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*Senior Research Engineer
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Experience

2008.7 - present, Senior Member of Research Staff, *Manager, Prototype Devices and Circuits, PARC.*

Management of 6 PhD/1 technician group including 200m² Class 10/100 clean room. Projects include p-Si large-area acoustics, a-Si medical imaging, large area array testing, novel oxide semiconductors, laser recrystallisation technology, barocrystallization, & MEMs displays.

2007.1 - 2008.7, Senior Member of Research Staff, Project Leader, PARC. *Large Area Acoustics.*

Circuit design, simulation, and testing of complex p-Si system for large area acoustic detection.

2005.9 - 2006.12, Member of Research Staff, Project Leader, PARC. *Micromachined displays.*

Project involves backplane and MEMs development of TMOS, a proprietary display technology invented by our partner, Uni-Pixel Displays, Inc. Activities include p-Si active-matrix design and modelling for high-voltage drive of MEMS, fabrication and process development of MEMS element, high-voltage testing, and writing term-sheets and contracts.

2000.1 - 2005.9, Member of Research Staff, Project Leader, PARC. *Organic electronics.*

The focus of this work is a joint venture with Motorola, Dow, and two Xerox research centers to explore the synthesis, characterization, and deposition of organic semiconducting materials and devices onto flexible substrates. The JV received substantial [NIST/ATP](#) support. (Project ID 2000 004209C). My work focused on designing pixels, array drive and sense electronics, and measurements of electric paper and displays.

1994.8 - 1999.12, Member of Research Staff, Xerox PARC. *Amorphous silicon imaging arrays.*

In 1994 PARC shipped an evaluation kit demonstrate the potential of amorphous silicon imaging arrays to replace film for radiology and non-destructive testing. Customers asked for more dynamic range, higher sensitivity, and less noise. I was one of two designers that designed and prototyped a 2304x3200 pixel imager product that achieved a noise floor of 1.5 Ke⁻. I then built a 14 bit, 10 MSPS ADC board with fiber output for use with experimental high fill factor and direct detection imagers for mammography. Activities include x-ray, optical, and electrical measurements, mixed-signal electronic prototyping, low-noise power supplies, mixed-signal system architecture, board design and layout, CPLD programming, fiber optical interface design, and transfer to manufacturing. See <http://www.dpix.com>.

1991.6 - 1994.6, Research Assistant, Stanford University. *Silicon micromachined displays.*

Co-inventor of the Grating Light Valve, a micromachined diffraction grating suitable for projection and head-mounted color displays. I modeled the diffraction grating optics and developed a Green's function approach to understand the electromechanics. Two critical fabrication issues were to develop a process for integrating two-dimensional arrays and to reduce stiction of the beam members. I solved both problems through the use of doped polysilicon. This technology was transferred to Sony and Silicon Light Machines. I helped write a successful ARPA proposal, modeled the optics and micro-mechanics, characterized the gratings, developed a new process and fabricated devices. <http://www.siliconlight.com>.

1988.6 – 1991.6 Research Assistant, Stanford University. *External-cavity surface emitting lasers & Spread-Spectrum Coding.*

My masters projects consisted of work designed to extend the limits of electro-optic sampling. I designed and built ECL and digital GaAs IC Golay code generators that were used in a spread-spectrum receiver at 500 MSPS. I also demonstrated CW lasing of an external cavity surface emitting laser in InGaAs/AlGaAs.

1989.9 - 1992.12 Teaching Assistant, Stanford University, Departments of Electrical Engineering and History.

1987.6 - 1987.9, Summer Technical Staff, MIT Lincoln Laboratory.

Education

PhD, Electrical Engineering, Stanford University, 1988-1994. Grating Light Valves for High Resolution Display. Best Student Paper Award, SID 1993.

MS, Electrical Engineering, Stanford University, 1988. School of Engineering Fellow.

BS, Electrical Engineering, University of California, Berkeley, 1984-1987. *Summa cum laude*, with Distinction. TBPi & EKN.

Professional

Judge, Computerworld Honors Program

Chair, Electronic Materials Society Symposium 2001. Vice-chair in 2000. Member of Program Committee 1998-2004.

Member: MRS. Senior Member: IEEE.

Inventions

1. 7,459,225 Micro-machined fuel cells
2. 7,425,734 Thin-film transistor array with ring geometry
3. 7,358,530 Thin-film transistor array with ring geometry
4. 7,321,356 Time Domain Printing for Electric Paper
5. 6,973,722 Release height adjustment of stressy metal devices by annealing before and after release
6. 6,872,320 Method for printing etch masks using phase-change materials
7. 6,751,865 Method of making a print head for use in a ballistic aerosol marking apparatus
8. 6,742,884 Apparatus for printing etch masks using phase-change materials
9. 6,523,928 Method of treating a substrate employing a ballistic aerosol marking apparatus
10. 6,511,149 Ballistic aerosol marking apparatus for marking a substrate
11. 6,467,862 Cartridge for use in a ballistic aerosol marking apparatus
12. 6,454,384 Method for marking with a liquid material using a ballistic aerosol marking apparatus
13. 6,416,157 Method of marking a substrate employing a ballistic aerosol marking apparatus
14. 6,408,054 Micromachined x-ray image contrast grids
15. 6,340,216 Ballistic aerosol marking apparatus for treating a substrate
16. 6,328,409 Ballistic aerosol making apparatus for marking with a liquid material
17. 6,252,215 Hybrid sensor pixel architecture with gate line and drive line synchronization
18. 6,201,633 Micro-electromechanical based bistable color display sheets
19. 6,180,428 Monolithic scanning light emitting devices using micromachining
20. 6,177,236 Method of making a pixelized scintillation layer and structures incorporating same
21. 6,136,210 Photoetching of Acoustic Lenses for AIP
22. 6,116,756 Monolithic Scanning Light Emitting Devices Using Micromachining
23. 6,116,718 Print Head For Use In A Ballistic Aerosol Marking Apparatus
24. 6,091,197 Full color tunable resonant cavity organic light emitting diode
25. 6,051,827 Hybrid sensor pixel architecture with threshold response
26. 6,031,248 Hybrid sensor pixel architecture
27. 6,005,238 Hybrid sensor pixel architecture with linearization circuit
28. 5,981,959 Pixelized Scintillation Layer and Structures Incorporating Same
29. 5,941,501 Passively Addressable Cantilever Valves
30. 5,897,097 Passively Addressable Fluid Valves Having S-Shaped Blocking Films

31. 5,854,705 Micropositioned Laser Source for Raster Output Scanners
32. 5,714,697 Sheet Materials Mass Measuring System
33. 5,744,732 Sheet Materials Transport System
34. 5,677,783 Method of Making a Deformable Grating Apparatus for Modulating a Light Beam and Including a Means for Obviating Stiction Between Grating Elements and Underlying Substrate
35. 5,634,636 Flexible Object Handling System using Feedback Controlled Air Jets
36. 5,459,610 Deformable Grating Apparatus for Modulating a Light Beam and Including a Means for Obviating Stiction Between Grating Elements and Underlying Substrate
37. 5,614,834 Sampling Receivers

Publications

1. Arias, A. C.; Daniel, J. H.; Apte, R. B.; Krusor, B. S.; Ng, T.; Sambandan, S.; Street, R. A. All Printed TFT Backplanes for Flexible Paper-Like Displays. *Spring MRS*. San Francisco, 2008.
2. Lu, J. P.; Apte, R. B.; Wang, Y.; Ho, J.H. High voltage active matrix backplane for driving array of MEMS devices based on offset-gate poly-Si high voltage TFT. *Spring MRS*. San Francisco, 2008.
3. Sambandan, S.; Apte, R. B.; Wong, W. S.; Lujan, R.; Young, M.; Russo, B.; Ready, S. E.; Street, R. A. Defect identification in large area electronic backplanes. *IEEE Trans Elect Dev*, 2008.
4. Daniel, J. H.; Arias, A. C.; Ready, S. E.; Wong, W. S.; Ng, T.; Krusor, B. S.; Lujan, R.; Apte, R. B.; Chabinye, M.; Street, R. A. Jet-printing of active-matrix backplanes for image sensors and electrophoretic displays. *Printed Electronics Europe 08*. Dresden, 2008.
5. Daniel, J. H.; Arias, A. C.; Russo, B.; Krusor, B. S.; Wong, W. S.; Ready, S. E.; Lujan, R.; Ng, T.; Street, R. A.; Apte, R. B.; Sambandan, S. A journey towards jet-printed electronics. *OSC 08*. Frankfurt, 2008.
6. Wong, W. S.; Ng, T.; Chabinye, M.; Lujan, R. A.; Apte, R. B.; Limb, S.; Street, R. A. Flexible a-Si:H-based image sensors fabricated by digital lithography. *Spring MRS*. San Francisco, 2007.
7. Ng, T.; Wong, W. S.; Lujan, R. A.; Apte, R. B.; Chabinye, M.; Limb, S.; Street, R. A. Flexible, polymer-based light sensor arrays on active-matrix backplanes fabricated by digital inkjet printing. *Spring MRS*. San Francisco, 2007.
8. Ready, S. E.; Wong, W. S.; Arias, A. C.; Salleo, A.; Apte, R. B.; Chabinye, M.; Street, R. A. Toolset for printed electronics. *International Conference on Digital Fabrication Technologies*. Denver, 2006..
9. Street, R. A.; Chabinye, M.; Apte, R. B.; Arias, A. C.; Daniel, J. H.; Ready, S. E.; Krusor, A.; Salleo, A. Printed polymer active-matrix display backplanes. *USDC-Flexible Display Conference*; 2006 February; Phoenix; AZ; USA.
10. Arias, A. C.; Daniel, J. H.; Apte, R. B.; Endicott, F.; Lujan, R. A.; Ready, S. E.; Street, R. A. Printed polymer-based TFTs for flexible display backplanes. *USDC-Flexible Display Conference*; 2006 February; Phoenix; AZ; USA.
11. Apte, R. B.; Street, R. A.; Arias, A. C.; Salleo, A.; Chabinye, M.; Wong, W. S.; Ong, B. S.; Wu, Y.; Liu, P.; Gardner, S. Printed organic electronics. Chapter in Crawford, G. P., editor. *Flexible Flat Panel Displays*. Chichester, England: Wiley; 2005: 219-262.
12. Chabinye, M.L.; Wong, W.S.; Arias, A.C.; Ready, S.; Lujan, R.A.; Daniel, J.H.; Krusor, B.; Apte, R.B.; Salleo, A.; Street, R.A.; Printing methods and materials for large-area electronic devices, *Proceedings of IEEE*. Volume 93, Issue 8, Aug. 2005 Page(s):1491 – 1499.
13. Daniel, J. H.; Krusor, B. S.; Apte, R. B.; Arias, A. C.; Wong, W. S.; Lujan, R. A.; Ready, S. E.; Street, R. A. Reflective Displays with Giant-area compatible Electronic Backplanes. *Spring MRS*, San Francisco, 2005.
14. Daniel, J. H.; Arias, A. C.; Wong, W. S.; Salleo, A.; Lujan, R. A.; Ready, S. E.; Chabinye, M.; Street, R. A.; Apte, R. B. Printed electronics for paper-like displays. *IMI's 2nd Paper-like displays conference*; 2005 February; St. Pete Beach; FL.
15. Arias, A. C.; Ready, S. E.; Lujan, R. A.; Wong, W. S.; Paul, K.; Chabinye, M.; Salleo, A.; Apte, R. B.; Street, R. A. Polymer transistor display backplanes: high performance inkjet printed devices. *American Chemical Society Annual Meeting*, San Diego, 2005.

16. Arias, A. C.; Ready, S. E.; Lujan, R. A.; Wong, W. S.; Chabinyk, M.; Salleo, A.; Apte, R. B.; Street, R. A. *High performance inkjet printed devices: polymer thin film transistors for display backplanes*. ICCEL-5. 2005
17. Street, R. A.; Wong, W. S.; Ready, S. E.; Lujan, R. A.; Arias, A. C.; Chabinyk, M.; Salleo, A.; Apte, R. B.; Antonuk, L. E. Printed active-matrix TFT arrays for x-ray imaging. *SPIE proceedings*.
18. Daniel, J. H.; Apte, R. B.; Arias, A. C.; Wong, W. S.; Lujan, R. A.; Krusor, B. S.; Chopra, N.; Kazmaier, P. M.; Street, R. A. Flexible electrophoretic displays with jet-printed active-matrix backplanes. *2005 SID*; 2005 May 25-27; Boston, MA. San Jose CA. XXXVI; Book II; 1630-1633.
19. Daniel, J. H.; Krusor, B. S.; Apte, R. B.; Arias, A. C.; Wong, W. S.; Lujan, R. A.; Ready, S. E.; Street, R. A. Reflective Displays with Giant-area compatible Electronic Backplanes. *Spring MRS*; 2005 March 28 - April 1; San Francisco.
20. Street, R. A.; Wong, W. S.; Ready, S. E.; Lujan, R. A.; Arias, A. C.; Apte, R. B. Jet-printing of active-matrix TFT backplanes for displays and sensors. *DigiFab 05*.
21. Arias, A. C.; Ready, S. E.; Paul, K.; Wong, W. S.; Chabinyk, M.; Lujan, R. A.; Salleo, A.; Apte, R. B.; Street, R. A.; Ong, B. S.; Wu, Y.; Liu, P. "Jet-printed polymer thin film transistor display backplane." *Advanced Materials*, 2005.
22. Arias, A. C.; Wong, W. S.; Daniel, J. H.; Lujan, R. A.; Ready, S. E.; Chabinyk, M.; Salleo, A.; Apte, R. B.; Street, R. A. "All jet-printed polymer thin-film transistor active-matrix backplanes." *Information Management Institute Conference*, November 2004.
23. Arias, A.C.; Ready, S.E.; Lujan, R.; Wong, W.S.; Paul, K.E.; Salleo, A.; Chabinyk, M.L.; Apte, R.; Street, R.A.; Wu, Y.; Liu, P.; Ong, B. All jet-printed polymer thin-film transistor active-matrix backplanes. *Applied Physics Letters*, v 85, n 15, 11 Oct. 2004, p 3304-6
24. Arias, A. C.; Paul, K.; Ready, S. E.; Wong, W. S.; Chabinyk, M.; Salleo, A.; Apte, R. B.; Street, R. A. "Printed Polymeric Transistor Arrays for Display Backplanes." *Spring MRS -2004*; 2004 April 12-16; San Francisco.
25. Arias, A. C.; Chabinyk, M.; Salleo, A.; Paul, K.; Apte, R. B.; Street, R. A. "Print-Patterned Polymer-Semiconductor and Amorphous Silicon Active-Matrix Display." *Flexible Displays & Microelectronics* , Tucson, February 2004.
26. Salleo, A.; Wong, W. S.; Paul, K.; Chabinyk, M.; Apte, R. B.; Street, R. A. "Polymer thin-film transistor arrays for display backplanes patterned by stamping." *MRS Fall 2003*, Boston, December 2003.
27. Salleo, A.; Chabinyk, M.; Paul, K.; Wong, W. S.; Apte, R. B.; Street, R. A. Bias stress effects and anomalous temperature dependence of charge transport in polymer thin-film transistors. *Materials Research Symposium*, Boston, December 2003.
28. K.E. Paul, W.S. Wong, S. Ready, M.L. Chabinyk, R.B. Apte, R.A. Street, B.S. Ong, and M.G. Dibbs. "Jet-Printing for the Fabrication of Organic-based Thin Film Transistors." Spring 2002 MRS, San Francisco, CA, 2002. Subm Proc MRS.
29. R.B. Apte, B. Ong, Y. Wu, W.S. Wong, S. Ready, R. Matusiak, J.-P. Lu, and R.A. Street, "Jet-printed a-Si:H TFT Arrays and Organic Transistors at PARC," Flexible Microelectronics Manufacturing Workshop, Phoenix, AZ, 14 January 2002.
30. Salleo, M. L. Chabinyk, K. E. Paul, R. B. Apte, R. A. Street, B. Ong, and M.G. Dibbs, "Fabrication Processes for Polymeric Organic Transistors," IMAPS Printing an Intelligent Future, Lake Tahoe, CA, 2002.
31. M.L. Chabinyk, W.S. Wong, K.E. Paul, R.B. Apte, R.A. Street, J.-P. Liu, Y. Wu, B.S. Ong, "Non-Lithographic Fabrication Of Polymeric Electronic Devices Using Inkjet Printing." Spring 2002 MRS, San Francisco, CA, 2002. Subm Proc MRS.
32. W.S. Wong et al., "Jet-Printed Fabrication Of A-Si:H Thin Film Transistors And Arrays." Spring 2002 MRS, San Francisco, CA, 2002. Subm Proc MRS.
33. A. Salleo et al. "Effect of dielectric surface on the performance of polymer devices," Spring 2002 MRS, San Francisco, CA, 2002. Subm Proc MRS.
34. Knipp, D.; Murti, D.K.; Krusor, B.; Apte, R.; Jiang, L.; Lu, J.P.; Ong, B.S.; Street, R.A. Photoconductivity of pentacene thin film transistors. *MRS 2002 Vol.665*, 2002, p 207-12

35. Knipp, D.; Street, R.A.; Krusor, B.; Apte, R.; Ho, J. Polycrystalline pentacene thin films for large area electronic applications. *Journal of Non-Crystalline Solids*, v 299-302, pt.B, April 2002, p 1042-6
36. D. Knipp, B.S. Krusor, R.B. Apte, J. Ho, R.A. Street, D.K. Murti, L. Jiang, "Polycrystalline pentacene thin films for transistor applications," ICAMS 19, 2001.
37. J.H. Daniel, B.S. Krusor, M. Mulato, R.B. Apte, R.K. Lau, J.P. Lu, R.A. Street, A. Goredema, D.C. Boils-Boissier, P.M. Kazmaier, "Large area MEMS: materials issues and applications," MRS Spring 2001.
38. D. Knipp, R.A. Street, B.S. Krusor, R.B. Apte, B.S. Ong, "Influence of the dielectric on the growth and the performance of pentacene thin film transistor," *MRS Fall 2001*.
39. Knipp, D.; Street, R.A.; Krusor, B.S.; Apte, R.B.; Ho, J. Influence of the gate dielectric on the morphological and electronic structure of pentacene films for transistor applications. *SPIE Proc*, v 4466, 2001, p 8-19
40. Daniel, J.H.; Krusor, B.; Lau, R.; Lu, J.P.; Wang, Y.; Mulato, M.; Apte, R.B.; Street, R.A.; Goredema, A.; Boils-Boissier, D.C.; Silver, S.E.; Kazmaier, P.M. MEMS materials and fabrication technology on large areas: the example of an X-ray imager. *MRS Vol.657*, 2001, p EE9.3.1-6
41. J.H. Daniel, B.S. Krusor, R.B. Apte, M. Mulato, K. Van Schuylenbergh, R. Lau, T. Do, R.A. Street, A. Goredema, D.C. Boils-Boissier, P.M. Kazmaier, "Micro-electro-mechanical system fabrication technology applied to large-area x-ray image sensor array," *J. Vac. Sci. Technol. A* 19(4), 2001.
42. D. Knipp, R. A. Street, B. Krusor, R. B. Apte, J. Ho, "Morphological and electronic structure study of pentacene thin film transistors," SPIE Sym. Organic Field Effect Transistors 2001.
43. D. Knipp, K. D. Murti, R. Apte, L. Jiang, B. S. Ong and R. A. Street, "Photoconductivity of small molecule organic transistors," MRS Spring Meeting, 2001. Proc. Mat. Res. Soc. Vol. 665, 2001.
44. R.A. Street, R.B. Apte, J.B. Boyce, J. Ho, R. Lau, F. Lemmi, J.-P. Lu, M. Mulato, S.E. Ready, K. Van Schuylenbergh, "Matrix-addressed x-ray detector arrays," *Hard X-Ray, Gamma-Ray, and Neutron Detector Physics II*, Proc. SPIE 4141, 263-273, November 2000.
45. J.H. Daniel, B.S. Krusor, R.B. Apte, R.A. Street, A. Goredema, J. McCallum, D.C. Boils-Boissier, P.M. Kazmaier, "Large-area MEMS fabrication with thick SU-8 photoresist applied to an x-ray image sensor array," *Micromachining and Microfabrication Process Technology VI*, Proc. SPIE 4174, August 2000.
46. R.A. Street, S.E. Ready, J.T. Rahn, K. Shah, P. Bennett, P. Mei, J.-P. Lu, R.B. Apte, J. Ho, K. van Schuylenbergh, F. Lemmi, and J. Boyce, "High resolution, direct detection x-ray imagers," *Medical Imaging 2000: Physics of Medical Imaging*, SPIE proc. 3977, 418-428, April 2000.
47. J.T. Rahn, F. Lemmi, J.-P. Lu, P. Mei, R.A. Street, S.E. Ready, J. Ho, R.B. Apte, K. van Schuylenbergh, R. Lau, R.L. Weisfield, R. Lujan, J.B. Boyce, Achieving high-resolution in flat-panel imagers for digital radiography (invited paper), *Medical Applications of Penetrating Radiation*, Proc. SPIE 3770, October 1999.
48. J.T. Rahn, F. Lemmi, R.L. Weisfield, R. Lujan, P. Mei, J.P. Lu, J. Ho, S.E. Ready, R.B. Apte, P. Nylén, J. Boyce, R.A. Street, "High resolution, high fill factor a-Si:H sensor arrays for medical imaging," Proc. SPIE 3659, Physics of Medical Imaging, February, 1999, San Diego, CA.
49. J. Rahn, F. Lemmi, P. Mei, J.P. Lu, J. Boyce, R.A. Street, R.B. Apte, S. Ready, K. van Schuylenbergh, J. Ho, R. Fulks, R. Weisfield, "High resolution, high fill factor a-Si:H sensor arrays for optical imaging," *Materials Research Society Proc.* 557, April 1999, San Francisco, CA.
50. R.A. Street, J. Rahn, K. Shah, P. Bennett, P. Mei, J.P. Lu, R.B. Apte, S.E. Ready, J. Ho, K. van Schuylenbergh, F. Lemmi, J. Boyce, "X-ray imaging using lead iodide as a semiconductor detector," Proc. SPIE 3659, Physics of Medical Imaging, February, 1999, San Diego, CA.
51. J. Rahn, F. Lemmi, J.-P. Lu, P. Mei, R.B. Apte, R.A. Street, R. Lujan, R.L. Weisfield, "High efficiency x-ray imaging using amorphous silicon flat panel arrays," *IEEE Nuclear Science Symposium and Medical Imaging Conference*, November 1998, Toronto.
52. J. Rahn, F. Lemmi, J.-P. Lu, P. Mei, R.B. Apte, R.A. Street, R. Lujan, R.L. Weisfield, J.A. Heanue, "High efficiency x-ray imaging using amorphous silicon flat panel arrays," *IEEE Transactions on Nuclear Science* 46(3), 457-61. *Nuclear Science Symposium* 1998.

53. R.A. Street, K.S. Shah, S.E. Ready, R.B. Apte, P.R. Bennett, M. Kluggerman, Y. Dmitriyev, "Large area medical imaging using Pbl2 direct detection," Proc. SPIE 3336, Physics of Medical Imaging, February, 1998, San Diego, CA.
54. R.L. Weisfield, M.A. Hartney, R.A. Street, R.B. Apte, "New amorphous silicon image sensors for x-ray diagnostic medical imaging applications," Proc. SPIE 3336, Physics of Medical Imaging, February, 1998, San Diego, CA.
55. R.B. Apte, R.A. Street, S.E. Ready, D.A. Jared, A.M. Moore, R.L. Weisfield, T.A. Rodericks, T.A. Granberg, "Large-Area, Low-Noise Amorphous Silicon Imaging System," Electronic Imaging, *Proc. SPIE* 3301, 2-8, January 1998, San Jose, CA.
56. R.A. Street, R.B. Apte, S.E. Ready, R.L. Weisfield, P. Nylen, "Amorphous Silicon Sensor Arrays for X-Ray and Document Imaging," MRS Symp. on Semiconductors for Room Temperature Radiation Detector Applications, December 1997, Boston, MA.
57. R.A. Street, R.B. Apte, T. Granberg, P. Mei, S.E. Ready, K.S. Shah, R.L. Weisfield, "High performance amorphous silicon image sensor arrays," ICAMS '97, August 1997, Budapest, Hungary. *Journal of Non-Crystalline Solids*, 227, 1306-1310.
58. R.A. Street, R.L. Weisfield, R.B. Apte, S.E. Ready, A. Moore, M. Nguyen, W.B. Jackson, P. Nylen, "Amorphous silicon sensor arrays for X-ray and document imaging." *Thin Solid Films* 296(1-2): 172-6 (1997). *Semiconductors for Room-Temperature Radiation Detector Applications II*, 399-410.
59. R.L. Weisfield, R.A. Street, R.B. Apte, A.M. Moore, "An Improved Page-Size 127 mm Pixel Amorphous Silicon Image Sensor for X-Ray Diagnostic Medical Imaging Applications," *Proc. SPIE* 3032, Physics of Medical Imaging, p. 14 (1997).
60. Street, R. A., Weisfield, R. L., Apte, R. B., Ready, S. E., Moore, A., Nguyen, M., Jackson, W. B., Nylen, P., "Amorphous silicon sensor arrays for x-ray and document imaging," Proc. European Materials Research Society, June 1996.
61. Street, R.A.; Wu, X.D.; Weisfield, R.; Ready, S.; Apte, R.; Nguyen, M.; Nylen, P. Large area amorphous silicon X-ray imagers. *Nuclear Instruments & Methods in Physics Research, Section A (Accelerators, Spectrometers, Detectors and Associated Equipment)*, v 380, n 1-2, 1 Oct. 1996, p 450-4
62. R.B. Apte, N. Nickel, R.A. Street, R. Weisfield, X.-D. Wu, S. Ready, M. Nguyen, P. Nylen, "Progress Towards a High-Resolution X-Ray Photon Counter." Materials Research Society Spring Meeting, April 1996, San Francisco CA. MRS Symp. 420, 177 (1996).
63. R.B. Apte, P. Mei, R. Weisfield, X.-D. Wu, S. Ready, R.A. Street. "Large-Area Imaging with Low Temperature Amorphous Silicon Photodiode Arrays (invited presentation)." International Semiconductor Device Research Symposium, ISDRS 95, December 1995, Charlottesville, NC.
64. R.A. Street, X.-D. Wu, R. Weisfield, S.E. Ready, R.B. Apte, M. Nguyen, P. Nylen. "Large area amorphous silicon x-ray imagers." 9th International Workshop on Room Temperature Semiconductor X-ray Detectors, September 1995, Grenoble, France. *Nuclear Instruments & Methods in Physics Research, Section A (Accelerators, Spectrometers, Detectors and Associated Equipment)* 380(1-2): 450-4.
65. R.A. Street, X.-D. Wu, R. Weisfield, S.E. Ready, R.B. Apte, D.K. Biegelsen, W.B. Jackson, P. Nylen, "Two dimensional amorphous silicon image sensor arrays," International Conference on Amorphous Semiconductors, 9/95. *Journal of Non-Crystalline Solids* 198, 1151-1154.
66. R.B. Apte, S. Ready, X. D. Wu, R. Weisfield, R.A. Street. "1536x1920 Pixel Imaging Arrays made with Hydrogenated Amorphous Silicon." Microfabrication Technology for Research and Diagnostics, September 1995, San Francisco, CA.
67. R.A. Street, X.-D. Wu, R.B. Apte, R. Weisfield, S. Ready, M. Nguyen, P. Nylen. "Two Dimensional Amorphous Silicon Image Sensor Arrays (invited presentation)." Materials Research Society Symposium, April 1995, 757-766, San Francisco, CA.
68. X.-D. Wu, R. A. Street, R. Weisfield, D. Biegelsen, W. Jackson, S. Ready, R.B. Apte. "Large Format A-Si:H 2-Dimensional Array as Imaging Devices." IEEE Workshop on Charge-Coupled Devices and Advanced Image Sensors, April 1995, Dana Point, CA.

69. R.B. Apte, F.S.A. Sandejas, W.C. Banyai, D.M. Bloom. "Deformable Grating Light Valves for High Resolution Displays." *Solid-State Sensors and Actuators*, June 1994, Hilton Head, SC, 1-6. Also reprinted in *Microlithography, Micromachining, and Microfabrication Handbook, Vol. 2: Micromachining and Microfabrication*, P. Rai-Choudhury, ed., SPIE, 1997; and *Milestone Selected Reprints: Optical MEMS*, Victor M. Bright, ed., SPIE, 1998.
70. F.S.A. Sandejas, R.B. Apte, W.C. Banyai, D. M. Bloom. "Surface Microfabrication of Deformable Grating Light Valves." *Solid-State Sensors and Actuators, TRANSDUCERS 93*, June 1993, Tokyo, Japan.
71. R.B. Apte, F.S.A. Sandejas, W.C. Banyai, D. M. Bloom. "Deformable Grating Light Valves for High Resolution Displays." *Society for Information Display Symposium, SID 93*, May 1993, Seattle WA.
72. Black, R.B. Apte, D.M. Bloom. "High-Speed Signal Averaging System for Periodic Signals." *Review of Scientific Instruments* (May 1992), vol. 63, no. 5, p. 3191-5.
73. G.R. Olbright, R.P. Bryan, W.S. Fu, R. Apte, D.M. Bloom. "Heterodyne Measurement of Linewidth, Tunability, and Frequency Synthesis of Vertical-Cavity Surface-Emitting Laser Diode Arrays." *IEEE Trans. on Electron Devices* (Dec. 1991), vol. 38, no. 12, p. 2698-9.
74. G.R. Olbright, R.P. Bryan, W.S. Fu, R. Apte, D.M. Bloom. "Heterodyne Measurement of Linewidth, Tunability, and Frequency Synthesis of Vertical-Cavity Surface-Emitting Laser Diode Arrays." *Device Research Conference*, 1991, June 17-19, IIIA_3-0_34.
75. Pezeshki, R.B. Apte, S.M. Lord, J.S. Harris, Jr. "Quantum Well Modulators for Optical Beam Steering Applications." *IEEE Photonics Technology Letters* (Sept. 1991), vol. 3, no. 9, p. 790-2.
76. G.R. Olbright, R.P. Bryan, W.S. Fu, R. Apte, D.M. Bloom, Y.H. Lee. "Linewidth, Tunability, and VHF-Millimeter Wave Frequency Synthesis of Vertical-Cavity GaAs Quantum-Well Surface-Emitting Laser Diode Arrays." *IEEE Photonics Technology Letters* (Sept. 1991), vol. 3, no. 9, p. 779-81.