

Ian Ferguson
Professor, Dept. Electrical and Computer Engineering

1. OVERVIEW

1.1 Biography

I am currently based Missouri University of Science and Technology (Missouri S&T). I have had leadership positions in both academia and industry throughout my career with increasing managerial and fiscal responsibilities. Most recently, I was the founding Vice Provost and Dean of the College of Engineering Computing at Missouri S&T. My research expertise is in building interdisciplinary teams to use compound semiconductor materials and devices for applications in the areas of sensors, illumination, energy harvesting, and spintronics. This research was supported through competitive research grants and contracts through various government agencies and others totaling over \$27M as a lead investigator in academia and industry. I have had active collaborations in the US, Europe, and Asia, which has resulted in numerous publications, conference proceedings, books, book chapters, and patents. In addition, I have been actively involved in the entrepreneurial process of establishing new companies in academia and industry, co-founding a business incubator. I am a Fellow of the Royal Society of Arts, Manufactures and Commerce (FRSA). I am also a Fellow of the Institute of Electrical and Electronic Engineering, Institute of Physics, and the International Society for Optical Engineering.

1.2 Education

- **Heriot Watt University, Scotland:** B.Sc. Physics (Honors) (1984).
- **University of St. Andrews, Scotland:** M.Sc. Optoelectronics (1986).
M.Sc. project completed at GEC Borehamwood, London, UK.
- **University of St. Andrews, Scotland:** Ph.D. Compound semiconductors (1989).
CASE Award with GEC Hirst Research Center, East Lane, London, UK.

1.3 Employment

- **Imperial College, London:**
Research Scientist, Interdisciplinary Research Center on Semiconductor Materials (1989- 1992).
- **Northwestern University, Chicago, IL:**
Director, Crystal Growth Facility, Materials Science and Engineering (1992-1994).
Research Assistant Professor, Electrical Engineering & Computer Science (1994-1996).
- **EMCORE Corporation, Somerset, NJ:**
Director, Research Development (1996-2001).
Director, Intellectual Property (1997-2001).
General Manager, *In-Situ* Products (1999-2001).
- **Georgia Institute of Technology, Atlanta, GA:**
Professor, School of Electrical Engineering (2001-2009).
Director, Focused Research Program on Next Generation Lighting (2002-2009).
Professor, School of Materials Science and Engineering (2004-2009).
- **The University of North Carolina at Charlotte, Charlotte, NC:**
Professor and Chair of Electrical and Computer Engineering Department (2009-2014).
Assistant Director, EPIC - Renewables and Energy Efficiency (2011-2014).
- **Missouri University of Science and Technology, Rolla, MO:**
Vice Provost and Dean of Engineering and Computing (2014-2015).
Professor, Department of Electrical and Computer Engineering (2014-present).
Professor, Department of Materials Science and Engineering (2015-present).
Professor, Department of Economics - Entrepreneurship and Innovation (2016-present).

1.4 Leadership and Related Accomplishments

Founding Vice Provost and Dean of Engineering and Computing - Missouri S&T

Missouri S&T's College of Engineering and Computing consists of nine academic departments, with over 215 faculty and over 7150 students consisting of 5241 undergraduate students and 1025 graduate students on campus of which 429 are in the Ph.D. program and an additional 893 are distance learning students. There are 18 engineering and computing undergraduate degree programs of which 16 are ABET accredited – more than three times the average of U.S. universities. This is complemented by 19 Master's degree and Ph.D. programs in engineering and computing of which 17 have an online presence. Missouri S&T was recently ranked No. 3 engineering school in the nation by *College Factual* and *USA Today*, and ranked 15th in the nation and first in the state of Missouri in terms of engineering bachelor degrees awarded, according to the American Society for Engineering Education. Missouri S&T's online graduate programs in engineering are among the top 20, according to *U.S. News & World Report*. Highlights include:

- Established a new College of Engineering and Computing at Missouri S&T. Prior to this time all department chairs reported directly to the Provost.
- Developed a college level strategic plan that closely coupled into that of the university's with a corresponding dashboard to monitor progress.
- Initiated a program to move the college towards being a Top 50 engineering program by analyzing the metrics used by US News rankings, Carnegie research classification, Association of American Universities and others.
- Identified differentiated revenue lines for the college that reflected its strength in both teaching and research.
- Realigned other non-academic divisions to the new college structure with the appropriate support.
- Set priorities for the college that were both internally and externally focused.
- Contributed the new Missouri S&T marketing campaign to better represent the breadth and depth of the college.

Operations:

- Created a new college office hiring the college's associate deans, office staff and other positions. This leadership team is still in place.
- Managed the transition of a number of chairs back to faculty positions and increased diversity with new interim chairs.
- Developed college level best practices and policies for hiring making it EEOC compliant, for faculty workload and in other areas.
- Initiated a base plus budget model with the Provost and others.
- Addressed various issues with faculty and staff compensation.

Educational Program:

- Successful completion of ABET accreditation for 16 academic programs; the largest university visit in that academic year.
- Moved the reporting lines for Freshmen Engineering to the college with additional hires.
- Developed a bid to the state legislature to expand a remote program at Missouri State University to add a mechanical engineering program that was successfully funded for \$3M of which \$2M/year were reoccurring.
- Resolved a critical issue with joint educational program that had resulted a significant institutional exposure. I closed down an overseas operation on short notice and brought the faculty back to the U.S.
- Co-PI for a successfully funded site i-CORP (NSF Innovation Corps) proposal.

Research:

- Addressed issues associated with an incentive program, 'self-award', that was not federal or state compliant. This resulted in significant funding being returned to various agencies.
- Developed and managed a cluster hiring process for the university.
- Developed university policy (II-26) to ensure that externally funded graduate assistantships captured the proper graduate student support in proposals.
- Created college specific programs to support faculty proposals development such as "Mentoring Mondays".
- Coordinated and supported the submission of Graduate Assistants in Areas of National Need programs which resulted in five being funded, the most for the institution.

Outreach:

- Defined the top 50 alumni that are college focused and whose giving is not diluted with other priorities to endow the college and the dean's position.
- Hosted many individual donor meetings very often 'healing relationships' associated with poor stewardship of current endowments.
- Met with civic leaders multiple times to discuss the economic development and entrepreneurship.
- Developed a successful pitch for the Experimental Mine Building and initiated the building phase of the project. This was a badly needed investment for the mining program that had stalled out for five years.
- Supported and re-optimized the pitch for expanding the Advanced Construction and Materials Lab.

Other:

- Actively involved in the rebranding of the university.
- Promoted Missouri S&T by a much increased presence at ASEE 2015 and 2016.
- Promoted the educational mission of the college through presentations at ASEE and MRS Conferences.

Professor and Chair of Electrical and Computer Engineering Department - UNC Charlotte

UNC Charlotte is North Carolina's urban research university. Located in the state's largest metropolitan area, UNC Charlotte is among the fastest growing universities in the UNC System. UNC Charlotte was established in 1946 and at the time I left had ~1,280 academic staff serving ~26,200 students of which ~21,200 are undergraduates. The ECE Department in the College of Engineering had 42 faculty members, 5 associated support staff, 460 undergraduates in two programs (Electrical Engineering and Computer Engineering), and 230 graduate students with 70 pursuing Ph.Ds. with a budget of ~\$5M/year. Highlights include:

- Successfully completed ABET and also managed SACs accreditation. Of these, the ABET accreditation is particularly noteworthy because the programs had no weaknesses, no concerns and no observations.
- The department climbed in the US News and World Report rankings from 125th to 77th.
- Experienced a more than doubling of the active award funding in the department from <\$2.0M in active programs to >\$5.5M and this was without my research contributions to this total or many of the new faculty.

Operations:

- Completed the final design and planning for EPIC (Energy Production and Infrastructure Center) and managed the transition of the ECE Department into this new \$70M, 200,000 ft² building, increasing the department's area by a factor of four.
- Hired and integrating eleven (11) faculty members into the ECE Department increasing the diversity of the department with three of these hires. Many of these were non-traditional faculty, mid-career hires, from industry and cluster hires associated with EPIC funding lines.
- Completed five year strategic planning; successfully implementing and meeting multiple one year tactical plans and goals.

Educational Program Developments:

- Integrated the principles of entrepreneurship into our programs. As a consequence, student teams have become very competitive in state and national competitions. They placed 1st in Five Ventures, 2nd in Ventureprise and 2nd in a social entrepreneurship competition.
- Increased the enrollment in the graduate programs by ~34% from 169 (110 MSEE and 59 Ph.D.) to 244 (156 MSEE and 68 Ph.D.) so the graduate student numbers are ~50% (1:2 ratio) of the undergraduate students.
- Created a graduate student association within the department that hosts a weekly coffee gathering, student presentation, poster competitions, and other events.

Outreach:

- Completed a restructuring of the external advisory board to include the positions of vice-chair and past-chair for better continuity in its leadership and define a line of succession.
- Established development goals for the ECE Department and ensuring the good stewardship of current gifts.
- As a Member of the Board for NCFirst brought the regional kickoff meeting to Charlotte inviting over 400 high school children and their parents, and more through video conference to another site in South Carolina.

Other:

- ECE faculty members were the lead in a student driven and constructed house for the DOE sponsored Solar Decathlon Competition. The Urban Eden home placed 1st as the People's Choice and 3rd in Engineering. It was the highest ranked US school beating Stanford and UCLA in a competition that was held in California.
- Actively involved in the Advance program at UNC Charlotte and establishing a National Center for Women & Information Technology effort.
- Established an 'Entrepreneur on Call' for the faculty in the department.

Professor of Electrical and Computer Engineering Department – Georgia Institute of Technology

The position at Georgia Institute of Technology was my first traditional faculty position that gave me the opportunity to teach classes. I was heavily involved in the development of the professional engineering program to help students to better develop their professional skill set. I participated every year in the minority focused Summer Undergraduate Research in Engineering/Science and Summer Undergraduate Research Fellowship programs while I was there. I also coordinated the Bobby Jones Fellowship program and, the funding and transfer of students between Georgia Institute of Technology and University of St. Andrews. I was the founder or co-founder of two successful, interdisciplinary, focused research programs in the areas of solid state lighting and thermal neutron detection. Seed funding was made available to initiate these programs focused on team building and marketing the effort, such as workshops to establish funding lines. The neutron detection work also resulted in me becoming Sam Nunn Security Fellow, part of a MacArthur Foundation Initiative, in the Center for International Strategy, Technology and Policy. This policy work resulted in a broader contact with government agencies.

Various positions – EMCORE Corporation

In EMCORE Corporation I held various positions in parallel including the Director of Research, Director of Intellectual Property (IP) and the Manager of In-Situ Products. I was responsible for the long term research and development for the company which was funded both internally and externally through government grants and contract. I became familiar with government contracting, regulations (OMB, FAR and DFAR) accounting and audits. We saw the company's IP portfolio increase from three patents to over 100 of IP in a five year period. I was also responsible for patent management and strategy, in particular, analyzing IP for funding events and acquisitions. I also established a small business unit, In-Situ Products, with initially thirty-six people as a separate profit and loss center to track performance.

Director, Crystal Growth Facility and Research Assistant Professor – Northwestern University

At Northwestern University, I completed the construction of a large clean room facility (>\$9M) when I first arrived and was responsible for its operation. Through this I learned about building codes (BOCA, UFC and NFPA), OSHA, toxic gas ordinances and emergency response. I also managed a multi-user crystal growth facility with many different internal and external stakeholders with diverse needs across multiple colleges and departments before becoming a research professor.

1.5 Other Leadership Activities, Programs and AppointmentsOther Leadership Activities

- Founder/CEO of ASDF Technology (2001-present).
- Founder/CTO of Bellwether Technology (2002-2008).
- Founding member of the Board (2001-2006), Chair of the Board (2006-2012) and acting CTO (Sept. 2005-Aug. 2008) of CERMET Inc.
- Director, Focused Research Program on Solid State Lighting (2002–2007).
- Assoc. Director, Focused Research Program on Pioneering Research in Nuclear Detection (2007–2009).
- Sam Nunn Security Fellow and Alumni of the MacArthur Foundation's Science, Technology and Security Initiative in the Center for International Strategy, Technology, and Policy, Georgia Tech (2008-present).
- Co-founder and Chairman of the Board for PiES: Project for innovation, Energy and Sustainability (2009-2014) and Emeritus Chairman (2014-present).
- Secretary (2011-2012), Vice-Chair (2012-2013), and Chair (2013-2014) of the Southeastern Electrical & Computer Engineering Department Heads Association (ECEDHA).
- Member Board of Directors for Southeastern Center for Electrical Engineering Education (SCEEE) (2011-2014).
- Member of Board of Forsyth Community College Nanotech Program (2012-2014).
- Member of Board of Directors NC FIRST (For Inspiration and Recognition of Science and Technology) Robotics (2012-2014).
- Member of the board of Pi Kappa Alpha (2014-present) and Sigma Phi Epsilon (2015-present).
- Missouri S&T - Phelps County Regional Medical Center Executive Board (2014-2015)
- Member of scientific and technical boards for various companies and have been active in fund raising.

Leadership Programs

- Center for Creative Leadership - Leadership Development Program, May 2013.
- Harvard Business School - Authentic Leadership Development, November-December 2016.
- Singularity University - Executive Program, May 2017.

Other Appointments

- Visiting Professor at Graduate Institute of Photonics and Optoelectronics, National Taiwan University, Taipei, Taiwan (Jan-July 2006).
- Guest Professor Huazhong University of Science and Technology (HUST) and the Wuhan National Laboratory for Optoelectronics (WNLO), Wuhan, China (2006-2008).
- Member of Georgia Tech and France's Centre National de la Recherche Scientifique (CNRS) Unité Mixte Internationale (UMI), Metz, France (2007-present).
- Visiting professorship Anna University Chennai, India (July 2008-present).
- Faculty Associate, the Center for Professional and Applied Ethics, UNC Charlotte (2009-2014).
- Adjunct Professor, Department of Physics, Georgia State University (2011-present).
- Adjunct Professor, Department of Physics, UNC Charlotte (2011-present).
- Visiting Professor, Department of Physics, University of Strathclyde, Scotland (2014-present).
- Visiting Professor in the Department of Physics and Nanotechnology, SRM University Kattankulathur, Tamilnadu, India (2015-present).

1.6 Research Achievements and Impact

I have purposely taken an interdisciplinary approach to research by working at the boundaries of academia and industry. The research for my M.Sc. in Optoelectronics was completed within industry and my Ph.D. was funded by a CASE award (Cooperative Award between Science and Engineering) that allowed me to complete this research within academia (St. Andrews/Glasgow) and industry (GEC/STL). I have also been fortunate to be a member or lead interdisciplinary teams during my time in academia, working within Physics (St Andrews, Imperial College), Materials (Northwestern, Georgia Tech), and Electrical Engineering (Glasgow, Northwestern, Georgia Tech) Departments and Schools. As a consequence, my research spans a broad spectrum in the areas of III-V and II-VI materials and devices for optoelectronic and other applications. My current research philosophy is focused on innovations in materials that bring new functionality to devices, rather than producing more complicated devices in established material systems. Significant research contributions include:

- The first detailed study of the optical properties of MBE-grown AlInAs and the measurement of the AlInAs deformation potential, *SST* **7**(1992)892.
- Discovery of phase separation mechanism in InAsSb that formed naturally occurring strained layer superlattices and the control of this process to produce long wavelength detectors operating at 10 μm , *JAP* **88**(2000)5733.
- The growth of the highest quality InSb (highest mobility, sharpest x-ray linewidth) using Reflection High Energy Electron Diffraction (RHEED) oscillations (and pyrometry) for materials optimization and the first hybrid FPA arrays for InSb grown on silicon and GaAs, *APL* **65**(1994)3338.
- Optimization of the MOCVD growth of GaN-based materials from a detailed understanding of the structural properties of these materials and subsequent growth (and fabrication) of p-i-n UV photodetectors with the lowest dark current ($<0.3 \text{ nA/cm}^2$), highest quantum efficiency ($>55\%$), and most rapid frequency response (3 GHz), *JKPS* **39**(2001)433.
- First detailed study of phase separation in InGaN and its relationship to the brightness of LED structures, and the correlation of the electroluminescence of the device and the carrier lifetime to a stretched exponential function related to disorder in the material, *JCG* **195**(1998)397.
- The first successful MOCVD growth of GaN on ZnO for a unique phosphor free, solid state light source and a route to lattice matched green emitters, *JAP* **102**(2007)106105.
- The development of a unique two terminal, broadband, spectrally dynamic, solid state illumination source that previously required a three terminal structure, *PSS(c)* **3**(2006)2223.
- The growth and fabrication of the first InGaN solar cell reported in the literature, *APL* **91**(2007)132117. These solar cells had a record open-circuit voltage (V_{oc}) of 2.1 V and are an essential building block for tandem solar cells of more than three junctions.
- The first detailed correlation of the structural, optical and magnetic behavior in relation to theories of room temperature ferromagnetism in transition metal (Mn, Fe, Cr and other TMs) doped GaN and ZnO has been completed showing that a double exchange mechanism is likely, *SST* **20**(2005)L5.

- First MOCVD growth of Ga(Gd)N materials, *JAP* **110**(2011)083920 and the first room temperature device showing spin injection using Ga(Gd)N based materials and devices, *MRS Proceedings* **1290**(2011)mrsf10-1290-i02-05.
- First thermal neutron detection in GaN, *PSS(c)* **9**(2012)957.

In industry, as the Director of Research at EMCORE, I was responsible for the development of III-Nitride growth technology through various small business grants. This resulted in a commercial reactor technology that is now part of a >\$1B/year industry. This contribution was recognized by a Small Business Administration Tibbett's Award for contributions to the SBIR Program, which at that time had already resulted \$200M of commercial product. This work also initiated the development of III-Nitride white light LEDs at EMCORE, early patents in this area (US#6,366,018 and US#6,404,125) and the development of technology which resulted in a joint venture between General Electric Lighting and EMCORE. This work was recognized by a Technology Utilization Foundation SBIR Technology of the Year Award. I also functioned as the General Manager of In-Situ Products at EMCORE. In this role I lead a team that developed a line of metrology systems from a DARPA program for monitoring and controlling growth that is now the standard for the compound semiconductor growth industry.

1.7 Service

I have made numerous contributions to the scientific community beyond my technological accomplishments. I have held leadership positions in several professional societies as chair or co-chair of international conferences. I founded the International Conference in Solid State Lighting that is hosted through SPIE. I have also operated as Chair of the Illuminating Engineering track. I have also served as a reviewer for numerous national and international grant making organizations including those in Finland, Austria, Hong Kong, Taiwan and others. I have been a member of the Fellows Committee for SPIE and IEEE (EDS). I have typically organize and/or chair 1-2 conferences or workshop a year in the US, Europe and Asia. Examples of service include:

- Member of the Editorial Board of Compound Semiconductor Magazine, 1999-2007.
- Coordinator for Bobby Jones Fellowship between the Georgia Institute of Technology and University of St. Andrews, 2001-2009.
- Participated in minority focused SURE (Summer Undergraduate Research in Engineering/Science) and SURF (Summer Undergraduate Research Fellowship) programs, 2002-2008.
- SPIE Chair for Program on Illumination Engineering, 2002-2011.
- Chairman, 1st- 4th International Forum on Solid State Lighting, China, 2004-2008.
- Chairman, International Workshop on Wide Band Gap Ferromagnetic Semiconductors, Edinburgh, Scotland, May 2005.
- Founding member of the editorial board for SPIE's Journal of Photonics for Energy, 2010-2013
- Member of the SPIE Fellows Committee, 2010-2013.
- Member of the IEEE (EDS) Fellows Committee, 2013.
- Founder and Chair of First International Conference on White LED's and Solid State Lighting; a biannual conference that is now meeting for the 6th time next year, 2007-present.
- Co-organized the Material Research Symposium A on 'Engaged Learning of Materials Science & Engineering in the 21st Century' which included the last presentation given by the Nobel Prize winner, Harold Kroto, 2015.
- Founding Chair for the International Conference on Solid State Lighting and LED-based Illumination Systems that is hosted by SPIE that is now in its 16th year, 2000-present.
- Steering Committee Chair for High-capacity Optical Networks and Emerging Technologies (HONET), Institute of Electrical and Electronic Engineers (IEEE), 2010-present.

1.8 Award and Honors

- Member of the honor societies; Eta Kappa Nu (HKN), Phi Beta Delta (ΦΒΔ), and Order of the Engineer.
- A paper titled "Magnetic and optical properties of GaMnN grown by Metalorganic Chemical Vapor Deposition," *Semiconductor Science and Technology* **20** (2005) L5 was selected for recognition in Institute of Physics Select Issue as research which shows "substantial advances or significant breakthroughs, a high degree of novelty, and a significant impact on future research".
- Best Paper/Presentation Award for "MOCVD Growth and Transition Metal Doping of GaN Nanostructures" at the NSF-sponsored International Center for Materials Research Summer School on Nanomaterials at the National Institute for Materials Science in Tsukuba, Japan, 2007.

- Awarded the 2008 Faculty Fellow in the Sam Nunn Security Program, based in the Center for International Strategy, Technology and Policy at Georgia Tech as part of the MacArthur Foundation's Science, Technology and Security Initiative.
- Fellow International Society for Optical Engineering (SPIE); Class of 2009.
- Fellow of Institute of Electrical and Electronic Engineering (IEEE); Class of 2010.
- An article in Journal of Physics D: Applied Physics, **44**, 224014 (2011), "Development of free-standing InGaN LED devices on Al₂O₃/Si substrate by wet etching", was in the top 10% of all articles downloaded across all IOP journals within three months of being published.
- Selected by the *Charlotte Business Journal* for 'General Excellence in Sustainable Leadership' in the 2011 Sustainable Business Awards for the work as the co-founder and Chairman of the Board for PiES: Project for innovation, Energy and Sustainability. A green business incubator whose mission includes; incubation, education and networking, www.pies-northcarolina.org.
- Fellow of Institute of Physics (FInstP); Class of 2011.
- PiES, the Project for innovation, Energy and Sustainability, won the Region of Excellence Award for "Growing the Economy" from Central Council of Governments for the incubation of twelve early stage companies in a 4-5 year period, 2014.
- PiES, the Project for innovation, Energy and Sustainability, was named a top five green incubator in the US by Ecowatch that are "Shaping the Future of Green Business", 2014
- Special initiate in Pi Kappa Alpha, 2015
- Chancellor's Challenge Award presented for innovation, entrepreneurship and development of Missouri S&T's National Science Foundation Innovation Corps Site Program. 2016.
- Fellow of the Royal Society of Arts, Manufactures and Commerce, FRSA 2017

1.9 Interests

I believe that a broadly educated person can truly appreciate work of others and I have a well-developed interests in the arts. I have written poetry, free format and structural, for the last 15-20 years, currently have a volume of poetry that I am completing, and perform periodically. I am an Associate Member of the Academy of American Poets. I have done photography for a number of years, primarily black and white, and have exhibited. I play the penny whistle so that I take a piece of Scotland with me wherever I go. My current interests include competitive BBQ (placed 3rd for sauce, 4th for pork shoulder and 5th for brisket at the world championships - Memphis in May), flying (member of the Aircraft Owners and Pilots Association and ~50% through private pilot license) and online cycling (Zwift).

2. SCHOLARLY ACCOMPLISHMENTS

2.1. Published Books and Parts of Books

I have edited two books, multiple book chapters, and fifteen conference proceedings and some of these contributions can be found at Amazon Author Central if they are still commercially available:

Amazon Author Central: <http://www.amazon.com/-/e/B00IQXB6RO>

Book(s):

Two (2) books including –

*Rare Earth and Transition Metal Doping of Semiconductor Materials:
Synthesis, Magnetic Properties and Room Temperature Spintronics*
Volkmar Dierolf, Ian Ferguson and John Zavada
Elsevier/Woodhead Publishing, Feb 2016, 470 pages

Book Chapters:

Nine (9) book chapters including -

Growth of ZnO for Neutron Detectors
E. A. Burgett, E. N. Hurwitz, N. E. Hertel, C. J. Summers, J. Nause, N. Lu and I. T. Ferguson
Handbook of Zinc Oxide and Related Materials: Volume 2 – Devices and Nano-Engineering, Z.C. FENG (Ed.)
Published by CRC Press Taylor and Francis Group; pp. 435-483

Conference Proceedings:

Fifteen (15) conference proceedings for SPIE and the MRS including -

Fifteenth International Conference on Solid State Lighting
I. T. Ferguson, N. Dietz and M. Kane
Proceedings of SPIE Volume **9954** (2016)

2.2 Refereed PublicationsSelected Refereed Journal Publications

I currently have over 480 refereed journal publications in the area of compound semiconductor materials and devices for detectors, emitters, solar cells, ferromagnetic materials, and more recently, nuclear detection. These works have been published in upper tier international journals including *Semiconductor Science and Technology*, *Applied Physics Letters*, *Journal of Applied Physics*, *IEEE Photonics Technology Letters*, *Physical Review B*, *Solid-State Electronics*, *Optical Engineering*, *Journal of Physics: Condensed Matter* and others with a corresponding H-Index of 39 (despite an extended period in academic administration and industry). This work has been featured on the cover page of *Optical Engineering* and has been reviewed in several other international magazines such as *Compound Semiconductor* and *Laser Focus World*. It has been my privilege to have collaborated with many students, post-docs, staff members and other researchers associated with this work and to be in a position through this to represent them now and in the future. A few papers are listed below according to a few broad subject areas with a more complete list being found at Google Scholar.

Google Scholar: <http://scholar.google.com/citations?user=YDFa3KUAAA&hl=en&oi=ao>

Materials Growth; MBE, MOCVD and ALD

High Quality AlN and GaN Epilayers Grown on (0001) Sapphire, (100) and (111) Silicon Substrates
P. Kung, A. Saxler, X. Zhang, I. T. Ferguson and M. Razeghi
Applied Physics Letters, **66**, (1995) pp. 2958-2961

Compositional instability in strained InGa_N epitaxial layers induced by kinetic effects
Y. Huang, A. Melton, B. Jampana, M. Jamil, J. H. Ryou, R. D. Dupuis and I. T. Ferguson
Journal of Applied Physics, **110**, (2011), pp. 064908-064912

Impurity Resonant States p-type Doping in Wide-Band-Gap Nitrides
Z. Liu, X. Yi, Z. Yu, G. Yuan, Y. Liu, J. Wang, J. Li, N. Lu, I. Ferguson and Y. Zhang
Scientific Reports **6** (2016) pp. 2-7

Ferromagnetic Materials

Magnetic properties of bulk Zn_{1-x}Mn_xO and Zn_{1-x}Co_xO single crystals
M. H. Kane, K. Shalini, C. J. Summers, R. Varatharajan, J. Nause, C. R. Vestal, Z. J. Zhang, and I. T. Ferguson
Journal of Applied Physics, **97**, (2005) pp. 023906-023910

Magnetic and optical properties of Ga_{1-x}Mn_xN grown by metalorganic chemical vapour deposition
M. H. Kane, A. Asghar, C. R. Vestal, M. Strassburg, J. Senawiratne, Z. J. Zhang, N. Dietz, C. J. Summers, I. T. Ferguson
Semiconductor Science and Technology, **20**, (2005), L5

Room temperature GaN-based spin polarized emitters
A. Melton, B. Kucukgok, Z. Liu, N. Dietz, N. Lu and I. Ferguson
SPIE OPTO, (2013) 863104-863104-9

Materials Characterization

Thermal Conductivity of Fully and Partially Coalesced Lateral Epitaxial overgrown GaN/sapphire (0001) by scanning thermal microscopy
D. I. Florescu, V. M. Asnin, Fred H. Pollak, A. M. Jones, J. C. Ramer, M. J. Schurman, and I. Ferguson
Applied Physics Letters, **77**, (2000) pp. 1464-1467

Characterization of InN layers grown by high-pressure chemical vapor deposition

M. Alevli, G. Durkaya, A. Weerasekara, A. Perera, N. Dietz, W. Fenwick, V. Woods and I. Ferguson
Applied physics letters, **89**, (2006), pp. 112119-11212

Infrared optical anisotropy of diluted magnetic Ga_{1-x}Mn_xN/c-sapphire epilayers with a GaN buffer layer by metalorganic chemical vapor deposition

Z. G. Hu, A. B. Weerasekara, N. Dietz, A. G. U. Perera, M. Strassburg, M. H. Kane, A. Asghar, and I. T. Ferguson.

Physical Review B, **75**, (2007) pp. 205320-205328

Devices: Detectors

InSb Infrared Photodetectors on Si Substrates Grown by Molecular Beam Epitaxy

E. Michel, J. Xu, J. D. Kim, I. T. Ferguson and M. Razeghi
IEEE Photonics Technology Letters, **8**, (1996) pp. 673-677

Low Dark Current GaN Avalanche Photodiodes

B. Yang, T. Li, K. Heng, C. J. Collins, J. Carrano, R. D. Dupuis, J. C. Campbell, M. J. Schurman and I. T. Ferguson

IEEE Journal of Quantum Electronics, **36**, (2000) pp. 1389-1394

A GaN/AlGaN Ultraviolet/Infrared Dual-Band Detector

G. Ariyawansa, M. B. M. Rinzan, M. Alevli, M. Strassburg, N. Dietz, A. G. U. Perera, S. G. Matsik, A. Asghar, I. T. Ferguson, H. Luo, A. Bezinger, and H. C. Liu,

Applied Physics Letters, **89**, (2006) pp. 091113-091116

Devices: Emitters

Air-voids embedded high efficiency InGaN-light emitting diode

E. H. Park, J. Jang, S. Gupta, I. Ferguson, C. H. Kim, S. K. Jeon, and J.S. Park

Applied Physics Letters, **93**, (2008) pp. 191103-191106

Efficiency droop in InGaN/GaN multiple-quantum-well blue light-emitting diodes grown on free-standing GaN substrate

Z. Liu, T. Wei, E. Guo, X. Yi, L. Wang, J. Wang, G. Wang, Y. Shi, I. Ferguson, and J. Li

Applied Physics Letters, **99**, (2011), pp. 091104-091107

p-InGaN/AlGaN electron blocking layer for InGaN/GaN blue light-emitting diodes

Z. Liu, J. Ma, X. Yi, E Guo, L. Wang, J. Wang, N. Lu, J. Li, I. Ferguson and A. Melton

Applied Physics Letters **101** (2012) pp. 261106

Devices: Solar Cells

Design and characterization of GaN/InGaN solar cells

O. Jani, I. Ferguson, C. Honsberg, and S. Kurtz

Applied Physics Letters, **91**, (2007) pp. 1-3

Design and realization of wide-band-gap (2.67 eV) InGaN p-n junction solar cell

Jampana, B. R., A. G. Melton, Jamil, M., Faleev, N. N., Opila, R. L., Ferguson, I. T. Honsberg, C. B

IEEE Electron Device Letters, **31**, (2010) pp. 32-34

Zinc oxide as an active n-layer and antireflection coating for silicon based heterojunction solar cell

B. Hussain, A. Ebon and I. Ferguson

Solar Energy Materials and Solar Cells **139** (2015) pp. 95-100

Thermoelectric Material and Devices

III-Nitrides for Energy Production: Photovoltaic and Thermoelectric Applications

N. Lu and I. Ferguson

Semiconductor Science and Technology, **28**, (2013), pp. 074023-074036

The structural properties of InGaN alloys and the interdependence on the thermoelectric behavior
 B Kucukgok, X Wu, X Wang, Z Liu, IT Ferguson, N Lu
AIP Advances **6** (2016), 025305

Other

Single-crystal Aluminum Nitride Nanomechanical resonators
 Cleland AN; Pophristic M; Ferguson I
Applied Physics Letters, **79**, (2001) pp. 2070-2072

Comparison of neutron conversion layers for GaN-based scintillators
 A. G. Melton, E. Burgett, T. Xu, N. Hertel, and I. T. Ferguson
Physica Status Solidi (c) **9**, (2012), pp. 957–959

Effects of blue light on the circadian system and eye physiology
 G. Tosini, I. Ferguson and K. Tsubota
Molecular Vision **22** (2016) pp. 61-72

2.3 Patents and Expertise Witness

Granted numerous patents in the US and elsewhere with some international filings and numerous provisional patents and invention disclosures in process.

Method and Apparatus for Performing Wavelength-conversion using Phosphors with Light Emitting Diodes
 DZ Garbuzov, JC Connolly, RF Karlicek Jr, IT Ferguson; *US Patent 6,404,125*

Apparatus for Performing Wavelength-conversion using Phosphors with Light Emitting Diodes
 DZ Garbuzov, JC Connolly, RF Karlicek Jr, IT Ferguson; *US Patent 6,366,018*

Apparatus for Growing Epitaxial Layers on Wafers by Chemical Vapor Deposition
 I Ferguson, A Gurary, M Spencer; *US Patent 6,547,876*

Thin Film Doped ZnO Neutron Detector
 JE Nause, EA Burgett, NE Hertel, I Ferguson; *US Patent 20,130,075,718*

INCOHERENT TYPE-III MATERIALS FOR CHARGE CARRIERS CONTROL DEVICES
 R Tsu, IT Ferguson, N Dietz; *US Patent 20,150,340,439*

Major expert witness cases

- PDR, Inc. v. United States; Fed. Cl. No. 03-2047C (2005-2007)
- Samsung v. OSRAM; Inv. No. 337-TA-798 (July 2011 – August 2012)
- CREE v. Feit/Unity Opto; Inv. No. No. 337-TA-947 (February 2015 – October 2015)

2.4 Presentations

Over 330 presentations including 70 keynote and invited addresses, over 100 seminar presentations and the remainder are conference presentations. Some recent presentations include:

- Keynote Address at SPIE - The international society for optics and photonics, San Diego, August 2010, "Would Edison have invented Solid State Lighting."
- Keynote Address at HONET, Riyadh, Kingdom of Saudi Arabia, December 2011, "The Development of a Universal Substrate Technology for the Growth of Light Emitting Diodes."
- Invited Lecture, University of New South Wales, Sydney, February 2012, Australia, "Wide Band Gap III-Nitride Compound Semiconductor Devices: The Universal Solution for Energy Applications."
- Plenary Talk at the Third International Symposium on Semiconductor Materials and Devices (ISSMD-3). Anna University, Chennai, India, February 2015, "Anything you can do 'GaN' can do better": III-Nitrides as a Universal Compound Semiconductor."
- Keynote Talk at the 3rd International Conference on Nanoscience and Nanotechnology (ICONN-2015), February 2015 at SRM University, Kattankulathur, India. "Beyond Nano: Spinning; Dazed and Confused!"

- Keynote Presentation at ASEE Zone III Meeting; September, 2015, Springfield, MO, “Do taxonomies matter for engineering education...?”
- Invited Talk at the Technical Innovation Forum IX: Materials Research Society Fall Conference, Boston, MA. December, 2015. “L’Entrepreneur’s Entrée.”
- Keynote presentation at HONET-ICT Haspolat, Nicosia, Northern Cyprus, October, 2016, “High Temperature Energy Harvesting in Wide Bandgap Semiconductors.”

3. GRANTS AND CONTRACTS

I raised funds for EMCORE Corporation (>\$20M in 5 years) while in the position of Director, Research Development through most of the major US funding agencies. In academia, I have been awarded numerous grants and contracts totaling over \$7.5M not including individual fellowships that the postdocs and students have won. Funding has come from Defense Advanced Research Project Agency, Office of Naval Research, National Science Foundation, Department of Energy, Air Force Office of Scientific Research, National Aeronautics and Space Administration, Army Research Office and a number of companies. The following is a list of grants and contracts for funding >\$50,000, smaller amounts and gifts are lumped together as one category. This does not include gifts of equipment and other in-kind contributions.

- “Development of High EQE Emitters for Miniaturized Biological Agent Detection Systems”, Defense Advanced Research Project Agency, June 2002 to May 2006; \$800,000.
- “A New Spin for the Nitrides”, National Science Foundation, August, 2002 to July, 2006; \$240,000.
- “Infrared Applications of III-nitride Quantum Dots”, National Science Foundation, August 2003 to July 2006; \$210,000.
- “Innovative Development of Next Generation and Energy Efficient Solid State Light Sources for General Illumination”, Department of Energy, September, 2003 to August, 2006; \$612,000.
- “MOCVD Growth of Multifunctional III-Nitride Quantum Dots”, Air Force Office of Scientific Research, July 2003 to October 2006; \$450,000.
- “Development of Large Format Visible-NIR Blind GaN UV Imager for Atmospheric Earth Science Applications”, National Aeronautics and Space Administration, July 2003 to July 2004; \$58,000.
- “Lattice Matched, High Efficiency Solid State Emitters on ZnO Substrates”, Department of Energy (subcontract from CERMET, Inc.), July 2004 to June 2007; \$795,000.
- “Novel III-Nitride Quantum Well Solar Cells”, National Renewable Energy Laboratory, September 2003 to August 2006; \$120,000.
- “A Comprehensive Study of P-doping in ZnO p-n Junctions”, Air Force Office of Scientific Research, September 2004 to August 2005; \$220,000.
- “Novel Green Emitters based on GaN/ZnO”, Phase II SBIR (subcontract with CERMET, Inc. (DARPA)), Dec, 2004 to June 2006; \$210,000.
- “Development of ZnO/GaN Hybrid Spin LEDs”, Phase II SBIR (subcontract with CERMET, Inc. (AFOSR)), Feb, 2005 to Jan, 2007; \$250,000.
- “Magneto-optical Characterization of Wide Band Gap Ferromagnetic Materials”, Army Research Office (DURIP), May, 2005 to April, 2006; \$99,000.
- “Development of Large Format Visible-NIR Blind GaN UV Imager for Atmospheric Earth Science Applications”, National Aeronautics and Space Administration, Jan 2005 to Dec 2006; \$80,000
- “VHSEC GaN-based Photovoltaic Solar Cells”, Defense Advanced Research Project Agency, September 2003 to August 2006; \$660,000.
- “Solar Decathlon: Homeostasis and Solid State Lighting”, Department of Energy (EERE), September 2005 to August 2007; \$200,000 (Co-PI).
- “Optimization of GaN LEDs using *in-situ* metrology”, Phase II SBIR (subcontract with Bellwether, Inc. National Science Foundation), September 2005 to November 2007; \$150,000.
- “Expitaxial Growth of GaN based LED structures on Sacrificial Substrates”, Department of Energy, October, 2006 – December, 2009; \$756,000.
- “Multiferroic Materials for multifunctional devices by Metalorganic CVD”, Air Force Office of Scientific Research, March, 2007 – November, 2010; \$525,000.
- “An Innovative Approach to Precision Fission Measurements Using a Time Projection Chamber”, Department of Energy, September, 2007 – September, 2011; \$160,000.
- “Nanotechnology Undergraduate Education: Certificate in Nanotechnology”, National Science Foundation, September 2008 to August 2011; \$200,000 (Co-PI).
- “NewPVonGlass”, Solaire photovoltaïque et habisol, February 2009 to January 2012; 240keuros (Co-PI)

- “Proof of Concept for External Band Bending Solar Cells”, Columbus Photovoltaics, March 2014 to June 2017; \$575,000 (PI) with additional funding pending.
- “Foundation, discretionary and other funds”, various sources, June, 2002 – present; ~\$536,000.

4. SUPERVISION AND TEACHING

4.1 Students Graduated

This is a list of students that I have supervised since 2001. I have also mentored a number of Ph.D. students at other institutions including Northwestern University, Rutgers and Imperial College.

- Michael Wang, School of Electrical and Computer Engineering, Ph.D., April 2006, ‘Optoelectronic Device Simulation: Optical Modeling for Semiconductor Optical Amplifiers and Solid State Lighting’
- David Nicol, School of Electrical and Computer Engineering, Ph.D., Dec 2006, ‘A Novel Solid State General Illumination Source’
- Hun Kung, School of Electrical and Computer Engineering, Ph.D., Dec 2006, ‘A Study of the Nucleation and Formation of Multifunctional Nanostructures using GaN-Based Materials for Device Applications’
- Matthew Kane, School of Materials Science and Engineering, Ph.D., May 2007, ‘Investigation of the Stability of Wide Bandgap Dilute Magnetic Semiconductors for Spintronics’
- Omkar Jani, School of Electrical and Computer Engineering, Ph.D., April 2008, ‘Development of Wide-Band Gap InGaN Solar Cells for High-Efficiency Photovoltaics’
- Nola Li, Schools of Electrical and Computer (and Materials Science) Engineering, Ph.D., Dec 2008, ‘GaN on ZnO: A New Approach to Solid State Lighting’
- Shalini Gupta, School of Electrical and Computer Engineering, Ph.D., Dec 2008, ‘Room Temperature Ferromagnetic Materials for Spintronic Applications’
- William Fenwick, School of Electrical and Computer Engineering, Ph.D., April 2009, ‘MOCVD Growth of GaN on Sacrificial Substrates’:
- Eric Burgett, School of Nuclear Engineering, Ph.D., February 2010 (Worked in group), ‘Novel Neutron Detectors’
- Tahir Zaidi, School of Electrical and Computer Engineering, Ph.D., April 2010, ‘Ferromagnetic Thin Films Aimed Towards Optoelectronic and Spintronic Applications’
- Balakrishnam R. Jampana, School of Electrical and Computer Engineering, Ph.D., Nov 2010, ‘Wide Bandgap InGaN Solar Cells: Materials Science and Device Engineering’
- Andrew Melton, School of Electrical and Computer Engineering, Ph.D., May 2011, ‘Development of Wide Bandgap Solid-State Neutron Detectors’
- Bahadir Kucukgok, June 2015, Ph.D. in Thermoelectric material and devices

Master students: David Gherardi, Paul Helm, Stephen Moore, My Tran, Dhairya Mehta, David Thomas, Jill Morris, 2006; Olivier Hamard, James Bain, John Buchanan, Peter Speirs, Petko Petkov, Elisa Hurwitz, Sasi Jothibasu and Paresh Patel.

4.2 Postdocs and Staff Supported

These postdocs and staff that I supervised have primarily been supported on research programs (DARPA, DOE, AFOSR and industry) with short term, 1-2 year, research goals programs. They include; Zhe Chuan Feng, 2002-present; Adam Payne, 2003-2004; Shalini Kandoor, 2003-2004; Sa Huang, 2003; Ali Asghar, 2003-2006; Ming Pan, 2004-2006; Todd Steiner, 2004-2005; Martin Strassburg, 2004-2007; June-O Song, 2005-2006; Eun-Hyun Park, 2005-2007; Vincent Woods, 2005-2009; Zaili Fang, 2006-2007; John Wang, 2006-2008; Shen-Jie Wang, 2006-2009; Hongbo Yu, 2007-2008; Eno Malguth, 2008-2009; Muhammad Jamil, 2008-2011; Zhiqiang Liu, 2010-2011; Andrew Melton, 2011-2013; Bob Wang, 2012-2013 and Chuanle Zhou 2014-present.

4.3 Undergraduate and high school students gaining research experience

I have actively tried to include underrepresented minorities from undergraduate students in my research programs. I had >40 undergraduate students work with me, most for two semesters including: Steven Siebert, Barry Mullins, David Nicol, Shawn Mason, Nick Spencer, Elisa Hurwitz, Tom McDaniel, David Ewing, Joshi Nisha, David Brown, Daegeun Yoon, Kevin Turchin, Anthony Hylick, Petko Petkov, Yew-Ching Chen, Weijia Yang, Lewis Howe, David Bucciero, Frankie Dumas, Nimra Tagi, Yuri Sylvester, Matthew DeVoe, Doug Brooks, Shilpa Mandava, Justin Vogt, Karol Medina, Patricia Nichols, Lemroy Culbert, Omar Sardar, John Oleynik, Steve Brown, Andrew Carlson, Matthew Oroc, Josh Dulin, Cameron Ferguson, Kelcy Yunling and Alyson Jones. In addition, a number of high school students Peter Sculley, Jeremy Nortey, Marshall Craft and others have spent a summer in the labs.