

Brian D'Andrade, Ph.D., P.E., CFEI, CCNA, CRE
Managing Engineer

Professional Profile

Dr. Brian D'Andrade is a Managing Engineer in Exponent's Electrical Engineering and Computer Science practice. Dr. D'Andrade's expertise is in electrical, electronic, and optical engineering; microelectronic systems; communication network topology, devices, and protocols; and semiconductor materials and devices. He has a decade of experience in the design, failure analysis, and physics of organic light emitting devices that are employed in flat panel displays and solid-state lighting, and over six years of experience in intellectual property related work involving writing patent applications, supporting patent litigation and examining infringing products.

His materials science experience includes examining and understanding the fundamental physics of device operation and chemical interactions, in high-vacuum, between organic semiconductors and impurities. His experience in communication networking includes analyses of communication systems used for conducting transactions on public data networks. These analyses involved evaluating communications transactions as handled by the various protocols used in LANs, WANs and private virtual circuits, and the analyses and/or configuration of routers, switches, Ethernet cards and wireless modems.

Prior to joining Exponent, Dr. D'Andrade participated in over 12 small business innovation research (SBIR) and solid-state lighting grants from the U.S. Department of Energy as either the principal investigator or the senior scientist. His research interests include: novel device architectures, energy efficient systems, optical outcoupling, organic memories, photovoltaics, printed flexible electronics, lighting design and efficiency, power electronics and smart grid technologies.

Dr. D'Andrade has significant experience with ultra-violet photoemission spectroscopy, X-ray photoemission spectroscopy, spectroscopic ellipsometry, time-correlated single photon counting, streak camera temporal spectroscopy, FTIR analysis, cryogenic refrigeration, ultra-high vacuum equipment, organic molecular beam epitaxy, e-beam evaporation, imaging and integrating spheres, sputtering, chemical vapor deposition (CVD), organic vapor phase deposition, spectroradiometers, thermal imaging, encapsulation, and physical vapor deposition (PVD).

At Exponent, Dr. D'Andrade has gained an extensive knowledge of GaN, AlGaInP, and ZnSe wide band-gap semiconductors and of non-volatile memory design and processing. His wide band-gap semiconductor knowledge includes: MOCVD and MBE growth methods, doping, and device architectures. His non-volatile memory work focuses on analysis of shallow trench isolation, interlayer dielectrics, spacers, metal contacts and other flash memory structures. Dr. D'Andrade also has investigated failures due to metallic whiskers, printed circuit board design, and faulty capacitors.

Academic Credentials and Professional Honors

Ph.D., Electrical Engineering, Princeton University, 2004
M.A., Electrical Engineering, Princeton University, 2001
B.S.E.E., Electrical Engineering, Pennsylvania State University (with honors and highest distinction), 1999

Honored by U.S. Department of Energy for research achievements in solid state lighting, 2008, 2007; Graduate President Fellow, Princeton University; Student Marshal, The Pennsylvania State University; Evan Pugh Scholar Award; Phi Kappa Phi; Phi Eta Sigma; Golden Key National Honor Society

Licenses and Certifications

Registered Professional Engineer, Connecticut, #28005
Registered Professional Engineer, Massachusetts, #49411
Registered Professional Engineer, Maryland, #39671
Registered Professional Engineer, New York, #088186-1
Certified Cisco Network Associate (CCNA)
Certified Fire and Explosion Investigator (CFEI)
Certified Reliability Engineer (CRE)

Patents

Patent 7,800,295: Organic light emitting device having a microcavity, September, 2010 (with Mike Weaver).

Patent 7,776,456: Organic light emitting devices with an emissive region having emissive and non-emissive layers and method of making, August 17, 2010 (with Theodore Zhou).

Patent 7,728,512: Organic light emitting device having an external microcavity, June 1, 2010.

Patent 7,710,017: Organic light emitting device having a transparent microcavity, May, 2010 (with V. Adamovich).

Patent 7,285,907: High efficiency multi-color electro-phosphorescent OLEDs, October 2007 (with M. Thompson, S. Forrest).

Patent 7,261,954: Organic light emitting devices having carrier blocking layers comprising metal complexes, August 2007 (with M. Thompson, X. Ren, V. Adamovich, S. Cordero, B. Alleyne, S. Forrest).

Patent 7,179,543: Doping of organic opto-electronic devices to extend reliability, February 2007 (with S. Forrest, A. Chwang).

Patent 7,022,421: Organic light emitting devices having carrier blocking layers comprising metal complexes, April 2006 (with M. Thompson, X. Ren, V. Adamovich, S. Cordero, B. Alleyne, S. Forrest).

Patent 7,009,338: High efficiency multi-color electro-phosphorescent OLEDs, March 2006 (with M. Thompson, S. Forrest).

Patent 6,869,695: White light emitting OLEDs from combined monomer and aggregate emission, March 2005 (with M. Thompson, J. Brooks, V. Adamovich, S. Forrest).

Patent 6,863,997: White light emitting OLEDs from combined monomer and aggregate emission, March 2005 (with M. Thompson, J. Brooks, V. Adamovich, S. Forrest).

Patent Application No. US20110057171: Long lifetime Phosphorescent Organic Light Emitting Device (OLED) Structures, filed December 28, 2007.

Patent Application No. US2010090620: Novel OLED display architecture, filed September 23, 2009.

Patent Application No. US2010090241: Emissive Layer Patterning for OLED, filed October 12, 2009.

Patent Application No. US2010013378: Intermediate connector for stacked organic light emitting devices, filed July 16, 2008.

Patent Application No. US20090200927: Organic light emitting device architecture, filed December 11, 2008.

Patent Application No. US 2009121621: Saturated color organic light emitting devices, filed October 24, 2008.

Patent Application No. US 2009121624: Stable blue phosphorescent organic light emitting devices, filed November 5, 2008 (with P. MacKenzie, M. Weaver, and J. Brown).

Patent Application No. US 2009121619: OLED having a charge transport enhancement layer, filed November 12, 2007 (with K. Rajan, K. Urbanik, R. Ma).

Patent Application No. US 20070103066: Stacked OLEDs with a reflective conductive layer, filed November 4, 2005 (with R. Hewitt, K. Rajan, V. Adamovich).

Patent Application No. US20070075631: Electron impeding layer for high efficiency phosphorescent OLEDs, filed October 4, 2005 (with M. Weaver, Y. Tung, J. Esler).

Patent Application No. US20060134465: Organic light emitting devices having carrier blocking layers comprising metal complexes, filed February 13, 2006 (with M. Thompson, X. Ren, V. Adamovich, S. Cordero, B. Alleyne, S. Forrest).

Publications

D'Andrade B, Kattamis AZ, Murphy PF, McNulty J, Souris S. Arcing enabled by tin whiskers. IEEE: Reliability Society 2010 Annual Technical Report, 2010.

Pinato A, Meneghini M, Cester A, Wrachien N, Tazzoli A, Zanoni E, Meneghesso G, D'Andrade B, Esler J, Xia S, Brown J. Improved reliability of organic light-emitting diodes with indium-zinc-oxide anode contact. IEEE Int. Reliability Physics Symposium, IRPS 2009, Montreal Canada, pp. 105–108, April 26–30, 2009.

D'Andrade B, Kattamis AZ. Flexible active-matrix organic light emitting displays. Silicon Valley Engineering Council J 2009; 1:18–21.

D'Andrade BW, Esler J, Lin C, Adamovich V, Xia S, Weaver MS, Kwong R, Brown J. White phosphorescent OLEDs. Maximizing the power efficacy lifetime product. Digest of Technical Papers of IMID/IDMC/Asia Display 2008.

D'Andrade BW, Weaver MS, Brown J. The great white organic hope. Photonics Spectra 2008; 42.

Giebink NC, D'Andrade BW, Weaver MS, Mackenzie PB, Brown JJ, Thompson ME, Forrest SR. Intrinsic luminance loss in phosphorescent small-molecule organic light emitting devices due to bimolecular annihilation reactions. J Appl Phys 2008; 103(4):044509-044501.

D'Andrade BW, Weaver MS, Mackenzie PB, Yamamoto H, Brown JJ, Giebink NC, Forrest SR, Thompson ME. Blue phosphorescent organic light emitting device stability analysis. Proceedings SID, Vol. 39, 2008.

D'Andrade BW, Esler J, Lin C, Weaver MS, Brown J. Extremely long lived white phosphorescent organic light emitting device with minimum organic materials. Proceedings SID, Vol. 39, 2008.

D'Andrade BW, Esler J, Lin C, Adamovich V, Xia S, Weaver MS, Kwong R, Brown JJ. Realizing white phosphorescent 100 lm/W OLED efficacy. Proceedings, SPIE, Vol. 7051, 2008.

D'Andrade B, Adamovich V, Weaver M, Lin C, Ma B, Mackenzie PB, Kwong R, Brown JJ. Phosphorescent OLEDs with saturated colors. Proceedings, SPIE, Vol. 6655, pp. 645–647, 2007.

D'Andrade B, Canzler TW, Hack M. PIN OLEDs—Enhanced performance and lifetime by improved structures and materials. Proceedings, IMDC, 2007.

D'Andrade B. White phosphorescent LEDs offer efficient answer. Nat Photonics 2007; 1(1):33–34.

D'Andrade BW, Tsai J-Y, Lin C, Weaver MS, Mackenzie PB, Brown JJ. Efficient white phosphorescent organic light-Emitting devices. Proceedings, SID, Vol. 38, pp. 1026–1029, 2007.

D'Andrade B, Weaver MS, Brown JJ. White phosphorescent organic light emitting devices. Proceedings, SPIE, Vol. 6655, pp. 6332–6334, 2007.

Weaver MS, Adamovich VI, D'Andrade B, Ma B, Kwong RC, Brown JJ. Phosphorescent OLEDs for displays and lighting. Proceedings, IMDC, 2007.

Weaver MS, Tung YJ, D'Andrade B, Esler J, Brown JJ, Lin C, Mackenzie PB, Walters RW, Tsai JY, Brown CS, Forrest SR, Thompson ME. Invited paper, Advances in blue phosphorescent organic light-emitting devices. Proceedings, SID, Vol. 37, pp. 127–130, 2006.

Canzler TW, Burghart M, Murano S, Blochwitz-Nimoth J, D'Andrade B, Hack M, Brown JJ. Highly power efficient organic light-emitting devices enabled by phosphorescent and p-i-n technologies. Proceedings, SPIE, Vol. 6333, pp. 633311, 2006.

D'Andrade BW, Brown JJ. Organic light-emitting device luminaire for illumination applications. Appl Phys Lett 2006; 88(19):192908.

D'Andrade B, Alleyne B, Hack M, Hewitt R, Brown JJ. White phosphorescent organic light emitting devices for lighting applications. Proceedings, SPIE, Vol. 6333, pp. 63330, 2006.

D'Andrade B, Brown JJ. White phosphorescent organic light emitting devices for display applications. Proceedings, SPIE, Vol. 6225, pp. 622514, 2006.

D'Andrade BW, Esler J, Brown JJ. Organic light-emitting device operational stability at cryogenic temperatures. Synth Met 2006; 156(5–6):405–408.

D'Andrade BW, Datta S, Forrest SR, Djurovich P, Polikarpov E, Thompson ME. Relationship between the ionization and oxidation potentials of molecular organic semiconductors. Org Electron 2005; 6(1):11–20.

Holmes RJ, Forrest SR, Sajoto T, Tamayo A, Djurovich PI, Thompson ME, Brooks J, Tung YJ, D'Andrade BW, Weaver MS, Kwong RC, Brown JJ. Saturated deep blue organic electrophosphorescence using a fluorine-free emitter. Appl Phys Lett 2005; 87(24):243507.

D'Andrade B, Adamovich V, Hewitt R, Hack M, Brown JJ. Phosphorescent organic light-emitting devices for solid-state lighting. Proceedings, SPIE, Vol. 5937, pp. 1–7, 2005.

D'Andrade B, Holmes R, Forrest S, Li J, Thompson M. Triple-doped white organic light-emitting devices grown in vacuum. Proceedings, SPIE, Vol. 5530, pp. 17–25, 2004.

D'Andrade BW, Forrest SR. White organic light-emitting devices for solid-state lighting. *Adv Mater* 2004; 16(18):1585–1595.

D'Andrade BW, Holmes RJ, Forrest SR. Efficient organic electrophosphorescent white-light-emitting device with a triple doped emissive layer. *Adv Mater* 2004; 16(7):624–628, 2004.

Brooks JJ, Kwong RC, Tung Y-J, Weaver MS, D'Andrade B, Adamovich V, Thompson ME, Forrest SR, Brown JJ. Comparison of blue-emitting phosphorescent dopants: Effect of molecular energy levels on device efficiency. *Proceedings, SPIE*, Vol. 5519, pp. 35–41, 2004.

D'Andrade B, Forrest SR. Effects of exciton and charge confinement on the performance of white organic p-i-n electrophosphorescent emissive excimer devices. *J Appl Phys* 2003; 94(5):3101–3109.

D'Andrade BW, Forrest SR, Chwang AB. Operational stability of electrophosphorescent devices containing p and n doped transport layers. *Appl Phys Lett* 2003; 83(19):3858–3860.

D'Andrade B, Forrest SR. Formation of triplet excimers and dimers in amorphous organic thin films and light emitting devices. *Chem Phys* 2003; 286(2–3):321–335.

Adamovich VI, Cordero SR, Djurovich PI, Tamayo A, Thompson ME, D'Andrade BW, Forrest SR. New charge-carrier blocking materials for high efficiency OLEDs. *Org Electron* 2003; 4(2–3):77–87.

Holmes RJ, D'Andrade BW, Forrest SR, Ren X, Li J, Thompson ME. Efficient, deep-blue organic electrophosphorescence by guest charge trapping. *Appl Phys Lett* 2003; 83(18):3818–3820.

D'Andrade BW, Thompson ME, Forrest SR. Controlling exciton diffusion in multilayer white phosphorescent organic light emitting devices. *Adv Mater* 2002; 14(2):147–151.

D'Andrade BW, Brooks J, Adamovich V, Thompson ME, Forrest SR. White light emission using triplet excimers in electrophosphorescent organic light-emitting devices. *Adv Mater* 2002; 14(15):1032–1036.

Adamovich V, Brooks J, Tamayo A, Alexander AM, Djurovich PI, D'Andrade BW, Adachi C, Forrest SR, Thompson ME. High efficiency single dopant white electrophosphorescent light emitting diodes. *New J Chem* 2002; 26(9):1171–1178.

D'Andrade BW, Baldo MA, Adachi C, Brooks J, Thompson ME, Forrest SR. High-efficiency yellow double-doped organic light-emitting devices based on phosphor-sensitized fluorescence. *Appl Phys Lett* 2001; 79(7):1045–1047.

Klauk H, D'Andrade B, Jackson TN. All-organic integrated emissive pixels. *Annual Device Research Conference Digest* 1999; 162–163.

Prior Experience

Senior Scientist, Universal Display Corporation, 2004–2008

Research Assistant, Princeton University, 2000–2003

Electrical Engineering Co-op, Kimberly-Clark Corporation, 1996

Peer Reviewer

- *Appl Phys Lett*
- *J Appl Phys*
- *Org Electron*
- *Journal of Physics D*
- *The Journal of the Society for Information Display*
- *Journal of the Electrochemical Society*
- *Nature*

Professional Affiliations

- American Society for Quality, ASQ (member)
- Institute of Electrical and Electronic Engineers, IEEE (Senior Member)
- National Association of Fire Investigators, NAFI (member)
- Penn State Alumni Association (life member)
- Princeton Graduate Alumni (life member)

Project Experience

Computer Networks

- Intellectual property/patent investigations of networks including Extranet, Internet, Intranet, VPN, WAN and LAN.
- Patent portfolio review.
- Programmed routers and switches for small to medium size enterprises.

Cryogenics and Vacuum Systems

- Operation of cryogenic systems.
- Operation and service of high and ultra high vacuum equipment, systems, and pumps.

Flat Panel Displays

- Report on the history, status, and differences in flat-panel displays.
- Design of novel outcoupling fixtures.
- Design of backlights.
- Analysis of thin film transistors (TFT), manufacturing and liquid crystals.

Illumination Engineering

- Design of manufacturing equipment for illumination systems.
- Application of measurement standards to facilitate research goals.
- Characterization of illumination sources.

Reliability and Quality Engineering

- Audit and gap analysis of manufacturing organization.
- Root cause analysis of power outages in large data center facilities.
- Fire Investigations involving consumer electronics.
- Analysis of failed capacitors using CT scans, frequency spectral analysis and ESR measurements.

Semiconductors

- Semiconductor packaging design, processing, and failure analysis.
- Semiconductor physics.
- Intellectual property analysis of front-end and back-end processes, semiconductor materials and devices.
- Technical due diligence.
- Memory technology analysis and reverse engineering.
- Production materials utilization and sourcing.