CURRICULUM VITAE

Martin Peckerar, Ph.D.

1a. Personal Information:

Dr. Peckerar is a specialist in the areas of microelectronic science and technology. He has worked in microcircuit process development (primarily high resolution patterning, for which he was named a fellow of the IEEE in 1994), in non-volatile memory design and process development and in battery technology. He has taught microelectronic circuit design at the University of Maryland (College Park, MD) since 1980. Notable accomplishments include:

- Lead process engineer on the Westinghouse Electric BORAM (Block oriented random access memory) – the first military grade non-volatile memory used in combat situations
- He is the inventor of the deep-depletion CCD imager used in x-ray and in short wavelength IR imaging.
- He developed the first CCD imager and read-out electronics demonstrated to be radiation hard out to 1 MRAD:Si while operating at 77K. This has been enabling technology in satellite imaging.
- He invented the plasma radiation source used in EUV and in x-ray lithography. This is a core technology for the Intel-led EUV consortium.
- Dr. Peckerar led the NRL team that was the worlds first to demonstrate and to exploit self-assembly (SA) in patterning technology. The polysiloxane attachment chemistries he developed have been used as a paradigm for SA pattern development to this day. This preceded work done at Harvard, and elsewhere, that eventually used many of the same chemistries.
- He led a design team that was the first to demonstrate neural-net based co-processor chips employing informational entropy regularization principles for optimal image reconstruction.
- University lead in a joint project with Sandia Laboratories and NASA to create a computer-aided design base for producing integrated circuits that work at 4K (and below) in ionizing radiation environments.
- He started and ran the Nanoelectronics Processing Facility (NPF) at the US Naval Research Laboratory. Originally the organization employed three people and had rudimentary equipment such as oxidation and diffusion furnaces. The facility eventually employed 25 people and included such advanced tooling as two JEOL nanowriter e-beam machines. This activity merged with the crystal growth group to become the Interface and Thin Film Sciences Branch (also led by Dr. Peckerar.)
- Dr. Peckerar was the Navy representative to the US international agreement panel on strategic arms control relating to electronic weapons systems (the Waasenaar and CoCOM agreements).
- Dr. Peckerar holds 23 US patents.
- H was awarded the University of Maryland's outstanding invention of the year in physical science award (2008) for a flexible thin-film battery cell supplying more current per unit area than lithium. The cell is recyclable and environmentally benign.
- This patent resulted in a university spin-off company (FlexEl, LLC) that was accepted into the state of Maryland's technology advancement program and now employs 5 people.
- Co-authoring 2 books, one of which is a standard textbook used worldwide in semiconductor process technology. He has edited 4 other texts.

1b. Education:

1971-1975 Ph.D., University of Maryland
1968-1971 M.S, University of Maryland
1964-1968 B.S., SUNY Stony Brook

1c. Awards:

- Fellow, IEEE 1994: For Contributions to and Leadership in X-ray and Microlithography.
- Outstanding Invention of the year (2008) in physical sciences, presented by the Maryland Office Of Technology Commercialization.
- First place in the University of Maryland's $75K Business Plan Competition (2009)
- Maryland Technology Enterprise Institute (MTECH/SAIC) $25K grants for battery development 2009
- Maryland State Incubator Company of the Year Award, May 2010

1d. Awards to Student Under my Supervision:

Best Paper Awards:

- **Wei Zhao.** Best student poster award, International Device Research Symposium, December, 2011.
- **Seokjin Kim**. IEEE Autotestcon Best Graduate Student Paper award 2007 AND 2008 (we won two years in a row). This is the IEEE's primer conference on test and evaluation.
- **Sanaz Adl**, IEEE Sensors Symposium 2007, best student paper award.
- **Nick Kratzmeier, James Weincke** and **Jeffrey Allnutt**: Admission into the BS/MS program

1e. Professional Experience:

2012-present Dr. Peckerar has co-founded two small businesses. The first, FlexEl LLC is a manufacturer of flexible electronic components and batteries. This company has partnered with Reynolds America to produce power supplies for the next generation of electronic cigarettes. The company is valued at $27M. In addition, Dr. Peckerar was a co-founder of CololCAD electronics, a company specializing in the creation of computer aided design tools for low temperature electronic systems used in space applications.

1981-2012 Professor, University of Maryland (College Park Campus)
Dr. Peckerar is Professor of analog systems design. He is author of the textbook Electronic Materials: Science and Technology (S.P. Murarka, co-author), the Korean Electronics Economy (with Mike Pecht) and Synthetic

Microstructures for Biological Research. In 1980, Professor Peckerar was appointed lecturer in the ECE department. From 1981-2002, he was professor part-time, holding joint appointments at the university and at the Naval Research laboratory. He became tenured professor full time in 2002, and he is currently professor, emeritus.

1981-2002 Branch Chief, Naval Research Laborarory, Washington, DC
Dr. Peckerar headed the Interface and Thin Films Branch. His responsibilities included management of the Nanoelectronics Processing Facility as well as the Laboratory for Advanced Materials Synthesis. Here, he developed sensor materials for visible, IR, UV and x-ray imaging. He also was Navy Manager of the DARPA Advanced Lithography Program.

1976-1981 ***Fellow Engineer, Westinghouse Corporation, Baltimore, MD***
Dr. Peckerar headed the Advanced MOS Technology Group. He designed and developed non-volatile memory systems and radiation-hardened components

1973-1976 Physicist, Naval Research Laboratory, Washington, DC
Dr. Peckerar worked in the area of x-ray spectroscopy (largely aimed at detecting environmental pollutants.)

1968-1973 Physicist, NASA Goddard, Greenbelt, MD
Dr. Peckerar performed component reliability studies for the first manned lunar program.

2. Research, Scholarly, and Creative Activities

a. Books.

i. Books authored.

S.Murarka, M. Peckerar, **Electronic Materials Science and Technology**, Academic Press, 1989.

M. Pecht, J. Bernstein, Daemon Searles and M.Peckerar, **The South Korean Electronics Industry**, CRC Press, 1997.

ii. Books edited.

M. Peckerar, M., J. Schnur and H. Stratton, **Synthetic Microstructures in Biological Research**, Plenum Press, New York, 1993. Re-issued in 2004.

M. Peckerar, "Electron-Beam X-Ray and Ion Beam Submicrometer Lithographies for Manufacturing II", Vol 1671 SPIE, San Jose, CA, 1992.

M. Peckerar, “Electron-Beam, X-Ray, and Ion Beam Lithographies For Manufacturing,” SPIE Proc. Vol. 1465 SPIE, San Jose, CA, 1991.

M. Peckerar and M. Postek, “Nanostructure Science, Metrology and Technology,” (With Mike Postek) SPIE Press, March 2002.

iii. Chapters in books.

M.Peckerar, R. Neidert, “High-Speed Microelectronics for Military Applications in the IEEE Press Anthology **VLSI Engineering**, V. Wohlfarth, W. Grobman, eds. (1985).

C. Marrian, M. Peckerar and Y. Pati "Electronic Neural Nets For Solving Ill-Posed Problems With An Entropy Regulariser," (with C. Marrian and Y. Pati), in **Maximum Entropy And Bayesian Methods**, J. Skilling (ed.), D. Reidel, Dordrecht, pp. 371-376 (1989).

M. Peckerar, P.T. Ho, R. Chen, "High Resolution Lithography For Optoelectronics," in **McGraw Hill Handbook On Optoelectronics**, R. Waynant, Ed.(1992).

Martin Peckerar and Milton Rebbert, "Advanced Materials Processes for Bio-Probes," in **Synthetic Microstructures in Biological Research**, Plenum Press, Edited M. Peckerar, J. M. Schnur H. Stratton, Pages 3-16, 1992.

M. Peckerar, F. Perkins, E. Dobisz, and O. Glembocki "Issues in Nanolithography for Quantum Effect Device Manufacture," (with in, **The Handbook of Microlithography, Micromachining and Microfabrication** P. Rai-Choudhury, ed., SPIE Press (1997).

E. Dobisz, F. Perkins, M. Peckerar "E-Beam and Proximal Probe Processes for Nanolithography," in **Microlithography: Science and Technology**, J.R. Sheats and B.W. Smith, eds. Marcel Dekker, New York, 1998. Re-issued in 2007.

M. Peckerar, "Nanolithography With Electron Beams: Theory and Practice," in **Direct-Write Technologies for Rapid Prototyping Applications**, A. Pique and D. Chrissey (eds.), Academic Press, San Diego, CA(2001).

b. Articles in Refereed Journals.

1. M. Peckerar "Electron Beam Studies of Schottky Barrier Detector Surfaces", IEEE Trans. Nuc. Sci **NS-20**, 383 (1973).

2. M. Peckerar "On the Origin of the Increase in Schottky Barrier Height with Increasing Interfacial Oxide Thickness", J. Appl. Phys. **45**, 4652 (1974).

3. D. B. Brown, J. V. Gilfrich, M. Peckerar, "Measurement and Calculation of Absolute Intensities of X-ray Spectra", J. Appl., Phys., **46,** 4537 (1975).

4. M. Peckerar, S. Mak, L. Skolnick, "The Role of Electron Trapping in the Plasma Anodization of Aluminum", Journal of the Electrochemical Society, **123**, 190C (1976).

5. M.H. White, J. Dzimianski and M. Peckerar, "Endurance of Thin-Oxide Non-Volatile MNOS Memory Transistors", IEEE Trans. Electron Devices, **ED-24** 577 (1977) .

6. M. Peckerar, D. Nagel, "X-Ray Imaging with Charge-Coupled Devices", J. of Appl. Physics**, 48**, 2565 (1977).

7. R. McLouski, M. Peckerar and J. Schruers, "The Effect of HCl Residual Treatment on MNOS Memory Transistors", J. Electrochemical Soc., **125**, 985 (1978).

8. D. Nagel and M. Peckerar, "Lithography and High Resolution Radiography with Pulsed X-rays" Jap. Jour. Appl. Phys., 472 (1978).

9. M. Peckerar, P. Blaise and R. Fulton, "Radiation Effects in MOS Devices Caused by X-ray and E-beam Lithography", JVST **16**, 1658 (1979).

10. D. Nagel and M. Peckerar, “Pulsed X-ray Lithography” Electron Letters, **14** 781 (1979).

11. M. Peckerar and N. Bluzer, “Hydrogen Annealed Nitride/Oxide Structures for Radiation Hardness”, IEEE Trans. Nuc. Sci., **NS-27** 1193 (1980).

12. H. Stein, P. Peercy and M. Peckerar, “Properties of Magnetron Sputtered Amorphous Hydrogenated Silicon” Journal of Mat’l Sci., **10** 797 (1981).

13. M. Peckerar, D. Nagel and D. Baker, “X-Ray Imaging with CCDs”, Appl. Phys. Lttrs. **39** 55 (1981).

14. R. Williams, J. Rife, D. Nagel, and M. Peckerar, “Instrumentation for X-UV Lithography at SURF II,” Nuc. Instr. and Methods, **195** 267 (1982).

15. M. Peckerar, C. Dozier, D. Brown, D. Patterson, D. McCarthy and D. Ma, “Radiation Effects Introduced By X-Ray Lithography in MOS Devices”, IEEE Trans. Nuc. Sci. **29(6),** pp. 1697-1701(1982).

16. D. Brown, D. Ma, C. Dozier and M. Peckerar, “Thermal Annealing of Radiation Induced Defects – A Diffusion Limited Process,” IEEE Trans. Nuc. Sci. **30(6),** 4059(1983).

17. M. Peckerar and D. Ma “Modeling Total Dose Effects in Narrow Channel Devices,” IEEE Trans. ED., **ED-30**, p. 1159, (1983).

18. M. Peckerar and R. Neidert, “High Speed Microelectronics for Military Applications”, Proc. IEEE **71**, p. 657, (1983).

19. R.R. Whitlock, M.H. Emery, J.A. Stamper, E.A. McLean, S.P. Obenschain and M. Peckerar, “Observation of Rayleigh-Taylor-Like Structures in a Laser-Accelerated Foil”, Phys. Rev. Ltrs., **52,** 819 (1984).

20. D.J. Nagel, M. Peckerar, C.M. Brown, M.L. Ginter, T.A. Robinson, T.J. McIlrath, and D.N. Carroll “Repetitively Pulsed-plasma Soft X-ray Source,” Appl. Optics **23**, 1428 (1984).

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22. A. Christou and M. Peckerar, “Planar MOCVD GaA1As/GaAs High-Frequency Mixer Diodes,” Elect. Ltrs. **21(7)** pp. 505-507 (1985).

23. P. Gohil, H. Kapoor, D. Ma, T. McIlrath, M. Ginter and M. Peckerar, “Soft X-Ray Lithography Using Radiation From Laser Produced Plasmas”, Appl Opt. **24,** p. 2024 (1985).

24. M. Pepin, P. Alaterre, M. Chaker, R. Fabbro, B. Faral, I. Toubhans, D. Nagel and M. Peckerar, "X-ray Sources for Microlithography Created by Laser Radiation at l = 0.26 mm," JVST B **5(1),** 27 (1987).

25. J. Bosier, M. Peckerar, D. McCarthy, N. Saks, D. Michels "Modeling UV Response of Rear Surface Sensitized Charge-Coupled Devices," Appl. Phys. Letters, **50(18),** 1295 (1987).

26. D. Ma, S. Qadri, and M. Peckerar "Double Crystal X-Ray Topographic Determination of Local Strain In Metal-Oxide-Semiconductor Devices," Appl. Phys. Letters **51(22)** 1827 (1987).

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32. C.R.K. Marrian and M. Peckerar, "Electronic "Neural" Net Algorithm for Maximum Entropy Solution of Ill-Posed Problems - Part II: Multiply Connected Electronic Circuit Implementation," IEEE Trans. Circ. Syst. **37(1)** 110(1990).

33. M. Peckerar, J. Goldhar, P.T. Ho, and K. Rhee, "A Novel Test Structure for Grating Pitch Determination With Near Ångstrom Accuracy", Jour. Appl. Phys. **68(10),** 5381(1990).

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41. D. Ma, G.J. Campisi, and S.B. Qadri and M. Peckerar, "Characterization Of Silicon On Insulator Substrates Using Reflection Mode Double Crystal X-ray Topography," Thin Solid Films, vol. 206, 27(1991).

42. D. Ma, S.B. Qadri, M. Peckerar and D. McCarthy "Double Crystal X-Ray Topography Characterization Of An Electrical Bias Induced Stress Variation In Metal-Oxide-Semiconductor Field Effect Transistors," Thin Solid Films **206**, p. 18 (1991).

43. M. Jacunski and Martin C. Peckerar, "A Model for Radiation Induced Edge Leakage in Bulk Silicon nMOS Transistors", IEEE Transactions on Nuclear Science, **39(6)**, December 1992.

44. R. A. Ghanbari, M. Burkhardt, D. A. Antoniadis, H. I. Smith, M. R. Melloch, K. W Rhee, M. C. Peckerar "Comparative Mobility Degradation in Modulation-Doped GaAs Devices After E-Beam and X-Ray Lithography," JVST **B10(6)**, pp. 2890-2892, (1992).

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46. R. A. Ghanbari, W.Chu, M. Burkhardt, M. L.Schattenburg, K. W. Rhee, R. Bass, M. Peckerar and M. R. Melloch, "Fabrication of Parallel Quasi-One-Dimensional Wires Using a Novel Conformable X-Ray Mask Technology", JVST **B10(6)**, pp. 3196-3199 (1992).

47. W. Chu, C. Eugster, A Moel, E. E. Moon, J. A. del Alamo, M. L. Schattenburg, K. W. Rhee, M. R. Melloch. "Conductance Quantization in a GaAs Electron Waveguide Device Fabricated by X-Ray Lithography", JVST B **10(6)**, Page 2966-2969, (1992).

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49. M.Peckerar, Milton Rebbert and Ganesh Gopalakrishnan, "Apparent Super Resolution in High-Contrast Photoresists," Appl. Phys. Lett **61 (17)**, p. 2037(1992).

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53. Ma, D.I., Qadri, S.B., Peckerar, M.C. and McCarthy, D. "Characterization of the electrical bias induced strain variation in metal-oxide-semiconductor field effect transistors using X-ray double crystal topography," JVST A (Vacuum, Surfaces, and Films) **10(4)** p1012(1992).

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55. Dobisz-EA, Marrian-CRK, Salvino-RE, Ancona-MA, Rhee-KW, and M. Peckerar "Thin Silicon-Nitride Films to Increase Resolution in E-Beam Lithography," Opt. Eng. **32(10),** p. 2452 (1993).

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57. K.W. Rhee and M. Peckerar "Proximity Effect Reduction Using Thin Insulating Layers," Appl. Phys. Lett., **62(5)** pp 533-534(1993).

58. M. Peckerar and J. R. Maldonado, "The Advanced Lithography Program - Governments Role in X-Ray-Development," Solid State Technology **37(6),** pp 44,(1994).

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d. Book Reviews, Other Articles, and Notes.

e. Talks, Abstracts, and Other Professional Papers Presented.

i. Invited talks, etc.

Over the years, I have lost track of the number of conference publications that I was invited to give. I estimate 10% of the talks listed below were invited.

ii. Refereed conference proceedings.

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iii. Unrefereed conference proceedings.

I haven't recorded these over the years.

f. Films, CDs, Photographs, Websites, etc.

g. Exhibits, Performances, Demonstrations, and Other Creative Activities

h. Original Designs, Plans, Inventions, Software, and/or Patents.

1. “Pulsed X-Ray Lithography,” patent # 4,184,078. Licensed to Hampshire Instruments, Marlborough Massachusetts.

2. “A Novel Technique For Aligning Photomask Layers In Microelectronics,” issued Feb. 4, 1986, patent #4,568,189.

3. “Method for fabricating thin film metallic meshes for use as Fabry-Perot interferometer elements, filters and other devices,” issued April 5, 1989, US patent #4,818,661.

4. “Maximum Entropy Deconvolver Circuit Based On Neural Net Principles,” July 18, 1989. US patent #4,849,925.

5. “Cross Entropy Deconvolver Circuit Adaptable to Changing Convolution Functions,” May 12, 1992, US Patent #5,113,367.

6. “Pulsed X-Ray Lithography - Amendment And Re-issue,” July 14,1992 Patent Re-issue Re. 33,992.

7. “High Resolution Metal Patterning Of Ultra Thin Films On Metal Substrates,” Dec. 31,1991, US Patent #5,077,085. Licensed by Shipley Corporation.

8. “High Resolution Patterning On Solid Substrates,” Jan. 7,1992, US Patent # 5,079,600. Licensed by Shipley Corporation.

9. “High-Aspect Ratio Metal Microstructures And Method For Preparing Same,” Aug. 30,1994, US Patent #5,342,737, amended and re-issued as US patent #5,814,414 on 9/29/98.

10. “System For Sampling The Sizes, Geometrical Distribution And Small Particles Accumulating On A Solid Surface,” Issued 8 June 1993, patent # 5,218,211.

11. “Method And System For Electron Beam Lithography,” 9 Aug 94, US patent 5,336,892.

12. “Method and Preparation of Mask for Ion Beam Lithography,” issued Oct. 22,1996, US patent #5,567,551.

13. “Sidewall Passivation by Oxidation During Refractory-Metal Plasma Etching,” Nov. 19, 1996, US Patent # 5,575,888.

14. “An alignment Fiducial For Improving Patterning Placement Accuracy in e-Beam Masks for X-ray Lithography,” May 1997. US patent #5703373.

15. “Bright Beam Method for Super-Resolution In e-Beam Lithography,” Filing date 23 Dec 1996, US patent # 5,825,040, Issued 10/20/98

16. "Lithographic mask and Method of Fabrication Thereof," US Patent 6,017,658, Issued 25 January 2000.

17. "Fully Self-Aligned High Speed Low Power MOSFET Fabrication, October, 2001, US patent #6,309,934.

18. "Methods For And Products Of Modification And Metallization Of Oxidizable Surfaces, Including Diamond Surfaces, By Plasma Oxidation," Navy Case 74,278. Issued February 19, 2002, US Patent Number 6,348,240.

19. "Fiducial Beam Position Monitor," May 21, 2002, US Patent Number 6,393,242

20. "Microelectronic device and method for label-free detection and quantification of biological and chemical molecules," November 19, 2002, US Patent Number 6,482,639

21. "Analog to digital converter using sawtooth voltage signals with differential comparator," January 16, 2007, US Patent Number 7,158,067 B2

22. "A Compressing Analog-to-Digital Converter," November 25, 2006, US Patent Number 7,142,145 B1.

23. "A Technique for Perfecting the Active Regions of Wide-Bandgap Semiconductor Nitride Devices", April 3, 2007. US Patent Number 7,198,970.

24. "Photolithographic mask exhibiting enhanced light transmission due to utilizing sub-wavelength aperture arrays for imaging patterns in nano-lithography," November 8, 2011, US Patent number 8052908.

25. "Photolithographic mask exhibiting enhanced light transmission due to utilizing sub-wavelength aperture arrays for imaging patterns in nano-lithography," November 8, 2011, US Patent number 8052908

The following patents have been "published" and are pending final approval by the USPO:

1. 20100028766 THIN FLEXIBLE RECHARGEABLE ELECTROCHEMICAL ENERGY CELL AND METHOD OF FABRICATION 02-04-2010 APPLICATION NUMBER 0028,766

j. Fellowships, Prizes, and Awards:

- Elected Fellow of the IEEE for contributions to Microlithography (1994).

k. Editorships, Editorial Boards, and Reviewing Activities for Journals and Other

Learned Publications:

- I am the US editor of the International Microelectronic Engineering Journal, an Elsevier Press publication with an impact factor of 1.583 (approximately equal to the 1.60 factor achieved by IEEE Transactions on Electron Devices, a journal with a similar target readership.)

- I am on the advisory of the annual Electron, Ion and Photon Beams and Nanoscience Conference. This is an American Vacuum Society sponsored conference – perhaps the premier conference in nanoscience fabrication technology in the world, with over 500 attendees per meeting. It is holding its 54th conference this year. I was also on the steering committee for 5 years, and served as conference technical chair in 2005.

l. Other.

- Two Edison Patent Awards for best invention of the year while at NRL:
  - "Pulsed X-Ray Lithography," patent # 4,184,078. Licensed to Hampshire Instruments, Marlborough Massachusetts, 1992.
  - "High Resolution Patterning On Solid Substrates," US Patent # 5,079,600. Licensed by Shipley Corporation, 1992.

- Two best paper of the year awards from NRL.
  - R.R. Whitlock, M.H. Emery, J.A. Stamper, E.A. McLean, S.P. Obenschain and M. Peckerar, "Observation of Rayleigh-Taylor-Like Structures in a Laser-Accelerated Foil", Phys. Rev. Ltrs., 52, 819 (1984).
  - Calvert-JM, Koloski-TS, Dressick-WJ, Dulcey-CS, Peckerar-MC, Cerrina-F, Taylor-JW, Suh-DW, Wood-OR, Macdowell-AA and D'souza-R, "Projection X-Ray Lithography With Ultrathin Imaging Layers and Selective Electroless Metallization," Opt. Eng. Vol. 32, iss 10, p. 2437 (1993).
- Outstanding Invention (Physical Sciences) Maryland State System 2008 "Worlds Highest Energy Density Thin Film Battery"

2. Work with federal agencies.

- Technical manager, US Advanced Lithography Program (1989-2000).

- Navy Delegate to the Wassenaar Treaty on Limiting Proliferation of Electronic Weapon Systems (1997-2003).

- Navy Delegate to the Controlled Commodities (CoCOM) Committee of the Department of Defense.

- Government representative to the National Academy of Sciences panel on Materials for High Density Electronic Packaging and Interconnection (NMAB report 449) 1990.

- Numerous NSF panels. Most recently the Nanomanufacturing Unsolicited

Proposal Panel P061211, May 18-19, 2006 and Nano,Microelectroncis Materials and Devices, P101799, 12-14 May 2010.

iv. Paid consultancies.

Expert Witness, DRAM technology, Milbank, Tweed Hadley Mcloy, 2007-2010 (patent infringement on the physical implementation of the DDR3 specification.) Working with Jim Klaiber, now at Pryor Cashman. ITC trial designation: Certain Dynamic Random Access Memory Devices and Products Containing Same.) Investigation Number: 337-TA-595

Expert Witness, battery technology, Finnegan 2011 (relating to battery applications in power tool technology.) Working with Tom Irving

Expert Witness, Non-Volatile Memory Technology, Winston Strawn 2014. Working with Vivian Kuo, J.C. Mascullo, David Enzminger and Dave Martens. ITC Trial designation: In the Matter of Certain Non-Volatile Memory Devices and Products Containing Same. Investigation Number: 337-TA-909.

Technical Consultant, National Institute of Aerospace In the area of power technology