUAL STUDENT GUIDANCE

B1. PH.D. STUDENTS

B.1.A. GRADUATED PH.D. STUDENTS

1) Gon Namkoong (co-advised with April S. Brown), Ph.D.
   Began advising Spring 2001
   Graduation date: Summer 2003
   Ph.D Thesis Title: Molecular Beam Epitaxy Grown III-Nitride Materials for High-Power and High-Temperature Applications: Impact of Nucleation Kinetics on Material and Device Structure Quality
   Currently Employed at: Old Dominion University – Professor
2) Shawn Burnham, Ph.D.
   Began advising Fall 2001
   Graduation date: Summer 2007
   Ph.D Thesis Title: Improved Understanding and Control of Magnesium-Doped Gallium Nitride By Plasma Assisted Molecular Beam Epitaxy
   Currently Employed at: HRL Laboratories, Malibu, CA
3) Alexander Carver, Ph.D.
   Began advising Fall 2001
   Graduation date: Spring 2009
   Project Title: Single Crystal Ferroelectric Oxides for Power Electronic and Optoelectronic Applications
   Currently Employed at: Jet Propulsion Laboratory, Pasadena, CA
4) Elaissa Trybus, Ph.D.
   Began advising: Summer 2003
   Graduation date: Spring 2009
   Project Title: InN Low Bandgap Semiconductors for Photovoltaic Applications
   Currently Employed at: Johns Hopkins University, Assistant Professor
5) David C. Pritchett, Ph.D.
   Began advising: Fall 2003
   Graduation date: Spring 2009
   Project Title: Epitaxial Patterning by Intelligent Real Time Control
   Currently Employed at: Northrop Grumman Inc., Los Angeles, CA
6) Kyoung-Keon Lee, Ph.D.
   Began advising Spring 2004
   Graduation date: Spring 2009
   Project Title: Integrated Optoelectronics using III-Nitride Epitaxy on LiNbO3 – Epitaxy and Device Fabrication
   Currently Employed at: Texas State University
7) Daniel Billingsley
   Began advising Fall 2005
   Graduation date: Spring 2010
   Project Title: Photo-assisted Epitaxy for In-Situ Epitaxial Patterning
   Currently Employed at: Sensor Electronic Technology, Columbia, SC
8) Michael Moseley
   Began Advising: Spring 2008
   Graduation Date: Spring 2013
   Project Title: Novel LED Using a Self-Luminescent, Lattice Matched Substrate

Won the North American Molecular Beam Epitaxy Conference Best Student Presentation Award in 2009 and again in 2010
Currently Employed at: Sandia National Laboratory, Albuquerque, NM

9) Jordan Greenlee
Date Began Advising: Spring 2010
Graduation Date: Spring 2014
Project Title: Cation Based Complimentary Memristors for Neuromorphic Applications
Won the Oscar P. Cleaver Award for making highest preliminary exam score
Won the North American Molecular Beam Epitaxy Conference Best Student Abstract Award in 2010
Currently Employed at the Micron Inc., Boise Idaho

10) Brendan Gunning
Date Began Advising: Fall 2010
Graduation Date: Spring 2016
Won the best Contribution at the Workshop on Compound Semiconductor Materials and Devices
Exams Passed and dates: Preliminary Exam, Fall 2010.
Project Title: III-Nitride Heterojunction Diodes and Bipolar Transistors
Currently Employed at: Sandia National Laboratory, Albuquerque, NM

11) Chloe Fabien
Date Began Advising: Fall 2011
Graduation Date: Spring 2016
Exams Passed and dates: Fall 2011.
Project Title: "InGaN Photovoltaics"
Currently Employed at: Oculus Inc., WA

12) Joshua Shank
Date Began Advising: Spring 2012
Graduation Date: Summer 2016
Exams Passed and dates: Spring 2012.
Project Title: "Materials and Devices for Neuromorphic Computing"
Currently Employed at: Sandia National Laboratory, Albuquerque, NM

13) Brooks Tellekamp
Date Began Advising: Fall 2012
Graduation Date: Fall 2018
Exams Passed and dates: Fall 2012.
Project Title: "Devices and Systems for Neuromorphic Computing"
Currently Employed at: National Renewable Energy Laboratory

14) Ehsan Vadiee (Note: Ehsan worked in the Doolittle lab for 2 years but eventually graduated from Arizona State University)
Date Began Advising: Spring 2017
Graduation Date: Spring 2019
Exams Passed and dates: N/A
Project Title: "InGaN Photovoltaics"

15) Evan Clinton
Date Began Advising: Fall 2014
Graduation Date: Fall 2019

Exams Passed and dates: N/A
Project Title: "AlInGaN Optoelectronic Devices and Tunnel Junctions"

16) Bill Zivasatienraj
    Date Began Advising: Fall 2017
    Graduation Date: Spring 2022
    Exams Passed and dates: Fall 2020
    Project Title: "Scaling of Lithium Metal Oxides for Neuromorphic Computing"
17) Zachary P. Engel
    Date Began Advising: Fall 2017
    Expected Graduation Date: Spring 2022
    Exams Passed and dates: N/A
    Project Title: "Al based III-Nitrides for Optoelectronics Applications"
18) Habib Ahmad
    Date Began Advising: Fall 2018
    Expected Graduation Date: Fall 2021
    Exams Passed and dates: N/A
    Project Title: "Thermal Interface Design of III-Nitrides for High Power Applications"
19) Aheli Ghosh
    Date Began Advising: Fall 2018
    Expected Graduation Date: Spring 2023
    Exams Passed and dates: N/A
    Project Title: "Three Terminal Devices for Neuromorphic Computing"
    Currently with Apple, Los Angelos
20) Chris Matthews
    Date Began Advising: Fall 2017
    Graduation Date: Fall 2023
    Exams Passed and dates: N/A
    NSF Fellowship Winner
    Project Title: "Overcoming Longstanding Synthesis Challenges Toward Realizing The Full Device Potential Of III-Nitride Semiconductors"
    Won best Student Presentation Award at the 14th International Conference on Nitride Semiconductors (ICNS), Fukuoka, Japan (2023)
21) Keisuke Motoki
    Date Began Advising: Fall 2018
    Graduation Date: Spring 2023
    Exams Passed and dates: N/A
    Project Title: "Structural Characterization and Understanding Growth Kinetics Of Modern III-Nitride Epitaxial Methods"
    Currently with IBM, New York

B1B. PHD IN PROCESS

22) Alex Weidenbach
    Date Began Advising: Fall 2017
    Expected Graduation Date: Spring 2022

Exams Passed and dates: N/A
Project Title: “Lithium Metal Oxides for Neuromorphic Computing”

23) Timothy M. McCrone
    Date Began Advising: Fall 2018
    Expected Graduation Date: Spring 2023
    Exams Passed and dates: N/A
    Project Title: “Synthesis of Lithium Metal Oxides for Neuromorphic Computing”
24) Sanghoo Lee
    Date Began Advising: Fall 2021
    Expected Graduation Date: Spring 2025
    Exams Passed and dates: N/A
    Project Title: “III-Nitride Power Devices and Materials”
25) Emily Marshall
    Date Began Advising: Fall 2022
    Expected Graduation Date: Spring 2026
    Exams Passed and dates: N/A
    Project Title: “III-Nitride Acoustic Filter Power Devices and Materials”
    Won best Student Presentation Award at the 14th International Conference on Nitride Semiconductors (ICNS), Fukuoka, Japan (2023)
26) Anusha Krishnan
    Date Began Advising: Fall 2022
    Expected Graduation Date: Spring 2026
    Exams Passed and dates: N/A
    Project Title: “Thermal Properties of III-Nitride Materials and Devices”
27) Paul Stephen Hutchinson Maltaghati
    Date Began Advising: Fall 2022
    Expected Graduation Date: Spring 2026
    Exams Passed and dates: N/A
    Project Title: “Thermal Properties of III-Nitride Materials and Devices”

B2. M.S. Students

B2a. Graduated with M.S. Thesis

25) Jordan Greenlee
    Date Began Advising: Spring 2010
    Graduation Date: Spring 2014
    Project Title: Cation Based Complimentary Memristors for Neuromorphic Applications
    Won the Oscar P. Cleaver Award for making highest preliminary exam score
    Won the North American Molecular Beam Epitaxy Conference Best Student Abstract Award in 2010
    Currently Employed at the Micron Inc., Boise Idaho
26) Joshua Shank
    Date Began Advising: Spring 2012
    Graduation Date: Summer 2016
    Exams Passed and dates: Spring 2012.
    Project Title: “Materials and Devices for Neuromorphic Computing”
    Currently Employed at: Sandia National Laboratory, Albuquerque, NM
27) James Compagnoni (Materials Science)

Date Began Advising: Fall 2011
Graduation Date: Spring 2013 (Quit Phd Program)
Project Title: MBE of $LiCoO_2$ for RF and Magnetic Applications
Currently Employed at Intel Inc.

28) Chris Matthews
Date Began Advising: Fall 2017
Graduation Date: Fall 2023
Exams Passed and dates: N/A
NSF Fellowship Winner
Project Title: "Surface Oxide Removal On Aluminum Nitride Substrates"
Won best Student Presentation Award at the 14th International Conference on Nitride Semiconductors (ICNS), Fukuoka, Japan (2023)

B2B. IN PROCESS WITH M.S. THESIS

29) None

B2C. GRADUATED M.S. NON-THESIS

30) Shannon Madison (Co-advised with Stephen Ralph)
Began advising Fall 2004
Graduation date: Fall 2006
Project Title: Integrated Optoelectronics using III-Nitride Epitaxy on LiNbO3 – Device Fabrication and Optical Design

31) Benjamin Small
Began advising Summer 2001
Graduation date: Spring 2002
Project Title: III-Nitride Electronic Device Fabrication

32) Nicholas Brown
Began advising: Spring 2007
Expected Graduation Date: Left Program Early
Exams passed and dates: Preliminary Exam, Spring 2006
Project Title: Modified MBE for In-situ Characterization of LiNbO3

33) Jonathon Lowder
Date Began Advising: Fall 2009
Expected Graduation Date: Spring 2014 (Quit Phd Program – did not pass Prelim)
Project Title: III-Nitride Heterojunction Diodes and Bipolar Transistors

34) James Compagnoni (Materials Science)
Date Began Advising: Fall 2011
Graduation Date: Spring 2013 (Quit Phd Program)
Project Title: MBE of LiCoO2 for RF and Magnetic Applications

35) William Laws Calley
Date Began advising: Spring 2005
Graduation date: Spring 2007 (Quit Phd Program)
Project Title: Lithium Niobium Oxide on SiC - Epitaxy and Device Fabrication

36) Joseph Merola
Date Began Advising: Fall 2014
Graduation Date: Spring 2016 (Quit Phd Program)
Exams Passed and dates: Fall 2012.

Project Title: “InGaN Photovoltaics”
Master’s Special Problems Students

37) Deepak Janakiraman, Ph.D. Candidate
    Began advising Fall 2002, quit Spring 2003
    Exams passed: None
    Project Title: III-Nitride Technology on Lithium Niobate for Optoelectronic Modulator Applications
38) Changsoo Hong, Ph.D. Candidate
    Began advising Spring 2002
    Expected Graduation date: Student switched advisors in Fall 2002
    Exams passed: None
    Project Title: Dual Diamond Damascene III-Nitride Technology for RF Power Electronic Applications

B2D. IN PROCESS M.S. NON-THESIS

None

B3. UNDERGRADUATE STUDENTS

B3A. PAID LABORATORY INTERNSHIP

Starting in 2003, several undergraduate students were integrated into research programs through paid positions. These positions averaged approximately 10 hours per week.

ECE undergraduate students responsible for laboratory equipment development, semiconductor characterization, semiconductor fabrication tool development include:

39) Saurav Sengupta during Fall 2003, Spring 2004 and Fall 2004
40) Brian S. Smith during Spring 2004 and Fall 2004
41) Eshwar Stalin during Summer 2004 and Fall 2004
42) Harris Chen Wang during Summer 2004
43) Abhishek Narula during Fall 2007-Spring 2008
44) Michael Moseley Spring, Summer fall 2007
45) Jack Bell Spring 2011-2012
46) Brooks Tellekamp Summer 2011-2012
47) Jacob Yount (ME) Summer, Fall 2015
48) Lauren Murphy (ME) Summer, Fall 2015
49) Mitchell Spears (ECE) Fall 2018
50) Amanda Tang (ECE) Fall 2022-Spring 2024
51) Johnathon Wright (MSE) Fall 2021-Present

B3B. BUSINESS INTERNSHIPS

Supervised Business Students providing real world management experience for undergraduate students responsible for program administration, financial management, accounting and reporting:

52) Stephanie Pippen Spring, Summer and Fall of 2004
53) Rachel Swafford during Spring 2005
54) Catherine Hammer during Summer 2005
55) Jordan Bush during Fall 2007 to Spring 2008

B3C. UNDERGRADUATE RESEARCH EXPERIENCE ADVISEMENT

56) Brinda K. Ramaiya: Advised on an Undergraduate Research Opportunities Project (UROP) Summer 2001. Topic: "Pyrometer Growth Monitor using Labview"
57) Brian Davis: Advised on a Summer Undergraduate Research in Engineering program Project (SURE) Summer 2001. Topic: "Labview automation of a Hall measurement system"
58) Peter Pappas: Advised on an Undergraduate Research Opportunities Project (UROP) Fall and Spring 2001/2002. Topic: "Microcontroller interface for an auto-tuning RF plasma matching network"
59) Mustayeen Nayeem: Advised on an Undergraduate Research Opportunities Project UROP) Summer 2002. Topic: "Implementation of a differential capacitance circuit in a deep level transient spectroscopy system"
60) Mark Verghese: Advised on an Undergraduate Research Opportunities Project (UROP) Spring and Fall 2002. Topic: "Temperature Control Implementation of a Semiconductor Growth Recipe Reader"
61) Hitesh Upadhyay: Advised on an Undergraduate Research Opportunities Project (UROP) Fall 2002 and Spring 2003. Topic: "Implementation of a variable magnetic field hall measurement system using Labview". ***This project was awarded a President's Undergraduate Research Award (PURA) to pursue this topic in Fall 2002 / Spring 2003.***
62) Dhairya Menta: Advised on an Undergraduate Research Opportunities Project (UROP) Spring 2002 and Fall 2002. Topic: "Implementation of a stepper motor control for a RF plasma source impedance matching network"
63) Reshma Parekh: Advised on an Undergraduate Research Opportunities Project (UROP) Fall 2002 and Spring 2003. Topic: "Development of a pulse interface for a deep level transient spectroscopy system"
64) Vikas J. Parekh: Advised on an Undergraduate Research Opportunities Project (UROP) Fall 2002. Topic: "Development of a MOSFET Characterization System based on source-measurement units"
65) Jinesh Karia: Advised on an Undergraduate Research Opportunities Project (UROP) Fall 2002. Topic: "Implementation of a variable frequency conductance measurement for extraction of the density of interface states"
66) Gautam Khanna: Advised on an Undergraduate Research Opportunities Project (UROP) Fall 2002. Topic: "Study of doping behavior in Lithium Niobate"
67) Salil Arora: Advised on an Undergraduate Research Opportunities Project (UROP) Fall 2002. Topic: "Design of a General Electronic Materials Characterization Photomask using AutoCad"
68) Ming Teng Han: Advised on an Undergraduate Research Opportunities Project (UROP) Fall 2002. Topic: "Implementation and Testing of a Mercury for Probe Rapid Characterization of Semiconductor Materials"
69) Ranit Windlass: Advised on an Undergraduate Research Opportunities Project (UROP) Summer 2003. Topic: "Design of a temperature compensated logarithmic voltage amplifier"
70) William Laws Calley III: Advised on an Undergraduate Research Opportunities Project (UROP) Summer 2003 and Fall 2003. Topic: "Sputtering of and Fabrication of LiNbO3 alternative gate dielectrics for SiC power transistors"

71) Brian S. Smith: Advised on an Undergraduate Research Opportunities Project (UROP) Spring 2003 and Summer 2003. Topic: "Implementation of a capacitance voltage measurement system in a Labview environment"
72) Alexis Sanderlin: Advised on an Undergraduate Research Opportunities Project (UROP) Spring 2003. Topic: "Determination of crystal quality by x-ray diffraction"
73) Alan Ngo: Advised on an Undergraduate Research Opportunities Project (UROP) Spring 2003. Topic: "MOSFET parameter extraction using Labview"
74) Arnab Das: Advised on an Undergraduate Research Opportunities Project (UROP) Spring 2004. Topic: "Computer Control of an Antimony valved cracker for molecular beam epitaxy"
75) John Erdelt: Advised on an Undergraduate Research Opportunities Project (UROP) Spring 2004. Topic: "Microcontroller implementation of a fuel injection system"
76) Ephraim Lucas: Advised on a Summer Undergraduate Research in Engineering program Project (SURE) Summer 2004. Topic: "Validation and Calibration of a SiC Chemical Vapor Deposition System"
77) Deborah M. Johnson: Advised on an Undergraduate Research Opportunities Project (UROP) Spring 2004. Topic: "Labview based Current-Voltage Characterization system development"
78) Andera Pinkney-Hawkins: Advised on a Summer Undergraduate Research in Engineering program Project (SURE) Summer 2005. Topic: "Labview Automation of a Photoluminescence Monochromator"
79) Michael Moseley: Advised on a Summer Undergraduate Research in Engineering program Project (SURE) Summer 2007. Topic: "Lapping and Polishing Oxide Substrates"
80) Fletcher Dostie: Advised an Undergraduate Research Opportunities Project (UROP) Fall 2010 and Spring 2011. Topic: Development of a Phase Lock Loop modulator with an analog variable frequency low pass filter.
81) Brookes Tellekamp: Advised a MRCEC Summer Internship Summer 2011. Topic: Metal Organic Molecular Beam Epitaxy of Complex Metal Oxides.
82) Raymond W. Chian: Advised an Undergraduate Research Opportunities Project (UROP) Summer 2012. Topic: Development of a Solar Simulator
83) Theodore Hecker: Advised an Undergraduate Research Opportunities Project (UROP) Spring 2012.Topic: Ultra-Low Current Measuring
84) Shukun Yang, Advised an Undergraduate Research Opportunities Project (UROP) Fall 2013. Topic: Development of a Phase Lock Loop modulator with an analog variable frequency low pass filter.
85) Jacob J. Yang, Advised an Undergraduate Research Opportunities Project (UROP) Fall 2014. Topic: Development of a Phase Lock Loop modulator with an analog variable frequency low pass filter.
86) Anand Ramanathan, Advised an Undergraduate Research Opportunities Project (UROP) Fall 2018. Topic: SPICE model of an Analog Memristor
87) Andrew Hellrigel, Advised a project developing a neuromorphic computing interface board. Won the Ga Tech Outstanding Undergraduate Researcher Award, Spring 2020 – Summer 2021.

B4. Service on Thesis or Dissertation Committees

B4a. Internal

Dates and Numbers not Recorded. Will Do hence forward.

B4b. External

Dates and Numbers not Recorded. Will Do hence forward.

B5. Mentorship of postdoctoral fellows or visiting scholars

B5a. Support/Advisement of Summer High School Teachers

1) Michael Lanham (Sprayberry High School) Summer 2003
2) Kaye Sheets (Patrick Henry High School) Summer 2006
3) Jacquelyn Thomas (DeKalb Co High School) Summer 2006
4) Bill Daly (Collins Hill High School) Summer 2011 and Summer 2012

C. Other Teaching Activities

C1. Course Development

Developed two senior special topics classes "Semiconductor Materials and Device Characterization" and "Devices for Renewable Energy" both of which have been extremely well received. Prior to these courses, seniors interested in microelectronics only had one senior elective from which to choose.

C2. Course Improvement

Developed World Wide Web-based course curriculums for ECE 3040, ECE3080, ECE6451, ECE6450 as well as two senior special topics classes "Semiconductor Materials and Device Characterization" and "Devices for Renewable Energy". These web sites contain animations and computer graphics to aid in the explanation of difficult concepts. They also contain homework assignments, solutions, lecture notes, and exam solutions (present and past) to supply students with adequate resources for the class. Several other professors have used this site as a template for their class development.

C3. Professional Development/Continuing Education

Taught distance learning section for ECE6450 in Fall 2014 and the GTREP course for ECE 3040 in Fall 2001 and Summer 2002 via distance learning.

C4. Other Teaching Activities

No Data

VI. SERVICE

A. Professional Contributions

List all national and international contributions of service and positions of leadership in the profession.

A1. Editorial Board Memberships

No Data

A2. Society Offices, Activities, and Membership

a. Senior Member of IEEE
b. Member of IEEE Electron Devices Society
c. Member of IEEE Instrumentation and Measurement Society
d. Member of Materials Research Society
e. Member of American Society of Engineering Educators (ASEE)
f. Member of American Physical Society
g. Member of American Vacuum Society

A3. Organization and Chairmanship of Technical Sessions, Workshops and Conferences

a. Chair of Office of Naval Research Workshop on Ferroelectronic Semiconductor Interfaces, April 7-11, 2002.
b. Program Committee for 2002 Electronic Materials Conference
c. Program Committee for 2002 IEEE Lester Eastman Conference on High Performance Devices
d. Program Committee for 2004 IEEE Lester Eastman Conference on High Performance Devices
e. Organizing Committee for 2005 International Conference on Silicon Carbide and Related Materials
f. Exhibits Chairman for 2005 International Conference on Silicon Carbide and Related Materials
g. Wide Bandgap Semiconductor Focus Session Chair/Co-organizer for American Physical Society March Meeting 2005
h. Program Committee for 2005 North American Molecular Beam Epitaxy Conference
i. Session Chair for Workshop on the Future of Electronics, Aruba, Dec. 18-22, 2004
j. Session Chair for 1999, 2002 Electronic Materials Conference
k. Program Committee, Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), 2005 Miami, FL.
l. Program Chair, Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), 2006, Phoenix AZ.
m. Program Chair, Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), 2007 Savannah, GA.
n. Program Committee, Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), 2008 Palm Springs, CA.
o. Program Committee, 2008 Electronic Materials Conference, June 25-27, 2008 Santa Barbara, CA.
p. Program Committee, Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), 2009 Fort Myers, FL
q. Program Committee, Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), 2010 Newport Beach, CA

r. Program Chair, International Workshop on Nitride Semiconductors 2010, Tampa FL
s. Program Committee for 2010 North American Molecular Beam Epitaxy Conference, Sept 26-29th 2010, Breckenridge, CO
t. Program Committee for 2010 International Molecular Beam Epitaxy Conference, August 22-27th, 2010 Berlin, Germany
u. Organizing and Program Committee, 2010 Electronic Materials Conference, June 22-24, 2011 Santa Barbara, CA.
v. Chair, Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), 2011 Savannah, GA
w. Program Chair, International Conference on Nitride Semiconductors 2013, Washington DC
x. Officer (secretary) Organizing Committee, Electronic Materials Conference, 2013-2015.
y. Organizing and Program Committee, Electronic Materials Conference, 2016-2018
z. Organizing Committee, Electronic Materials Conference, 2018-Present
aa. Program Committee, Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), 2013 New Orleans, LA
bb. Chair North America Molecular Beam Epitaxy Conference, Atlanta 2012
cc. Organizational Committee, North America Molecular Beam Epitaxy Conference, 2013-present
dd. Program Committee, Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), 2014 San Antonio, TX
ee. Program Committee, Workshop on Compound Semiconductor Materials and Devices (WOCSEMMAD), 2015 Tucson, AZ
ff. Chair, International Workshop on Nitride Semiconductors 2016, Orlando FL
gg. Program Committee, International Workshop on Nitride Semiconductors 2018, Kanazawa Japan
hh. Chair, International Conference on Nitride Semiconductors 2019, Bellevue WA
ii. Program Committee, International Workshop on Nitride Semiconductors (IWN) 2022, October 09–14, 2022 in Berlin, Germany
jj. Program Committee, International Conference on Nitride Semiconductors (IWN) 2023, October 2023 in Fukuoka, Japan
kk. Program Chair, International Workshop on Nitride Semiconductors (IWN) 2024, November 2024 in Oahu, Hawaii

A4. Technical Journal or Conference Referee Activities

a. Review of Scientific Instruments
b. Journal of Electrochemical and Solid State Letters
c. Journal of Electronic Materials

d. Proceedings of the Materials Research Society
e. IEEE Transactions on Electron Devices
f. IEEE Electron Device Letters
g. Applied Physics Letters
h. Journal of Applied Physics
i. Journal of Materials Science
j. Journal of Vacuum Science and Technology
k. Thin Solid Films
l. Solid State Electronics
m. Nature
n. Nature Communications
o. Conference on the Physics of Vacuum Science and Technology

A5. Proposal Panels and Reviews

a. NSF SBIR panel review, Spring 2001, 2002, 2004, 2008, 2011, 2014
b. NSF CAREER panel review, Fall 2004, 2016
c. United States Army Research Office-proposal, Spring 2004, 2016
d. NSF - proposal review, Fall 2004, 2014, 2015, 2016, 2017, 2020, 2021
e. NSF MRI panel review, Spring 2005, 2007
f. NSF Division of ECCS, Fall 2006, 2014, 2016, 2019
g. AFOSR 2017, 2019, 2021, 2023

B. Public and Community Service

No Data

C. Institute Contributions

C1. Institute Committee Service

ECE Faculty Senate 2018

C2. College Committee Service

No Data

C3. School Committee Service

a. ECE Undergraduate Curriculum Committee, Fall 2001-2009
b. ECE Curriculum Study Committee, Summer 2004, Fall 2004
c. ECE Instrumentation Committee, Spring 2001-Summer 2001
d. EE Curriculum Subcommittee, Fall 2009 and Spring 2010
e. ECE Faculty Recruitment Committee, 2010-2014
f. ECE Statutory Advisement committee, 2009-2013, 2019-present
g. Faculty Life Action Committee (FLAC) 2018-2019
h. ECE Graduate Committee 2014-present
i. ECE Microsystems/Nanotechnology TIG Chair 2015-2019

j. ECE Nanotechnology Faculty Recruitment Committee 2019-Present
k. Future of ECE's Workplace (FEW) Taskforce 2022

C4. PROGRAM DEVELOPMENT: RESEARCH

No Data

C5. PROGRAM DEVELOPMENT: ACADEMIC

Co-led through the graduate committee the revision for the School of ECE's preliminary exam improvement.

C6. OTHER INSTITUTE SERVICE CONTRIBUTIONS

1) Hosted a number of laboratory/campus tours for middle school age science and math organizations throughout his academic career.
2) Judged IEEE Undergraduate Student Paper Contest, Spring 2002.
3) Presentation given for the Women of Electrical and Computer Engineering, Women's Undergraduate Research Orientation on April 16, 2005.
4) Hosted three minority students as part of the Summer Undergraduate Research Experience (SURE) program, summer 2001, 2003 and 2005.
5) Advised four high school science teachers summer (GIFT, NRC and MRESEC) internship during summers of 2003, (2) 2006, and 2011
6) Hosted various high school and junior high field trips in 2006-2011.