David R. Allee
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David R. Allee is a professor of electrical engineering at Arizona State University. From 2004 until 2016, Allee was also the Director of R&D for backplane electronics for the Flexible Display Center where he investigated a variety of flexible electronics applications with a focus on large area sensing arrays for radiation detection and electric and magnetic field imaging. In 2017, he became the Associate Director of Electrical, Computer and Energy Engineering where he oversees the online program. He is currently leading workforce development for the SHIELD USA project to strengthen U.S. semiconductor packaging capabilities. He has received numerous teaching awards and has been a regular consultant with several semiconductor industries. He has co-authored over 145 archival scientific publications and U.S. patents, and is a member of the National Academy of Inventors, IEEE and the American Astronomical Society.

EDUCATION/TRAINING

Cambridge University	Post-Doc	1990-1991	Electrical Engineering
Stanford University	Ph.D.	1990	Electrical Engineering
Stanford University	M.S.	1986	Electrical Engineering
University of Cincinnati	B.S.	1984	Electrical Engineering

EMPLOYMENT HISTORY

Jan. 2017 – Present	Associate Director, School of Electrical Engineering, Arizona State University
Aug. 2009 – Present	Full Professor, School of Electrical Engineering, Arizona State University
Jan. 2004 – Jan. 2016	Director of R&D of Backplane Electronics, Flexible Display Center
May 2011 – Present	Consultant with KnowledgeBridge Intl.
Aug 2013. – Dec. 2013	Sabbatical at the Army Research Laboratory
Aug. 1997 – Aug. 2009	Associate Professor, Dept. of Electrical Engineering, Arizona State University
June 2003 – Aug. 2003	Design Consultant, Motorola, Tempe, AZ
Jan. 2001 - Dec. 2002	Design Consultant, Philips Semiconductors, Tempe, AZ
Aug. 2000 - Dec. 2000	Sabbatical at Intel, Chandler, AZ
May 1999 - Oct. 1999	Design Consultant, Scientific Monitoring, Tempe, AZ
Jan. 1996 - Dec. 1997	Design Consultant, Intel, Chandler, AZ
Aug. 1991 - Aug. 1997	Assistant Professor, School of Electrical Engineering, Arizona State University

HONORS AND DISTINCTIONS:

Consistently Top 5% of Teachers Award, Best Teacher Award, College of Engineering, 2008, Young Faculty Teaching Excellence Award, College of Engineering, 1994/1995

Chair of Flexible Electronics Conference at SPIE Defense, Security and Sensing 2013

Guest Editor for special issues of Journal of Display Technology and Sensors (online)

Military Sensing Symposium, Battlespace Acoustic, Seismic, Magnetic, and Electric-Field Sensing and Signatures, Program Committee, 2014-2019

Custom Integrated Circuits Conference, Technical Program Committee, 2001-2005, Educational Session Chair 2005 and Analog Sub-committee Chair 2005

Member of National Academy of Inventors, American Astronomical Society, IEEE

Publications:

Archival Refereed Journal Papers:

1. Z. Lythgoe, T.F. Long, M.J. Buchholz, A.R. Livernois, K. Kanuteh, D.R. Allee, A. Pal, I.R. Graham, Z.D. Drummond, "Design and Validation of a Very Low-Power Measurement Unit for the Distribution System," in IEEE Transactions on Industry Applications, 2024.
2. Z. D. Drummond, K. E. Claytor, R. N. Adelman, D. R. Allee and D. M. Hull, "Planar Near-Field Electric Field Sensor Array Applications Facilitated by Neural Networks," in *IEEE Sensors Journal*, vol. 21, no. 18, pp. 21038-21049, 15 Sept.15, 2021, doi: 10.1109/JSEN.2021.3099984.
3. Z. D. Drummond, K. E. Claytor, D. R. Allee and D. M. Hull, "An Optimized Subspace-Based Approach to Synchrophasor Estimation," in IEEE Transactions on Instrumentation and Measurement, vol. 70, pp. 1-13, 2021, Art no. 1001213, doi: 10.1109/TIM.2020.3017059.
4. Hugh E. Chung, Hugh E. Chung, Michael McMaster, Angelo Delluomo, Oscar Vazquez, Alvin Su, Anthony M. Wilson, and David R. Allee, "Active Two-Dimensional Electric Field Imaging at Very Low Frequencies," IEEE Sensors, vol.17 , issue: 21, pp. 7123-7130, Nov. 2017, 10 pages
5. L. Smith, J.W.Murphy, J.Kim, S.Rozhdestvenskyy, I.Mejia, H.Park, D.R.Allee, M. Quevedo-Lopez, B.Gnade, "Thin film CdTe based neutron detectors with high thermal neutron efficiency and gamma rejection for security applications," *Nuclear Instruments and Methods in Physics Research A*, vol. 838, pp. 117-123, 2016
6. H. Chung, W. Ye, S. Vora, S. Rednour, D. Allee, "A passive very low frequency electric field imager," *IEEE Sensors*, vol.16 , issue: 9, pp. 3181 – 3187, May 2016
7. J. Smith, A. Couture, J. Stowell, and D. Allee, "Self-aligning overlapping and optically seamless flexible electronic tiles for ultra-large-area digital x-ray imaging," *IEEE Transactions on Components, Packaging and Manufacturing Technology*, 2014;4(6):1109-1115
8. G.R. Kunnen, J. Smith, H. Chung, D.R. Allee, "A TFT-based, Multi-Stage, Active Pixel Sensor for Alpha Particle Detection," *Electronics Letters*, vol. 50, no. 9, Apr 2014, 2 pages (Featured Article)
9. J. Smith, S. Shah, M. Goryll, J. Stowell, and D. Allee, "Flexible ISFET biosensor using IGZO metal oxide TFTs and ITO sensing layer," *IEEE Sensors Journal*, Vol. 14, No. 4, April 2014, pp. 937-938
10. J. Smith, A. Couture, and D. Allee, "Charge emission induced transient leakage currents of a-Si:H and IGZO TFTs on flexible plastic substrates," *Electronics Letters*, Vol. 50, No. 2, January 16, 2014, pp. 105-106
11. R. Wahl, F. Wang, H. Chung, G. Kunnen, S. Yip, E. Lee, E. Pun, G. Raupp, D. Allee, J. Ho, "Stability and low-frequency noise in InAs NW parallel array thin film transistors," *IEEE Electron Device Letters*, Vol. 34, No. 6, 2013, pp. 765-767
12. S. Kim, X. Zhang, R. Daugherty, E. Lee, G. Kunnen, D.R. Allee, E. Forsythe, and J. Chae, "Design and implementation of electrostatic micro-actuators in ultrasonic frequency on a flexible substrate, PEN (polyethylene napthalate), *Sensors and Actuators, A: Physical*, 2012, 8 pages
13. Sangpyeong Kim, Xu Zhang, Robin Daugherty, Ed Lee, George Kunnen, David R. Allee, Eric W. Forsythe, and Junseok Chae, "MEMs based ultrasonic electrostatic actuators on a flexible substrate," *IEEE Electron Device Letters*, vol. 33, no. 7, 2012, pp. 1072-1074
14. David R. Allee, Guest Editorial, *IEEE/OSA Journal of Display Technology*, vol. 8, no. 7, 2012, p. 372
15. John W. Murphy, George R. Kunnen, Israel Mejia, Manuel A. Quevedo-Lopez, David Allee, Bruce Gnade, "Optimizing diode thickness for thin-film solid state thermal neutron detectors," *Applied Physics Letters*, vol. 101, no. 14, 2012, 5 pages
16. Ed Lee, George Kunnen, Alfonso Dominguez, David R. Allee, "A low noise dual stage a-Si:H active pixel sensor," *IEEE Transactions on Electron Devices*, vol. 59, no. 6, pp. 1679-1685, June 2012
17. Ahmet Durgan, Constantine A. Balanis, Craig R. Birtcher, David R. Allee, "Design, Fabrication, Simulation, and Testing of Flexible Bow-Tie Antennas," *IEEE Transactions on Antennas and Propagation*, vol. 59, no. 12, pp. 4425-4435, 2011
18. Aritra Dey, Sameer Venugopal, David R. Allee and Lawrence T. Clark, "Impact of Drain Bias Stress on Forward/Reverse Mode Operation of a-ZIO TFTs," *Solid State Electronics*, vol. 62, pp. 19-24, 2011
19. Edward H. Lee, Anil Indluru, David R. Allee, Lawrence T. Clark, Keith E. Holbert, and Terry L. Alford, "Effects of Gamma Irradiation and Electrical Stress on a-Si:H Thin-Film Transistors for Flexible Electronics and Displays," *IEEE Journal of Display Technology*, vol. 7, no. 6, pp. 325 - 329, 2011

20. Indluru, A.; Venugopal, S. M.; Allee, D. R.; Alford, T. L., "Effect of the Anneal Time on the Enhanced Performance of a-Si:H TFTs for Future Display Technology," *IEEE Journal of Display Technology*, vol. 7, no. 6, pp. 306 - 310, 2011
21. Aritra Dey, Adrian Avendanno, Sameer Venugopal, David R. Allee, Manuel Quevedo, and Bruce Gnade, "CMOS TFT Op-Amps: Performance and Limitations," *IEEE Electron Device Letters*, vol. 32, no. 5, pp. 650-652, 2011
22. Bryan D. Vogt, Barry O'Brien, David R. Allee, Doug Loy, Bulent Akgun and Sushil K. Satija,"Distribution of hydrogen in low temperature passivated amorphous silicon (a-Si:H) films from neutron reflectivity," *Journal of Non-Crystalline Solids*, vol. 357, no. 3, pp. 1114-1117, 2011
23. Korhan Kaftanoglu, Sameer M. Venugopal, Michael Marrs, Aritra Dey, James R. Wilson, Edward Bawolek, David R. Allee, and Doug Loy, "Stability of IZO and a-Si:H TFTs Processed at Low Temperature (200C)" *IEEE Journal of Display Technology*, vol. 7, no. 6, pp. 339-343, 2011
24. Aritra Dey, Anil Indluru, Sameer M.Venugopal, David R. Allee and Terry L. Alford, 'Effect of Electro-Mechanical Stress on a-ZIO TFTs,' *IEEE Electron Device Letters*, vol. 31, no. 12, pp. 1416-1418, December 2010.
25. Nazanin Darbanian, Sameer Venugopal, Shrinivas Gopalan Uppili, David R. Allee, and Lawrence T. Clark, "Flexible Amorphous Silicon Non-Volatile Memory," *Journal of the Society of Information Displays*, Vol. 18, No. 5, pp. 346-350, 2010
26. Manuel Quevedo, S. Gowrisanker, D Allee, S Venugopal, R Krishna, K Kaftanoglu, H.N. Alshareef, and B. E. Gnade, "Novel Materials and Integration Schemes for CMOS-Based Circuits for Flexible Electronics," *Electrochemical Society Transactions*, Vol. 25, No. 7, Issue Title: ULSI Process Integration 6, pp. 503-511, 2009
27. S. Gowrisanker, M.A. Quevedo-Lopez, H. N. Alshareef, B.E. Gnade, S. Venugopal, R. Krishna, K. Kaftanoglu, D.R. Allee, "A Novel Low Temperature Integration of Hybrid CMOS Devices on Flexible Substrates," *Organic Electronics*, vol. 10, no. 7, pp. 1217-1222, Nov. 2009
28. David R. Allee, Lawrence T. Clark, Bryan D. Vogt, Rahul Shringarpure, Sameer M. Venugopal, Shrinivas Gopalan Uppili, Korhan Kaftanoglu, Hemanth Shivalingaiah, Zi P. Li, J.J. Ravindra Fernando, Edward J. Bawolek, and Shawn O'Rourke, "Degradation Effects in a-Si:H Thin Film Transistors and Their Impact on Circuit Performance," *IEEE Transactions on Electron Devices,* vol. 56, no. 6, pp. 1166-1176, June 2009
29. Jiaying Cai, Karel Cizek, Brent Long, Kenyon McAferty, Casey G. Campbell, David R. Allee, Bryan D. Vogt, Jeff La Belle and Joseph Wang, "Flexible Thick-Film Electrochemical Sensors: Impact of Mechanical Bending and Stress on the Electrochemical Behavior," *Sensors and Actuators B: Chemical,* vol. 137, pp. 379-385, 2009.
30. Rahul Shringarpure, Sameer Venugopal, Korhan Kaftanoglu, Lawrence T. Clark, David R. Allee, and Edward Bawolek, "Compact modeling of amorphous silicon thin film transistors with BSIM3," *Journal of Society of Information Displays*, vol. 16, p. 1147-1155, 2008.
31. Rahul Shringarpure, Sameer Venugopal, Lawrence T. Clark, David R. Allee, Edward Bawolek, "Localization of gate biased induced threshold voltage degradation in a-Si:H TFTs," *IEEE Electron Device Letters,* Vol. 29, No. 1, 2008, pp. 93-95.
32. Nathan D. Hindman, Ziyan Wang, Lawrence T. Clark, and David R. Allee*, "*Experimentally Measured Input Referred Voltage Offsets and Kickback Noise in RHBD Analog Comparator Arrays," *IEEE Transactions on Nuclear Science*, Vol. 54, No. 6, Part 1, 2007, pp. 2073-2079.
33. G.B. Raupp, S.M. O'Rourke, C. Moyer, B.P. O'Brien, S.K. Ageno, D.E. Loy, E.J. Bawolek, D.R. Allee, S.M. Venugopal, J. Kaminski, D. Bottesch, J. Dailey, K. Long, M. Marrs, N.R. Munizza, H. Haverinen, N. Colaneri, " Low-temperature amorphous-silicon backplane technology development for flexible displays in a manufacturing pilot-line environment," *Journal for the Society of Information Displays*, Vol. 15, No. 7, 2007, pp. 445-454
34. Zi Li, Sameer Venugopal, Rahul Shringarpure, David R. Allee and Lawrence T. Clark, "Noise Margin Analysis of a-Si:H Digital Circuits," *Journal for the Society of Information Displays*, Vol. 15, No. 4, 2007, pp. 251-259
35. Rahul Shringarpure, Sameer Venugopal, Zi Li, Lawrence T. Clark, David R. Allee, Edward Bawolek, and Daniel Toy, "Circuit Simulation of Threshold Voltage Degradation in a-Si:H TFT's Fabricated at 175°C," *IEEE Transactions on Electron Devices,* Vol. 54, No. 7, July 2007, pp. 1781-1783

36. Alex Z. Kattamis, I-Chun Cheng, Ke Long, Bahman Hekmatshoar, Kunigunde Cherenack, Sigurd Wagner, James C. Sturm, Sameer Venugopal, Douglas E. Loy, Shawn M. O'Rourke and David R. Allee, "Amorphous silicon thin-film transistor backplanes deposited at 200C on clear plastic for lamination to electrophoretic displays," *IEEE Journal of Display Technology*, Vol. 3, No. 3, 2007, pp. 304-308.
37. Sameer M. Venugopal, and David R. Allee, "Integrated a-Si:H source drivers for 4" QVGA electrophoretic display on flexible stainless steel substrate," *IEEE Journal of Display Technology*, Vol. 3, No. 1, March 2007, pp. 57-63.
38. Sameer M. Venugopal, David R. Allee, Zi Li, and Lawrence T. Clark, "Threshold-voltage recovery of a-Si:H digital circuits," *Journal of the Society for Information Displays*, Vol. 14, No. 11, November 2006, pp. 1053-1057.
39. Peter Smith, David Allee, Curt Moyer, and Douglas Loy, "Flexible Transistor Arrays," *Information Display*, Vol. 21, No. 6, June 2005, pp. 18-22
40. Islam, M.M.; Allee, D.R.; Konasani, S.; Rodriguez, A.A., "A low-cost digital controller for a switching DC converter with improved voltage regulation," *Power Electronics Letters*, *IEEE*, Volume 2, Issue 4, Dec. 2004 Page(s):121 – 124
41. H.C. Kim, D.R. Allee, and T.L. Alford, "Thickness Dependence on the Thermal Stability of Silver Thin Films," *Applied Physics Letters*, Vol. 81, p. 4287, 2002
42. M. Hasan, H.H. Shen, D.R. Allee, M. Pennell, "A Behavioral Model of a 1.8V, Flash A/D Converter Based on Device Parameters*," IEEE Transactions on Computer-Aided Design*, vol. 19, no. 1, Jan. 2000, pp. 69-82
43. W. Xie, X. Dai, L.S. Xu, D.R. Allee, and J. Spector, "Fabrication of Cr Nanostructures with the Scanning Tunneling Microscope," *Nanotechnology*, vol. 8, no. 2, June 1997, p.88-93
44. C.B. Wheeler, D.L. Mathine, S.R. Johnson, G.N. Maracas, and D.R. Allee, "Selectively Oxidized GaAs MESFET's Transferred to a Si Substrate," *IEEE Electron Device Letters*, vol. 18, no. 4, p138, April 1997
45. C. Wheeler, S. Daryanani, D.L. Mathine, G.N. Maracas, and D.R. Allee, "Monolithic Integration of a GaAs MESFET with a Resonant Cavity LED using a Buried Oxide Layer," *Photonics Technology Letters* 9(2), p194, 1997
46. D.K. Ferry, M. Khoury, D.P. Pivin Jr., K.M. Connolly, T.K. Whidden, M.N. Kozicki, and D.R. Allee, "Nanolithography," *Semicond. Sci. Technol*. 11, p.1552, 1996.
47. D.L. Mathine, H. Nejad, D.R. Allee, R. Droopad, and G.N. Maracas, "Reduction of the Thermal Impedance of VCSELs after Integration with Copper Substrates," *Appl. Phys. Lett*.., 69(4), p. 463, July 1996.
48. H.C. Day, D.R. Allee, "Selective area oxidation of Si3N4 with an ambient scanning tunneling microscope," *Nanotechnology* 6, p1, 1995.
49. L.S. Xu, and D.R. Allee,"Ambient Scanning Tunneling Lithography of Langmuir Blodgett and Self-Assembled Monolayers," *J. Vac. Sci. Technol. B*, 13(6), p2837, Nov. 1995.
50. H.J. Song, M.J. Rack, K. Abugharbieh, S.Y. Lee, V. Khan, D.K. Ferry, and D.R. Allee,"25nm Chromium oxide lines by scanning tunneling lithography in air," *J. Vac. Sci. Technol. B*, 12(6), pp. 3720-3724, Nov./Dec. 1994.
51. H.C. Day, D.R. Allee, "Selective area oxidation of silicon with a scanning force microscope," *Appl. Phys. Lett.*, 62 (21), pp. 2691-2693, 24 May 1993.
52. H.C. Day, D.R. Allee, R. George and V.A. Burrows, "Nanometer scale patterning of a monolayer Langmuir-Blodgett film with a scanning tunneling microscope in air," *Appl. Phys. Lett.,* , 62 (14), pp. 1629-1631, 5 April 1993.
53. M. Van Hove, G. Zou, W. De Raedt, Ph. Jansen, R. Jonckheere, M. Van Rossum, A. Hoole, D.R. Allee, A.N. Broers, P. Crozat, Y. Jin, F. Aniel, and R. Adde," Scaling behavior of delta-doped AlGaAs/InGaAs HEMT's with gatelengths down to 60nm and source-drain gaps down to 230nm," *J. Vac. Sci. Technol. B*, 11(4), pp. 1203-1208, Jul. / Aug. 1993.
54. D.R. Allee, X.D. Pan, A.N. Broers, and C.P. Umbach, "Ultra-high resolution electron beam patterning of SiO2: a review," presented at the *IIAS Symposium on Science and Technology of Mesoscopic Structures*, New Public Hall, Nara, Japan, November 6-8, 1991, Invited Talk, in *Science and Technology of Mesoscopic Structures*, Eds. S. Namba, C. Hamaguchi, and T. Ando, Springer Verlag, Tokyo, p362 (1992)

55. D.R. Allee, C.P. Umbach, and A.N. Broers, "Direct Nanometer Scale Patterning of SiO2 with Electron Beam Irradiation,"*J. Vac. Sci. Technol. B*, 9(6), pp. 2839-2843, Nov. / Dec. 1991.
56. X. Pan, D.R. Allee, and A.N. Broers, "Nanometer Scale Pattern Replication Using E-Beam Direct Patterned SiO2 as the Etching Mask," *Appl. Phys. Lett.*, 59 (24), pp.3157-3158, 9 December 1991.
57. D.R. Allee, and A.N. Broers, "Limits of Nano-Gate Fabrication," *IEEE Proceedings*, vol. 79, no. 8, pp. 1093-1105, Aug. 1991.
58. S.Y. Chou, D.R. Allee, R.F.W. Pease, and J.S. Harris Jr., "Lateral Resonant Tunneling Transistors Employing Field Induced Quantum Wells and Barriers," *IEEE Proceedings*, vol. 79, no. 8, pp. 1131-1139, Aug. 1991.
59. D.R. Allee, and A.N. Broers, "Direct Nanometer Scale Patterning of SiO2 with Electron Beam Irradiation through a Sacrificial Layer," *Appl. Phys. Lett*., 57(21), pp. 2271-2273, Nov. 19, 1990.
60. D.R. Allee, S.Y Chou, J.S. Harris Jr., and R.F.W. Pease, "Resonant Tunneling of 1-Dimensional Electrons Across an Array of 3-Dimensionally Confined Potential Wells," *Superlattices and Microstructures*, Vol. 7, No. 2, pp. 131-134, 1990.
61. D.R. Allee, S.Y. Chou, J.S. Harris Jr., and R.F.W. Pease, "Engineering Lateral Quantum Interference Devices Using Electron Beam Lithography and Molecular Beam Epitaxy," *J. Vac. Sci. Technol. B* , 7(6), pp. 2015-2019, Nov./Dec. 1989.
62. N.I. Maluf, S.Y. Chou, J.P. McVittie, S.W.J. Kuan, D.R. Allee, and R.F.W. Pease, "Effects of Chromium on the Reactive Ion Etching of Steep-Walled Trenches in Silicon," *J. Vac. Sci. Technol. B* 7(6), pp. 1497-1501, Nov./Dec. 1989.
63. S.Y. Chou, D.R. Allee, R.F.W. Pease, and J.S. Harris Jr., "Observation of Electron Resonant Tunneling in a Lateral Dual Gate Resonant Tunneling Field Effect Transistor," *Appl. Phys. Lett.* 55(2), pp. 176-178, 10 July 1989.
64. D.R. Allee, J.D. Pehoushek, and R.F.W. Pease, "Novel Monte Carlo Simulation of Space-Charge-Induced Energy Broadening in Laser Irradiated Cathodes," *J. Vac. Sci. Technol. B*, 6(6), pp. 1989-1994, Nov./Dec. 1988 .
65. S.W.J. Kuan, C.W. Frank, C.C. Fu, D.R. Allee, P. Maccagno, and R.F.W. Pease, "Ultrathin Polymer Films for Microlithography," *J. Vac. Sci. Technol. B*, 6(6), pp. 2274-2279, Nov./Dec. 1988.
66. P.R. de la Houssaye, D.R. Allee, Y. Pao, D.G. Schlom, J.S. Harris, and R.F.W. Pease, "Electron saturation velocity variation in InGaAs and GaAs channel MODFETs for gate length to 550A," *IEEE Electron Device Letters*, Vol. 9, No. 3, March 1988, pp. 148-150.
67. D.R. Allee, P.R. de la Houssaye, D.G. Schlom, J.S. Harris, and R.F.W. Pease, "Sub-100nm Gate Length GaAs MESFETs and MODFETs Fabricated by a Combination of Molecular Beam Epitaxy and Electron Beam Lithography," *J. Vac. Sci. Technol. B* , 6(1), pp. 328-332, Jan./Feb. 1988.

Awarded US Patents

1. US patent 10589124, awarded 2020
   Integrated high-resolution untethered flexible neural implant
   Joseph Smith, Barry O'Brien, Yong-kyun Lee, Edward Bawolek, Jennifer Blain Christen, Michael Goryll, Jitendran Muthuswamy, George R. Kunnen, David Allee
2. *US patent* 10,416,244, awarded 2019
   Three-dimensional imaging utilizing low frequency magnetic fields
   David R. Allee, Gregory P. Spell, Brett Larsen, Anthony M. Wilson, Owen C. Ma
3. *US patent* 10,180,504, awarded 2019
   Adaptive Detection Sensor Array and Method of Providing and Using the Same
   Joseph Smith, E. Forsythe, David Allee
4. *US patent* 10,147,360, awarded 2018
   Rugged Display Device Architecture
   Michael Hack, David Allee
5. *US patent* 9,910,171, awarded 2018, Thin Film Transistor Detection Systems and Related Methods, George Kunnen, David Allee
6. *US patent 9,903,959*, awarded 2018
   Adaptive detection sensor array and method of providing and using the same
   Joseph Smith, Eric Forsythe, and David Allee
7. *US patent 8,860,197*, awarded 2014

Integrated circuits secure from invasion and methods of manufacturing the same
Lawrence T. Clark, and David R. Allee

8. *US patent 8,860,575*, awarded 2014
   Flexible identification systems and related methods
   David R. Allee, Lawrence T. Clark, Terry L. Alford, Constantine A. Balanis, James T. Aberle, and Kevin Baugh
9. *US patent 8,796,608*, awarded 2014
   Dual stage active pixel devices and related methods
   Edward H. Lee, David R. Allee, and George R. Kunnen
10. *US patent 8,610,223*, awarded 2013
    Embedded microelectromechanical systems sensor and related devices and methods
    Narendra V. Lakamraju, Sameer M. Venugopal, Stephen M. Phillips, David R. Allee
11. *US patent 8,488,370*, awarded 2013
    Differential threshold voltage non-volatile memory and related methods
    Sameer M. Venugopal, David R. Allee, Lawrence T. Clark, Nazanin Darbanian
12. *US patent 8,462,565*, awarded 2013
    Differential threshold voltage non-volatile memory and related methods
    Sameer M. Venugopal, David R. Allee, Lawrence T. Clark
13. *US patent 8,319,191*, awarded 2012
    Sensor devices and related methods
    David R. Allee
14. *US patent 8,319,561*, awarded 2012
    Amplifiers with depletion and enhancement mode thin film transistors and related methods
    Sameer M. Venugopal, Aritra Dey, David R. Allee
15. *US Patent No. 6,819,124*,
    Detection of electromigration in integrated circuits
    D.R. Allee, and T.L. Alford
16. *US Patent No. 6,304,784*
    Flexible Probing Device and Methods for Manufacturing the Same
    D.R. Allee, and L.C. Jaw
17. *US Patent No. 6,255,979*
    CMOS Flash Analog to Digital Converter Compensation
    D.R. Allee, and B.R. McDaniel

Refereed International Conference Proceedings Publications:

1. Z. Lythgoe, T.F. Long, M.J. Buchholz, A.R. Livernois, K. Kanuteh, D.R. Allee, A. Pal, I.R. Graham, Z.D. Drummond, "Design and Validation of a Very Low-Power Measurement Unit," in 2024 IEEE Texas Power and Energy Conference.
2. M. Goryll, T.J. Thornton, C. Wang, S.M. Phillips, D. Allee, "Online undergraduate laboratories in electrical engineering", IEEE Frontiers in Education, 16-19 October 2019, Cincinnati, Ohio 4 pages
3. Z. Drummond, I. Lontsi, K. Claytor, B. Parks, D. Hull, D. Allee, "Real time accurate measurements of power systems," Military Sensing Symposium, Battlespace, Acoustic, Seismic, Magnetic and Electric-field Sensing and Signatures, 22-25 October 2018, Gaithersburg, Maryland, 16 pages
4. J.T. Smith, E. Bawolek, J. Trujillo, G. Raupp, D.R. Allee, J.B. Christen, "Adapting large area flexible hybrid TFT/CMOS electronics and display technology to create an optical sensor array architecture," International Symposium on Circuits and Systems (ISCAS), 2017 IEEE, 28-31 May 2017, Baltimore, Maryland, 4 pages
5. D. Allee, D. Hull, and E. Forsythe, "Very low frequency electric field imaging of concealed structures," Military Sensing Symposium, Battlespace, Acoustic, Seismic, Magnetic and Electric-field Sensing and Signatures, 20-23 June 2016, Gaithersburg, Maryland, 9 pages
6. Joseph T. Smith, Ankur Shah, Yong-Kyun Lee, Barry O'Brien, Dixie E. Kullman, David R. Allee, Jitendran Muthuswamy, and Jennifer Blain Christen, "Optogenetic Neurostimulation of the Auricular Vagus using Flexible OLED Display Technology to Treat Chronic Inflammatory Disease and Mental Health Disorders," GOMAC Tech Conference,14-17 March 2016, Orlando, FL, 4 pages

7. J. T. Smith, E. W. Forsythe ; D. R. Allee ; J. B. Christen, "Adaptive digital x-ray detector for high sensitivity medical fluoroscopy imaging, Biomedical Circuits and Systems Conference (BioCAS), 2015 IEEE, 22-24 Oct. 2015, Atlanta, Georgia, 4 pages
8. D. Allee, E. Forsythe, D. Morton, and D. Hull, "Flexible hybrid electronics for large area sensing arrays: x-rays, neutrons, and low frequency electric fields," Military Sensing Symposium, Battlespace, Acoustic, Seismic, Magnetic and Electric-field Sensing and Signatures, 28-31 October 2014, Springfield Virginia, 14 pages
9. Brett W. Larsen, Hugh Chung, Alfonso Dominguez, Jacob Sciacca, Narayan Kovvali, Antonia Papandreou, David R. Allee, "Applying matching pursuit decomposition to UGS footstep classification," *SPIE 2013 Defense Security & Sensing Symposium*, Baltimore, MD, 29 April to 3 May 2013, 6 pages
10. Israel Mejia, Ana L. Salas-Villasenor, John W. Murphy, George R. Kunnen, Kurtis D. Cantley, David R. Allee, Bruce E. Gnade, Manuel A. Quevedo-Lopez, "High performance logic circuits using solution based, low temperature semiconductors for flexible electronics," *SPIE 2013 Defense Security & Sensing Symposium*, Baltimore, MD, 29 April to 3 May 2013, 6 pages
11. Joseph T. Smith, Michael Marrs, Mark Strnad, Raj B. Apte, David R. Allee, Nicholas Colaneri, Eric Forsythe, David C. Morton, "Flexible digital x-ray technology for far forward remote diagnostic and conformal x-ray imaging applications," *SPIE 2013 Defense Security & Sensing Symposium*, Baltimore, MD, 29 April to 3 May 2013, 6 pages
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13. Alfonso Dominguez, George R. Kunnen, Michael Vetrano, Joseph T. Smith, Michael Marrs, David R. Allee, "Development of a testbed for flexible sensing arrays, *SPIE 2013 Defense Security & Sensing Symposium*, Baltimore, MD, 29 April to 3 May 2013, 6 pages
14. George R. Kunnen, Daniel Pressler, Edward H. Lee, David R. Allee, John W. Murphy, Israel Mejia, Manuel Quevedo, and Bruce Gnade, "Large area sensing arrays for detection of thermal neutrons," *IEEE Nuclear Science Symposium*, Anaheim, CA, October 27- November 3, 2012, 6 pages
15. Aritra Dey, David R. Allee, "Amorphous silicon 5 bit flash analog to digital converter," *2012 Custom Integrated Circuits Conference*, San Jose, California, San Jose, California, Sept. 9-12, 2012, 4 pages
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17. Aritra Dey, David R. Allee, "Amorphous silicon current steering digital to analog converter," *2011 Custom Integrated Circuits Conference*, San Jose, California, San Jose, California, Sept. 19-21, 2011, 4 pages
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20. Michael A. Marrs, Sameer M. Venugopal, Curtis D. Moyer, Edward J. Bawolek, Dirk Bottesch, Barry P. O'Brien, Rita J. Cordova, Jovan Trujillo, Douglas P. Loy, Gregory B. Raupp, David R. Allee," Low Temperature Zinc Indium Oxide Backplane Development for Flexible OLED Displays in a Manufacturing Pilot Line Environment," *Materials Research Society Spring Proceedings*, San Francisco, California, April 25-29, 2011, 6 pages
21. Ahmet C. Durgun, Mark S. Reese, Constantine A. Balanis, Craig R. Birtcher, David R. Allee, and Sameer Venugopal, "Flexible Bow-Tie Antennas with Reduced Metallization," *Radio Wireless Week*, Phoenix, Arizona, January 16-19, 2011, pp. 50-53
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23. Aritra Dey, Sameer M.Venugopal, Adrian E. Avendano, David R Allee, Manuel Quevedo and Bruce E. Gnade, 'Flexible Interface Electronics for Large Area Sensors,' *27th Army Science Conference*, Orlando, Florida, Nov. 29 to Dec. 2, 2010, 8 pages
24. N. Lakamraju, S.M. Venugopal, D.R. Allee, and S.M. Phillips, "Flexible shock sensor tag with integrated display," *27th Army Science Conference*, Orlando, Florida, Nov. 29 to Dec. 2, 2010, 5 pages
25. N.V. Lakamraju, S.M. Venugopal, D.R. Allee and S.M. Phillips, "Shock wave pressure sensors on PEN substrate," *IEEE 2010 Sensors Conference*, Waikoloa, HI, Nov. 1-4, 2010, 4 pages
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27. A.C. Durgun, M.S. Reese, C.A. Balanis, C.R. Birtcher, D.R. Allee and S.M. Venugopal, "Flexible Bow-tie Antennas," *2010 IEEE International Symposium on Antennas and Propagation & CNC-USNC/URSI Radio Science Meeting*, Toronto, Ontario, Canada, July 11-17, 2010, 4 pages
28. S.M. Venugopal, M. Marrs, and D.R. Allee, "Integrated Source Drivers for Electrophoretic Displays Using Low Temperature IZO TFTs," *Society for Information Displays, International Symposium, Digest of Technical Papers*, May 23- 28, 2010, Seattle, Washington, 3 pages
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51. O. Cifdaloz, S. Konavani, A.A. Rodriguez, M.I. Islam, and D. Allee, "DC-DC buck converter design: a sampled-data approach," *Proceedings of the 2006 American Control Conference*, June 14-16, 2006, Minneapolis, Minnesota, pp. 2765-2770
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53. G. B. Raupp, Shawn M. O'Rourke, David R. Allee, Sameer M. Venugopal, Edward J. Bawolek, Douglas E. Loy, Curt Moyer, Scott K. Ageno, Barry P. O'Brien, Steve Rednour and Ghassan E. Jabbour, "Flexible reflective and emissive display integration and manufacturing", *SPIE Symposium Proceedings* 5801, 194-203 (2005).

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61. A.N. Broers, X. Pan, D.R. Allee, C.P. Umbach, "Nanolithography and Direct Exposure of SiO2 Layers," Molecular Electronics: Science and Technology, St. Thomas, Virgin Islands, Dec. 1990, AIP Conference Proceedings, vol. 262, editor: Ari Aviram, pp.151-162, (1992).
62. D.R. Allee, P.R. de la Houssaye, D.G. Schlom, B.W. Langley, J.S. Harris, and R.F.W. Pease, "Sub-100nm Gate Length GaAs MESFETs Fabricated by Molecular Beam Epitaxy and Electron Beam Lithography," in *Proceedings IEEE/Cornell Conference on Advanced Concepts in High Speed Semiconductor Devices and Circuits*, pp.190-198, Aug. 10-12, 1987, Ithaca, New York.

International Conference Proceedings Abstracts and Presentations:

1. Lindsey Smith, John W. Murphy, Sergiy Rozhdestvenskyy, Israel Mejia, Manuel Quevedo-Lopez, Bruce Gnade, George R. Kunnen, and David R. Allee, "Strategies for Improving the Intrinsic Efficiency of CdTe/CdS-based Thin-Film Thermal Neutron Detectors," SORMA West 2016, May 23-26, Berkeley, California
2. H. Chung, W. Ye, S. Vora, J. Gorrie, A. Wilson, C. Reynolds, A. Lucas, M.Oman, S. Rednour, D. Allee, "A very low frequency electric field imager," 2016 Flex Conference, Monterey, CA, 29 Feb – 3 March, 2016
3. Eric Forsythe, David R. Allee, Jiamin Shi, David C. Morton, Nicholas Colaneri, "Flexible electronics for Army applications," *SPIE 2013 Defense Security & Sensing Symposium*, Baltimore, MD, 29 April to 3 May 2013
4. D.R. Allee, "Flexible Electronics, what is it good for?" *Flexible & Printed Electronics Conference*, 29 January to 2 February, 2013, Phoenix, Arizona
5. Kevin LaRosa, Bryan Vogt, and David R. Allee, "Ultra-Sensitive Gas Sensors Using Mesoporous Carbon Films and High Precision Time Interval Measurements," *Flexible Electronics and Displays Conference*, February 8-10, 2011, Phoenix, Arizona
6. Narendra V. Lakamraju, Sameer M. Venugopal, David R. Allee and Stephen M. Phillips, "Passive Blast Measurement System with Integrated Electrophoretic Readout," *Flexible Electronics and Displays Conference*, February 8-10, 2011, Phoenix, Arizona – Best Student Poster, 2nd place
7. Aritra Dey, Anil Indluru, Sameer M. Venugopal, Terry L. Alford and David R. Allee, "Mechanical Stress Testing of Amorphous Zinc Indium Oxide TFTs Fabricated at Low Temperatur," *Flexible Electronics and Displays Conference*, February 8-10, 2011, Phoenix, Arizona
8. E.H. Lee, A. Indluru, D.R. Allee, L.T. Clark, K.E. Holbert, and T.L. Alford, "Electrical Reliability of a-Si:H TFTs with Gamma Radiation and Electrical Stress," *Flexible Electronics and Displays Conference*, February 1-4, 2010, Phoenix, Arizona

9. N.V. Lakamraju, K. Kaftanoglu, S.M. Venugopal, D.R. Allee and S.M. Phillips, "Integrated Blast Dosimeter on Flexible Substrate," *Flexible Electronics and Displays Conference*, February 1-4, 2010, Phoenix, Arizona
10. A. Dey, K. Kaftanoglu, and D.R. Allee, "Design of Analog to Digital Converter with Flexible Thin Film Transistors," *Flexible Electronics and Displays Conference*, February 1-4, 2010, Phoenix, Arizona
11. K. Kaftanoglu, A. Dey. S.M. Venugopal, and D.R. Allee, "Flexible CMOS Infra-Red Tag," *Flexible Electronics and Displays Conference*, February 1-4, 2010, Phoenix, Arizona
12. A. Indluru, S.M. Venugopal, D.R. Allee, and T. Alford, "Effect of Anneal Time on the Performance of a-Si:H TFT's on Flexible Substrates," *Flexible Electronics and Displays Conference*, February 1-4, 2010, Phoenix, Arizona
13. S.M. Venugopal, E. Bawolek, M. Marrs, K. Kaftanoglu, A. Dey, J. Wilson, A. Indluru, T. Alford, D.R. Allee and S. O'Rourke, "Effect of Bias Stress on Low Temperature Indium Zinc Oxide Thin Film Transistors on PEN Substrates," *Flexible Electronics and Displays Conference*, February 1-4, 2010, Phoenix, Arizona
14. M.A. Quevedo-Lopez, A. Avendano, D. Mao, H. Stiegler, and B. E. Gnade, S. Venugopal, D. Allee, "Reliability Improvement in Fully integrated CMOS Devices Using Low Temperature Hybrid Gate Dielectrics," *Flexible Electronics and Displays Conference*, February 1-4, 2010, Phoenix, Arizona
15. K. Kaftanoglu, S.M. Venugopal, and D.R. Allee, "Flexible CMOS Manchester Adder on PEN Substrate using Organic and a-Si:H TFTs," *Flexible Electronics and Displays Conference*, February 2-5, 2009, Phoenix, Arizona
16. D.R. Allee, "Flexible Display and Flexible Electronics," *IEEE Workshop on Emerging Device and Packaging Technologies*, 11 December 2007, Phoenix, Arizona
17. N.D. Hindman, Z. Wang, L.T. Clark, D.R. Allee, "Experimentally measured input referred voltage offsets and kickback noise in RHBD analog comparator arrays," *Nuclear and Space Radiation Effects Conference*, July 23-27, 2007, Honolulu, Hawaii
18. G.R. Raupp, N. Colaneri, S.M. O'Rourke, J. Kamminski, D.R. Allee, S.M. Venugopal, E.J. Bawolek, D.E. Loy, C. Moyer, S.K. Ageno, B.P. O'Brien, D. Bottesch, S. Rednour, J. Dailey, and K. Long, "AM TFT Technology Development and Pilot Line Manufacturing for Reflective and Emissive Flexible Displays," *Flexible Displays and Microelectronics Conference*, February 5-8, 2007, Phoenix, Arizona
19. Alex Z. Kattamis, Kunigunde Cherenack, Bahman Hekmatshoar, I-Chun Cheng, Sigurd Wagner, James C. Sturm, Sameer Venugopal, Daniel Toy, Douglas E. Loy, Shawn M. O'Rourke, and David R. Allee "Amorphous Silicon Thin-Film Transistor Backplanes Deposited at High Temperature on Clear Plastic for Electrophoretic Displays, *49th Electronic Materials Conference*, June 20-22, 2007, Notre Dame, Indiana
20. Mike Pennell, and David Allee, "Behavioral Model Correlation Based on Process Specific Device Parameters," *The IEEE/ACM International Workshop on Behavioral Modeling and Simulation (BMAS'98)* Oct 27-28, 1998, Orlando, FL.
21. B.J. Skromme, Y. Zhang, Q. Zhang, R. Droopad, C. Choi, R. Ramamurti, G.N. Maracas, R. Somasekharan, D.R. Allee, "Optical Properties of Heteroepitaxial InP/GaAs and GaAs/InP Grown by Gas Source Molecular Beam Epitaxy," in abstracts of the *1992 Electronic Materials Conference*, MIT, Cambridge Massachusetts, June 24-26, 1992.
22. D.R. Allee, A.N. Broers, and C.P. Umbach, "Direct Nanometer Scale Patterning of SiO2 with Electron Beam Irradiation," in *abstracts of the 1991 IEEE Workshop on Micrometer and Submicrometer Lithography*, Koloa, Kauai, Hawaii, August 19-23, 1991, Invited Talk
23. D.R. Allee, and A.N. Broers, "Resolution Limits of Nanostructure Fabrication Techniques," in *lecture notes of14th Workshop on Electron Transport in Low Dimensional Structures*, Gwatt, Switzerland, Oct. 18-20, 1990, Invited Talk.
24. D.R. Allee, A.N. Broers, M. Van Rossum, S. Borghs, W. De Raedt, H. Launois, B. Etienne, Y. Jin, R.Adde, R. Castagne, A. Antonetti, and D. Hulin, "Performance and Physical Limits of Heterostructure Field Effect Transistors," *Esprit Conference 1990*, Brussels, Belgium.
25. S.Y. Chou, D.R. Allee, R.F.W. Pease, and J.S. Harris Jr., "Quantum Interference Devices Fabricated Using Molecular Beam Epitaxy and Ultra-High Resolution Electron Beam Lithography," in *abstracts of the 47th Annual Device Research Conference*, June 19-21, 1989, MIT Cambridge, Massachusetts.

26. S.Y. Chou, J.S. Harris, R.F.W. Pease, D.R. Allee, P.R. de la Houssaye, M. McCord, D. Narum, D.G. Schlom, "Sub-100nm Fabrication and Devices," *1987 American Physical Society March Meeting*, New York, Invited Talk.
27. J. Lo, C.Hwang, T.C. Huang, R. Campbell, D.R. Allee, "Magnetic and Structural Properties of High Rate Dual Ion-Beam Sputtered NiFe Films," *Abstracts of 31st Annual Conference on Magnetism and Magnetic Materials*, p. 86, 1986.

Invited Presentations:

28. D.R. Allee, "History of Microelectronics," Military Sensing Symposium, Battlespace, Acoustic, Seismic, Magnetic and Electric-field Sensing and Signatures, 28-31 October 2024, Laurel, Maryland
29. D.R. Allee, "A brief history of microelectronics," Army Research Laboratory, Adelphi, MD, 10 April 2024, audience ~95
30. D.R. Allee, "VLF electric field imaging," Army Research Laboratory, Adelphi, MD, 21 June 2017, audience ~30
31. D.R. Allee, "VLF electric and magnetic field coupling into cables," Army Research Laboratory, Adelphi, MD, 28 June 2016, audience 20
32. D.R. Allee, "Very Low Frequency Electric Field Imaging," Army Research Laboratory, Adelphi, MD, 27 July 2015, audience 10
33. B. Gnade, D. Allee, "Large Area, High Sensitivity, Neutron Detection," DHS-DNDO Academic Research Initiative Annual Review, Dallas Texas, 7-9 July 2015, ~150 attendees
34. Flexible Hybrid Electronics, Semicon Korea 2015, Seoul, Korea, February 4, 2015, ~150 attendees
35. Military Applications of Flexible Electronics, Army Research Laboratory, Adelphi, Maryland, October 1, 2013, ~50 attendees

Because of the DoD travel ban, I presented the following two papers at the IEEE Sensors Conference on behalf of the Army Research Labs:

36. C.A. Browning, S.J. Vinci, J. Zhu, D.M. Hull, M.A. Noras, "An Evaluation of Electric-Field Sensors for Projectile Detection" presented at the IEEE Sensors Conference, Baltimore, MD, Nov. 3-6, 2013, audience ~30
37. S. Ghionea, G. Smith, J. Pulskamp, S. Bedair, C. Meyer, D. Hull, "MEMS electric field sensor with lead zirconate titanate (PZT) – actuated electrodes", presented at the IEEE Sensors Conference, Baltimore, MD, Nov. 3-6, 2013, audience ~100
38. D.R. Allee, Eric Forsythe, "Hybrid Flexible Electronics," Symposium on Materials and Processes for Flexible Devices and Electronics, University of Massachusetts at Amherst, 16 May 2013, ~150 people
39. D.R. Allee, "Flexible Electronics: Potential and Reality," FlexTech Alliance Workshop: Metal Oxide TFT Devices and Technology, San Francisco Marriott Marquis, San Francisco, CA, 11 July 2012, ~120 people
40. D.R. Allee, "Flexible Electronics: Potential and Reality," University of Akron, Akron, OH, 27 May 2012, ~100 people
41. D. Allee, "Flexible Electronics," City University of Hong Kong, 1 November 2011, audience 50
42. D. Allee, "Flexible Sensor Systems," to Dr. Zachary Lemnios, Assistant Secretary of Defense, 1 June 2011, audience 1
43. D. Allee, "Flexible Sensor Systems," to Glenn Gaffney, Deputy Director of National Intelligence, and Christopher Darby, CEO of InQTel, 28 October 2011, audience 2
44. D.R. Allee, "Flexible Electronics: What are the gaps from a designer's perspective?" Flex Tech Alliance Workshop, San Jose, CA, 10 November 2010, 40 people
45. D.R. Allee, "Flexible Electronics: Potential and Reality," International Materials Research Congress, Cancun, Mexico, Aug. 15-19, 2010, 60 people
46. D.R. Allee, "Flexible Electronics: What can/might/should it do?," CMOS Emerging Technologies Conference, Whistler, Canada, May 19-21, 2010, 50 people
47. D.R. Allee, "Flexible Electronic Integrated Systems," Distinguished Scholar Symposium on Display Technology, Hanyang University, South Korea, 18 June 2009, 200 people
48. D.R. Allee, "Flexible CMOS Circuits for Display Applications," Society for Information Displays Conference, San Antonio, Texas, 2009, 200 people
49. D.R. Allee, " Flexible Electronics," Army FDC Day, Phoenix, AZ, Feb 2009, 50 people

50. D.R. Allee, “Threshold Voltage Instability in a-Si:H TFTs and the Implications for Flexible Displays and Circuits,” Presented at the 8th International Meeting on Information Displays, Kintex, South Korea, 13-17 October 2008.
51. D. Allee,” Degradation Effects in Amorphous Silicon Thin Film Transistors and Their Impact on Circuit Performance,” presented at Sharp Laboratories of America, Portland, Oregon, 8 August 2008
52. D. Allee, “Degradation Effects in a-Si:H TFTs and Their Impact on Circuit Performance,” presented at the IEEE International Reliability Physics Symposium, April 2008, Phoenix, Arizona
53. D. Allee, “Flexible Displays and Flexible Electronics,” IEEE Workshop on Emerging Device and Packaging Technologies, 10 December 2007, Phoenix, Arizona
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