Robert C. Baumann

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EDUCATION

Ph.D. **Electrical Engineering,** **1990**
Rice University, Houston, TX
Advisor: Prof. Thomas Rabson
Thesis title: "Deposition, Characterization, and Applications of Thin Film $LiNbO_3$."

B.A. **Physics (cum laude),** **1984**
Bowdoin College, Brunswick, ME
Advisor: Prof. Michael Corson
Thesis title: "Heat Capacity Measurements Using AC Microcalorimetry for Studying Phase Transitions in Liquid Crystals."

WORK EXPERIENCE

October 2018 – current **Adjunct Research Professor**
Southern Methodist University (SMU),
Lyle School of Engineering, Dallas TX

- Mentoring graduate and under-graduate students on various projects spanning radiation characterization, gate dielectric reliability, and radiation effects in silicon and III-V devices.
- Assisting in the creation of a research institute for mission-critical component and systems engineering.
- Focused on building simulation capability for assessing reliability and radiation effects issues.
- Managing undergraduate summer R&D and senior design projects.

August 2018 – current **President / Chief Consultant**
Radiosity Solutions LLC, Dallas TX

- Providing top-tier and start-up companies with decisive solutions solving radiation effects issues in medical electronics, Silicon, GaN and Carbon nanotube space electronics, and satellite environment modeling, shielding, and reliability mitigation techniques.
- Offering customized training at all levels, for engineers, scientists, and management focused on semiconductor reliability and radiation effects issues and solutions.
- Supporting customer radiation test campaigns (standards compliance, DOE, calculations, final reports) for new product development.

May 2012 – May 2018 **Chief Technologist, TI Fellow**
Aerospace and Defense Products
Texas Instruments, Dallas TX

- Influenced/led cross-functional teams developing new space power solutions (wide-V_{in} POL, etc.).
- Conceived/spearheaded development of the industry's most robust high temp. and radiation-hard non-volatile memory (Space FRAM) and hardened ARM M0+ microcontroller with embedded FRAM.
- Drove in-house capability hardware/software improvements for testing to enable faster product development cycles. Upgraded characterization capabilities and radiation report content and format greatly enhancing customer confidence in the results and increasing revenues.
- Frequently consulted to solve major production stop issues by outside business units (auto., medical, etc.).

WORK EXPERIENCE (Continued)

July 1999 – May 2012 **Reliability Technologist, TI Fellow**
Silicon Technology Development
Texas Instruments, Dallas TX

- Created and grew corporate radiation effects and reliability program into industry leading group.
- Worked with packaging groups to create in-house ultra-low-alpha (ULA) packaging flows.
- Created radiation transport code that enabled accurate estimation of package alpha-particle contribution.
- Developed custom radiation transport and charging code modeling antenna effects during processing.
- Frequently consulted by major customers for reliability and radiation effects issues.

July 1998 - July 1999 **130nm Reliability Branch Manager, Senior Fellow**
Silicon Technology Development
Texas Instruments, Dallas TX

- Led reliability expert teams in developing models & controls for 130nm digital CMOS nodes.
- Initiated and consulted on process modifications that ultimately switched TI 180nm and future nodes away from the use of BPSG reducing failure rates of TI products by up to 8x.
- Developed industry's first on-line soft error reliability calculator (now 500nm to 16nm technology).
- Established standardized alpha emission testing of all ULSI materials.

Nov. 1995 – July 1998 **Research & Development Branch Manager**
Reliability Sciences Group
Tsukuba R&D Center, Tsukuba-shi, JAPAN

- Founded "special forces" team providing state-of-the-art physical and electrical failure analyses (PFA, EFA) rapidly solving high-profile production stop issues for Japanese manufacturing centers.
- Created first on-line reliability database for all reports and evaluations allowing rapid access to reliability and PFA as it was obtained/reported.
- Pitched and received $1M from senior VP to expand activity (purchased JEOL FIB and other crucial tools) to better support customers and manufacturing sample preparation.

July 1993 - Nov. 1995 **Reliability Engineering Manager**
ULSI Reliability Group
Texas Instruments, Mihomura, JAPAN

- Led reliability team driving successful SUN CPU, 64Mb DRAM, and other key product developments.
- Technology liaison for Japanese (Hitachi, TI Japan, etc.) and U.S. manufacturing groups.
- Assisted packaging group in reliability experiments in the development of LOC packaging.
- Invented novel stress circuit justifying higher voltage (frequency) entitlement (accounting for dynamic CHC effects) while maintaining industry-leading reliability performance.

June 1989 - July 1993 **Reliability Engineer**
DRAM Development Group,
Texas Instruments, Dallas TX

- Discovered cosmic thermal neutron activation of ^{10}B in BPSG mechanism and implemented TI processes (removal or isotopic replacement of ^{10}B) and package solutions (shielding) leading to nearly 10x improvements in reliability of all digital electronics products. This innovation also spurred industry-wide reliability improvements due to removal of ^{10}B from processes.
- First to suggest to TI management cosmic ray neutron reactions as dominant cause of soft errors before the industry realized the full impact of this effect (circa 1990). First to suggest use of altitude experiment to prove theory (since neutron flux scales with altitude while alpha emissions do not).

WORK EXPERIENCE (Continued)

- Using neutron activation analysis and alpha counting, definitively proved that alpha-particles were NOT the dominant source of soft errors in DRAM as commonly thought.
- Developed standardized methodologies and transport code to do alpha particle radiation characterizations.
- Developed and drove fan-out of world-wide wafer-level reliab. control (WLRC) methods for dielectrics.
- Created reliability models for 4 & 16Mb DRAM burn-in reduction that saved $150M/year. Developed wafer-level TDDB, current-ramp, voltage-ramp reliability characterization and modeling of gate transistor and 3D trench capacitor dielectrics.

INTERNSHIPS

May 1985 - June 1986 — Ophthalmic Corneal Topography Development
Eyesys, Houston TX.

- Developed product case design and created product renderings and technical slides for multiple presentations to investors and hospital management during development of the product.

Summer 1983 — Variable Transmittance Window Project (Air Force)
EIC Laboratories, Norwood MA.

- Optimized reactive RF sputtering deposition process and characterized electrical leakage and optical transmittance of WO_3 thin films on ITO substrates vs. proton injection levels for use in variable transmittance window applications. Developed novel vacuum coatings and used electrical and optical characterization.

Summer 1982 — Ionospheric Radar Project
U. Lowell Physics Dept., Lowell MA

- Designed, laid-out, fabricated, and assembled critical PC-boards for instrumentation used in atmospheric/ionospheric radar systems.

HONORS & AWARDS

- 2015 NSREC **Outstanding Data Workshop Paper.**
- 2013 NSREC **Outstanding Conference Paper**.
- EDS **Distinguished Lecturer** (2006-2012 – IEEE Electron Devices Society).
- 2011 IRPS **Best Student Talk Award**.
- 2009 IRPS **Best Student Talk**.
- 2006 **JEDEC Chairman's Award** – (for JESD89/89A - rarely given outside of JEDEC.
- Elected to **Fellow, IEEE** (2005).
- Elected to Texas Instruments **Fellow** of Technical Staff (2005).
- Elected to Texas Instruments **Distinguished Member** of Technical Staff (2001).
- Elected to Texas Instruments **Senior Member** of Technical Staff (1999).
- 1994 **Best Paper Award** - TI Japan Technical Conference.
- Elected to Texas Instruments **Group Member** of Technical Staff (1993).
- **Noel C. Little Prize** for outstanding work in experimental physics (Bowdoin College 1984).

INVENTIONS

1. J. A. Rodriguez and R. C. Baumann, "Method and circuit enabling ferroelectric memory to be fixed to a stable state" **U.S. Patent 10,546,626 B2** issued Jan. 28, 2020.
2. J. A. Rodriguez, R. C. Baumann, and R. A. Bailey, " Random number generation in ferroelectric random access memory (FRAM)," **U.S. Patent 10,152,257 B2**, issued Dec. 11, 2018.
3. R. C. Baumann and J. A. Rodriguez, "Method and circuit enabling ferroelectric memory to be fixed to a stable state" **U.S. Patent 9,934,840 B2**, issued April 3, 2018.
4. J. A. Rodriguez, R. C. Baumann, and R. A. Bailey, "Random number generation in ferroelectric random access memory (FRAM)," **U.S. Patent 9,851,914 B2**, issued Dec. 26, 2017.
5. R. C. Baumann and J. M. Carulli, "Integrated circuit with automatic total ionizing dose (TID) exposure deactivation," **U.S. Patent 9,275,747**, issued March 1, 2016.
6. R. C. Baumann, "Integrated circuit with automatic deactivation upon exceeding a specific LET value," **U.S. Patent 8,896,978**, issued Nov. 25, 2014.
7. R. C. Baumann and J. M. Carulli, "Reliability Determination Taking Into Account Effect Of Component Failures On Circuit Operation," **U.S. Patent 8,689,168**, issued April 1, 2014.
8. X. Zhu and R. C. Baumann, "Method Of Fabricating An Integrated Circuit To Improve Soft Error Performance," **U.S. Patent 7,523,422**, issued April 21, 2009.
9. X. Zhu and R. C. Baumann, "Method Of Fabricating An Integrated Circuit To Improve Soft Error Performance," **U.S. Patent 7,234,121**, issued June 19, 2007.
10. R. C. Baumann, "High Activity, Spatially Distributed Radiation Source For Accurately Simulating Semiconductor Device Radiation Environments." **U.S. Patent 7,081,635**, issued July 25, 2006.
11. R. C. Baumann, "High Activity, Spatially Distributed Radiation Source For Accurately Simulating Semiconductor Device Radiation Environments." **U.S. Patent 6,914,447**, issued July 5, 2005.
12. **Japanese Patent 8154396 A**: "Integrated Circuit Having Thermal Neutron Shielding Material"
13. M. Hwang, W. R. McKee, R. C. Baumann, "Thermal neutron shielded integrated circuits." **U.S. Patent 6,239,479**, issued May 29, 1996.
14. R. C. Baumann, "High density CMOS circuit with split gate oxide." **U.S. Patent 5,866,445**, issued Feb. 2, 1999.
15. R. C. Baumann and T. Z. Hossain, "Electronic device and process achieving a reduction in alpha particle emissions from boron-based compounds essentially free of boron-10." **U.S. Patent 5,523,597**, issued June 4, 1996.
16. R. C. Baumann and T. Z. Hossain, "Electronic device and process achieving a reduction in alpha particle emissions from boron-based compounds essentially free of boron-10." **U.S. Patent 5,395,783**, issued March 7, 1995.

EXTERNAL TECHNICAL LEADERSHIP

- IEEE IEDM, ED, TDMR, VLSI, IRPS, NSREC and Semiconductor Manufacturing **reviewer**. (1999-2018)
- **Technical Reviewer** (2013-2014) **-** provided substantial technical inputs on JEDEC JEP-151 " Test Procedure for the Measurement of Terrestrial Cosmic Ray Induced Destructive Effects in Power Semiconductor Devices"
- **General Chair**, 2012 IEEE RADGround – all-day session of terrestrial radiation effects.
- **Technical Committee Chair – Data Workshop,** RADECS 2020.
- **Technical Committee Member** IEEE NSREC (2002 - 2009).

EXTERNAL TECHNICAL LEADERSHIP (cont.)

- **Technical Committee Member** IEEE IOLTS (2004, 2007, 2008).
- **Chairman** of SRC SEU committee (2004-2007) that made major revisions to JESD89 (JESD89A).
- **Vice-Chairman** of JEDEC committee (2003-2006) developing standard alpha counting methods (JESD221).
- **Technical Committee Chairman** IEEE IRPS (2002-2004) - Single Event Upset session
- **Chairman** of SEMATECH Soft Error Working Group (2000-2003)
- **Technical Session Chairman** IEEE NSREC (2003) - SEU effects in commercial microelectronics
- Texas Instruments **Technical Council Representative** (2002-2005) responsible for mentoring and administrating technical ladder promotion.
- **Co-led Silicon Industry Association's (SIA) Expert Panel** formed by Board-of-Directors to modify International Traffic in Arms Regulations (ITAR) export controls (2002-2011). Drove negotiations and provided expert testimony to U.S. State, Defense, and Commerce Department officials and Congressional sub-committees directly responsible for changes made to ITAR to protected U.S. commercial semiconductor products from inadvertent capture, avoiding billions of dollars in revenue loss due to export restrictions.
- **Chairman of SRC SEU committee and JEDEC** (2000-2012) originated by NASA through SRC. One of the primary authors responsible for creating the JEDEC JESD89 and its first revision JESD89A test standard "Measurement and Reporting of Alpha Particle and Terrestrial Cosmic Ray-Induced Soft Errors in Semiconductor Devices" – that became the defacto international standard for microelectronics in the terrestrial environment.
- **Vice-chairman of JEDEC committee** (2003-2011) and one of the primary authors responsible for creating the JEDEC JESD-221 test standard "Alpha Radiation Measurement in Electronic Materials."
- **Committee member of JEDEC JESD89A test standard revision committee** (2014-2019) for "Measurement and Reporting of Alpha Particle and Terrestrial Cosmic Ray-Induced Soft Errors in Semiconductor Devices".

BOOK CHAPTERS

- R. C. Baumann, "Radiation Effects Hand Book", chapters 1, 2, 3, 5, and 7, in ***Handbook of Radiation Effects***, Texas Instruments, June 2019.
- R. C. Baumann, "Radiation Effects on Advanced Microelectronic Technologies", chapter in ***Handbook of Semiconductor Manufacturing Technology***, 2nd edition, Y. Nishi and R. Doering, CRC, July 9, 2007.
- R. C. Baumann, "Soft Errors in Commercial Integrated Circuits", chapter in the ***International Journal of High Speed Electronics and Systems***, May 2004.

PEER-REVIEWED PUBLICATIONS

1. D. Oliveira, S. Blanchard, N. DeBardeleben, F. Santos, G. Dávila, P. Navaux, S. Wender, C. Cazzaniga, C. Frost, R. Baumann, and P. Rech, "An Overview of the Risk Posed by Thermal Neutrons to the Reliability of Computing Devices," 50th Annual IEEE-IFIP International Conf. Dependable Systems and Networks-Supplemental Volume (DSN-S), June 2020, pp. 92-97.

2. D. Oliveira, S. Blanchard, N. Debardeleben, F. dos Santos, G. Davila, P. Navaux, C. Cazzaniga, C. Frost, R. Baumann, P. Rech, "Thermal Neutrons: A Possible Threat for Supercomputers and Safety Critical Applications," 2020 IEEE European Test Symposium (ETS), May 2020 pp. 1-6.

PEER-REVIEWED PUBLICATIONS (cont.)

3. D. Oliveira, F. F. dos Santos, G. P. D´avila, C. Cazzaniga, C. Frost, R. C. Baumann, and P. Rech, "High-Energy vs. Thermal Neutron Contribution to Processor and Memory Error Rates", Trans. Nucl. Sci., 67(6), IEEE, Jan. 2020, pp. 1161-1168.

4. J. Cruz-Colon, V. Narayanan, W. N. Vonbergen, R. G. Roybal, R. C. Baumann, "Radiation Evaluation of the HVD233-SP CAN Transceiver", Proc. 2018 Radiation Effects Data Workshop (REDW), IEEE, pp. 1- 5.

5. M. Hamlyn, P. L. Hower, K. Warren, and R. C. Baumann, "Transmission Line Pulse Test Method for Estimating SEB Performance of n-Channel Lateral DMOS Power Transistors", Trans. Nucl. Sci., 65(1), IEEE, Jan. 2018, pp. 249-255.

6. J. Cruz-Colon, V. Narayanan, W. N. Vonbergen, R. G. Roybal, and R. C. Baumann, "Radiation Evaluation of the CDCLVP111-SP Low Voltage 1:10 LVPECL Clock Distributor", Proc. 2017 Radiation Effects Data Workshop (REDW), IEEE, pp. 1 - 6.

7. J. Cruz-Colon, M. Hamlyn, V. Zhu, B. A. Dahl, Thang Trinh, R. C. Baumann, "Radiation Evaluation of the TPS7H3301-SP Linear Regulator for Double Data Rate (DDR) Applications", Proc. 2016 Radiation Effects Data Workshop (REDW), IEEE, pp. 1 - 5.

8. J. M. Trippe, R. A. Reed, R. A. Austin, B. D. Sierawski, R. A. Weller, E. D. Funkhouser, M. P. King, B. Narasimham, B. Bartz, R. C. Baumann, J. Labello, J. Nichols, R. D. Schrimpf, and S. L. Weeden-Wright, "Electron-Induced Single Event Upsets in 28 nm and 45 nm Bulk SRAMs", Trans. Nucl. Sci., 62(6), IEEE, Dec. 2015, pp. 2709 – 2716.

9. B. A. Dahl, J. Cruz-Colon, R. C. Baumann, J. A. Rodriguez, C. Zhou, J. Rodriguez-Latorre, S. Khan, T. San, and T. Trinh, "Radiation Evaluation of Ferroelectric RAM Embedded in 180nm CMOS Technology", Proc. 2015 Radiation Effects Data Workshop (REDW), IEEE, pp. 1– 6.

10. S. L. Weeden-Wright, M. P. King, N. C. Hooten, W. G. Bennett, B. D. Sierawski, R. D. Schrimpf, R. A. Weller, R. A. Reed, M. H. Mendenhall, D. M. Fleetwood, M. L. Alles, and R. C. Baumann, "Effects of Energy-Deposition Variability on Soft Error Rate Prediction", IEEE Trans. Nucl. Sci., 62(5), IEEE, Sept. 2015, pp. 2181 – 2186.

11. M. P. King, R. A. Reed, R. A. Weller, M. H. Mendenhall, R. D. Schrimpf, B. D. Sierawski, A. L. Sternberg, B. Narasimham, J. K. Wang, E. Pitta, B. Bartz, D. Reed, C. Monzel, R. C. Baumann, X. Deng, J. A. Pellish, M. D. Berg, C. M. Seidleck, E. C. Auden, S. L. Weeden-Wright, N. J. Gaspard, C. X. Zhang, and D. M. Fleetwood, "Electron-Induced Single-Event Upsets in Static Random Access Memory", Trans. Nucl. Sci., 60(6), IEEE, Dec. 2013, pp. 4122 – 4129.

12. R. C. Baumann, "Determining the impact of alpha-particle-emitting contamination from the Fukushima Daiichi disaster on Japanese manufacturing sites", Trans. Nucl. Sci., IEEE, 59(4), Oct. 2012, pp. 1186 – 96.

13. M. A. Clemens, B. D. Sierawski, K. M. Warren, M. H. Mendenhall, N. A. Dodds, R. A. Weller, Robert A. Reed, P. E. Dodd, M. R. Shaneyfelt, J. R. Schwank, S. A. Wender, and R. C. Baumann, "The Effects of Neutron Energy and High-Z Materials on Single Event Upsets and Multiple Cell Upsets", Trans. Nucl. Sci., 58(6), IEEE, Dec. 2011, pp. 2591 – 2598.

14. B. D. Sierawski, R. A. Reed, M. H. Mendenhall, R. A. Weller, R. D. Schrimpf, S. Wen, R. Wong, N. Tam, R. C. Baumann, "Effects of scaling on muon-induced soft errors", Proc. International Reliability Physics Symposium (IRPS), IEEE, May 2011, pp. 3C.3.1 - 3C.3.6.

PEER-REVIEWED PUBLICATIONS (cont.)

15. R. C. Baumann, "Determining the impact of alpha-particle-emitting contamination from the Fukushima Daiichi disaster on Japanese manufacturing sites", European Conference on Radiation and Its Effects on Components and Systems (RADECS), Sept. 2011, Sevilla, Spain, pp. 784 - 787.

16. B. D. Sierawski, M. H. Mendenhall, R. A. Reed, M. A. Clemens, R. A. Weller, R. D. Schrimpf, E. W. Blackmore, M. Trinczek, B. Hitti, J. A. Pellish, R. C. Baumann, S. Wen, R. Wong, and N. Tam, “Muon-Induced Single Event Upsets in Deep-Submicron Technology”, Trans. Nucl. Sci., 57(6), IEEE, Dec. 2010, pp. 3273 – 3278.

17. N. A. Dodds, J. M. Hutson, J. A. Pellish, R. A. Reed, H. S. Kim, M. D. Berg, M. R. Friendlich, A. M. Phan, C. M. Seidleck, M. A. Xapsos, X. Deng, R. C. Baumann, R. D. Schrimpf, M. P. King, L. W. Massengill, and R. A. Weller, “Selection of Well Contact Densities for Latchup-Immune Minimal-Area ICs”, Trans. Nucl. Sci., 57(6), IEEE, Dec. 2010, pp. 3575-3581.

18. B. D. Sierawski, K. M. Warren, R. A. Reed, R. A. Weller, M. H. Mendenhall, R. D. Schrimpf, R. C. Baumann, and V. Zhu, “Contribution of Low-Energy (< 10 MeV) Neutrons to Upset Rate in a 65 nm SRAM”, Proc. 48th Annual International Reliability Physics Symp. (IRPS), IEEE, May 2010, pp. 395 –399.

19. J. A. Pellish, M. A. Xapsos, K. A. LaBel, P. W. Marshall, D. F. Heidel, K. P. Rodbell, M. C. Hakey, P. E. Dodd, M. R. Shaneyfelt, J. R. Schwank, R. C. Baumann, X. Deng, A. Marshall, B. D. Sierawski, J. D. Black, R. A. Reed, R. D. Schrimpf, H. S. Kim, M. D. Berg, M. J. Campola, M. R. Friendlich, C. E. Perez, A. M. Phan, and C. M. Seidleck, “Heavy ion testing at the galactic cosmic ray energy peak”, Euro. Conf. on Rad. and its Effects on Components and Systems (RADECS), Bruges, Belgium, Sept. 2009, pp. 559-562.

20. B. D. Sierawski, J. A. Pellish, R. A. Reed, R. D. Schrimpf, K. M. Warren, R. A. Weller, M. H. Mendenhall, J. D. Black, A. D. Tipton, M. A. Xapsos, R. C. Baumann, X. Deng, M. J. Campola, M. R. Friendlich, H. S. Kim, A. M. Phan, and C. M. Seidleck, “Impact of Low-Energy Proton Induced Upsets on Test Methods and Rate Predictions”, Trans. Nucl. Sci., 56(6), IEEE, Dec. 2009, pp. 3085-3092.

21. J. A. Pellish, M. A. Xapsos, K. A. LaBel, P. W. Marshall, D. F. Heidel, K. P. Rodbell, M. C. Hakey, P. E. Dodd, M. R. Shaneyfelt, J. R. Schwank, R. C. Baumann, X. Deng, A. Marshall, B. D. Sierawski, J. D. Black, R. A. Reed, R. D. Schrimpf, H. S. Kim, M. D. Berg, M. J. Campola, M. R. Friendlich, C. E. Perez, A. M. Phan, and C. M. Seidleck, “Heavy Ion Testing With Iron at 1 GeV/amu”, Trans. Nucl. Sci., 57(5), IEEE, Oct. 2009, pp. 2948-2954.

22. J. M. Hutson, J. A. Pellish, A. D. Tipton, G. Boselli, M. A. Xapsos, H. Kim, M. Friendlich, M. Campola, S. Seidleck, K. LaBel, A. Marshall, X. Deng, R. C. Baumann, R. A. Reed, R. D. Schrimpf, R. A. Weller, and L. W. Massengill, “Evidence for Lateral Angle Effect on Single-Event Latchup in 65 nm SRAMs”, Trans. Nucl. Sci., 56(1), IEEE, Feb. 2009, pp. 208-213.

23. A. D. Tipton, J. A. Pellish, J. M. Hutson, R. C. Baumann, X. Deng, A. Marshall, M. A. Xapsos, H. S. Kim, M. R. Friendlich, M. J. Campola, C. M. Seidleck, K. A. LaBel, M. H. Mendenhall, R. A. Reed, R. D. Schrimpf, R. A. Weller, and J. D. Black, “Device-Orientation Effects on Multiple-Bit Upset in 65 nm SRAMs”, Trans. Nucl. Sci., 55(6), IEEE, Dec. 2008, pp. 2880-2885.

24. R.C. Baumann and D. Radaelli, “Determination of Geometry and Absorption Effects and their Impact on the Accuracy of Alpha Particle SER Extrapolations”, Trans. Nucl. Sci., 54(6), IEEE, Dec. 2007, pp. 2141-2148.

25. X. Zhu, X. Deng, R.C. Baumann and S. Krishnan, “A Quantitative Assessment of Charge Collection Efficiency of N+ and P+ Diffusion Areas in Terrestrial Neutron Environment”, Trans. Nucl. Sci., 54(6), IEEE, Dec. 2007, pp. 2156 – 2161.

PEER-REVIEWED PUBLICATIONS (cont.)

26. J. M. Hutson, J. D. Pellish, G. Boselli, R. C. Baumann, R. A. Reed, R. D. Schrimpf, R. A. Weller, and L. W. Massengill, "The Effects of Angle of Incidence and Temperature on Latchup in 65 nm Technology", Trans. Nucl. Sci., 54(6), IEEE, Dec. 2007, pp. 2541-2546.

27. X. Zhu, R. C. Baumann, B. Takala, D. Dohmann, and L. Martinez, "Correlating Geometry and Shielding Effects on Accelerated Soft Errors in 90nm SRAM Using Spallation Neutron Beams", Radiation Effects Data Workshop, IEEE, Dec. 2006, pp. 191-194.

28. R.C. Baumann, "Radiation-induced soft errors in advanced semiconductor technologies", Trans. on Device and Materials Reliability, IEEE, 5(3), Sept. 2005, pp. 305 – 316.

29. R.C. Baumann, "Soft errors in advanced computer systems", Design & Test of Computers, IEEE, 22(3), May-June 2005, pp. 258 – 266.

30. X. Zhu, R.C. Baumann, C. Pilch, J. Zhou, J. Jones, and C. Cirba, "Comparison of product failure rate to the component soft error rates in a multi-core digital signal processor", Proc. 43rd Annual International Reliability Physics Symposium (IRPS), IEEE, April 2005, pp. 209 – 219.

31. R.C. Baumann, "Impact of Single-Event Upsets in Deep-Submicron Silicon Technology", Materials Research Soc., MRS Bulletin on Single-Event Upsets in Microelectronics, 28(2), Feb. 2003, pp. 117-120.

32. R.C. Baumann, "The Impact of Technology Scaling on Soft Error Rate Performance and Limits to the Efficacy of Error Correction", Proc. International Electron Devices Meeting (IEDM), IEEE, San Francisco, CA, Dec. 2002, pp. 329 – 332.

33. R.C. Baumann, and E. Smith, "Neutron-induced ^{10}B fission as a major source of soft errors in high density SRAMs", Elsevier Microelectronics Reliability, 41(2), Feb. 2001, pp. 211-218.

34. R.C. Baumann, "Soft Errors in Advanced Semiconductor Devices Part I – The Three Radiation Sources", Trans. on Device and Materials Reliability, IEEE, Vol. 1, No. 1, March 2001, pp. 17 - 22.

35. M. Hashimoto and R. C. Baumann, "Investigation of cell leakage and data retention in eDRAM", Proc. 26th European Solid-State Circuits Conf., Sept. 2000, pp. 356 – 359.

36. R. C. Baumann and E. B. Smith, "Neutron-Induced Boron Fission as a Major Source of Soft Errors in Deep Submicron SRAM Devices", Proc. 38th Annual International Reliability Physics Symposium (IRPS), IEEE, April 2000, pp. 152 – 157.

37. H. Kitagawa, R. Baumann, I. Takigasaki, K. Maeda, Y. Ohashi, Y. Kikuchi, and S. Murata, "Channel hot carrier impact on the reliability performance of PMOS submicron transistors", 6th International Symposium on Physical & Failure Analysis of Integrated Circuits, IEEE, July 1997, pp. 125-126.

38. R. C. Baumann, T. Z. Hossain, S. Murata, and H. Kitagawa, "Boron as a Primary Source of Radiation in High Density DRAMs", VLSI Technology Symposium Proc., IEEE, June 1995, pp. 81-82.

39. R. C. Baumann, T. Z. Hossain, S. Murata, and H. Kitagawa, "Boron Compounds as a Dominant Source of Alphas in Semiconductor Devices", Proc. 33nd Annual International Reliability Physics Symposium (IRPS), IEEE, May 1995, pp. 297-302.

40. M. Amagai, H. Seno, K. Abe, R. C. Baumann, and H. Kitagawa, "Cracking Failures in LOC Packages Induced by Chip Backside Contamination", Proc., 44th Elec. Component & Tech. Conf., IEEE, May 1994, pp. 171-176

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41. M. Amagai, R. Baumann, S. Kamei, M. Ohsumi, E. Kawasaki, and H. Kitagawa, “Development of a tapeless lead-on-chip (LOC) package”, Proc., 44th Elec. Component & Technology Conference, IEEE, May 1994, pp. 506-512.

42. M. Amagai, M. Ohsumi, E. Kawasaki, R. Baumann, H. Kitagawa, “The effect of polyimide surface morphology and chemistry on package cracking induced by interfacial delamination”, Proc. 32nd Annual International Reliability Physics Symposium (IRPS), IEEE, April 1994, pp. 101-107.

43. T. A. Rost, H. Lin, T. A. Rabson, R.C. Baumann, and D.L. Callahan, “Deposition and analysis of lithium niobate and other lithium niobium oxides by rf magnetron sputtering”, J. Appl. Physics, 72 (9), Nov. 1992, pp. 4337-4340.

44. T.A. Rost, T.A. Rabson, B.A. Stone, D.L. Callahan, and R.C. Baumann, “Physical structure of lithium niobate thin films”, Trans. on Ultrasonics, Ferroelectrics and Frequency Control, 38 (6), IEEE, Nov. 1991, p. 640-643.

45. T. A. Rost, R. C. Baumann, B.A. Stone, and T.A. Rabson, “Physical characterization of RF sputtered lithium niobate films”, Proc. 7th International Symposium on Applications of Ferroelectrics, IEEE, June 1990, pp. 125 -128.

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INVITED TALKS / CONFERENCE PAPERS

1. R.C. Baumann, “Part IV – Radiation Hardness Assurance in the "Wild West" of Commercial Space”, Short Course, 57th Internat. Nuclear and Space Radiation Effects Conf. (NSREC), IEEE, virtual Dec. 2020.

2. R.C. Baumann, “Terrestrial Radiation and its Impact on the Reliability Performance of Microelectronics”, Tutorial, 58th International Reliability Physics Symposium. (IRPS), IEEE, virtual Apr. 2020.

3. R.C. Baumann, “When "Meta Machines" Hear the Banshee Wail of the Cosmos: Microelectronic scaling trends and their impact on resiliency to cosmic-rays (single event effects)", 45th Asilomar Microcomputer Workshop, Pacific Grove, CA, April. 26-28, 2019.

4. R.C. Baumann, “How Radiation Induces Amnesia, Seizure, and Dementia-Like Symptoms in Microelectronics”, UC Davis Physics, Davis, CA, April 8, 2019.

5. R.C. Baumann, “Making the Grade: From COTS to Space-grade Electronics”, Keynote, IEEE Electronic Packaging Society 10th Annual SER Workshop, San Jose, CA, Oct. 24, 2018.

INVITED TALKS / CONFERENCE PAPERS (cont.)

6. R.C. Baumann, "From COTS To Space Grade Electronics: Which Is The Best For Your Mission?", Keynote for Topical session, European Conf. on Radiation and its Effects on Components and Systems (RADECS), Göteborg, Sweden, Sept. 17, 2018.

7. R.C. Baumann, "Silicon Amnesia and Dementia: Radiation induced failures on the Internet of Things (IoT)", Masters Lecture, University of Bologna, Italy, March 2018.

8. R.C. Baumann, "Space and terrestrial radiation and its effects on electronics", Graduate Seminars, U.T. Dallas, Texas, April 2018.

9. R.C. Baumann, "Funny stories from terrestrial radiation effects", European Conf. on Radiation and its Effects on Components and Systems (RADECS), Geneva, Switzerland. Oct. 2017.

10. R.C. Baumann, "The Space Radiation Environment and Component Mitigation Techniques for Dependable Space Systems", Dependable Systems and Networks (DSN), IEEE, Industrial Session, Denver, CO, June 2017.

11. R.C. Baumann, "Space Radiation: Effects on Electronics and Process/Design Mitigation Strategies", Japan Soc. of Applied Physics, 21th Domestic Workshop on Technologies and Physics Relating Interfaces of Electronic Devices, Mishima, Japan, Jan. 2017.

12. R.C. Baumann, "Radiation EFX Deep Dive: India 2016", Texas Instruments Tech Day Conferences, Indian Space Research Organization (ISRO) and affiliates, Hyderabad and Trivandrum, India, Nov. 2016.

13. R.C. Baumann, "The Natural Radiation Environment and its Impact in Microelectronics (for non-device experts)", 40th Annual International Meeting on Radiation Processing (IMRP), Vancouver, BC, Canada, Nov. 2016.

14. R.C. Baumann, "Space and terrestrial radiation and its effects on electronics", parts II, Graduate Seminars, U.T. Dallas, Texas, April 2016.

15. R.C. Baumann, "Space and terrestrial radiation and its effects on electronics", parts I, Graduate Seminars, U.T. Dallas, Texas, April 2016.

16. R.C. Baumann, "Development of a Robust Ferroelectric Memory Technology for Harsh Non-volatile Memory Applications", Microelectronics Reliability & Quality Workshop (MRQW), Los Angeles, CA, Feb. 2016.

17. R.C. Baumann, "Space and terrestrial radiation and its effects on electronics", parts II, Graduate Seminars, U.T. Dallas, Texas, April 2015.

18. R.C. Baumann, "Space and terrestrial radiation and its effects on electronics", parts I, Graduate Seminars, U.T. Dallas, Texas, April 2015.

19. R.C. Baumann, "Silicon Amnesia and Dementia: Radiation Effects in Microelectronics," Council on Ionizing Radiation Measurements and Standards Conference (CIRMS), NIST, Gaithersburg, MD, April 2015.

20. R.C. Baumann, "Radiation Effects in Electronics (R2E): Challenges for the Future", Future Circular Collider Conference, Washington, D.C., March 2015.

21. R.C. Baumann, "From COTS to space grade electronics-improving reliability for Harsh environments", International Integrated Reliability Workshop (IIRW), IEEE, Lake Tahoe, CA, Oct. 2014.

INVITED TALKS / CONFERENCE PAPERS (cont.)

22. R.C. Baumann, “Space & terrestrial radiation and its effects on electronics”, Seminar, hosted by American Vacuum Society (AVS), University of Dallas, Texas, June 2014.

23. R.C. Baumann, “Industrial challenges and trends in terrestrial single-event effects (SEE)”, CERN Seminar, Geneva, Switzerland, Jun. 2014.

24. R.C. Baumann, “Landmarks In Terrestrial Single-Event Effects”, Short Course, 50th International Nuclear and Space Radiation Effects Conf. (NSREC), IEEE, San Francisco, CA, July 2013.

25. R.C. Baumann, “Terrestrial Radiation Environment Effects: The Device Manufacturer’s Point-of-View”, RADSOL Conference, at CNRS, Paris, France, May 2013.

26. R.C. Baumann, “Neutron and Alpha Particle Effects in Electronics”, Short Course, RADGROUND, European Conf. on Radiation and its Effects on Components and Systems (RADECS), Biarritz, France, Sept. 2012.

27. R.C. Baumann, “Radiation Damage to (CMOS) Electronics: How is Field Characterization Important?”, 12th Symposium on NEUtron and Ion DOSimetry (NEUDOS12), Aix-en-Provence, France, Aug. 2012.

28. R.C. Baumann, “Ghosts in the Machine – How subatomic-scale events impact us and what we can do about it”, International Integrated Reliability Workshop (IIRW), IEEE, Lake Tahoe, CA, Oct., 2011.

29. R.C. Baumann, “Impact of Single Event Effects on Nano Technologies”, Electron Devices Distinguished Lecture, IEEE, University of Texas, Arlington, Nov. 4, 2010.

30. R.C. Baumann, “Reliability Impact of Radiation in Advanced Commercial CMOS Technology”, 24th International Conf. on the Application of Accelerators in Research and Industry (CAARI), Fort Worth, TX, Oct. 2010.

31. R.C. Baumann, “The New JEDEC JESD89A Test Standard – How it is different than the old one and why we should use it”, European Conf. on Radiation and its Effects on Components and Systems (RADECS), Deauville, France, Sept. 2007.

32. R.C. Baumann, “The importance of LANSCE for single-event effects reliability modeling for commercial semiconductors”, Los Alamos Users Group Conference (LUG), Santa Fe, NM, June 2007.

33. R.C. Baumann, “The impact of Single Event Effects on Advanced Digital Technologies”, Electron Devices Distinguished Lecture, IEEE, University of Texas, Austin, Dec. 7, 2006.

34. R.C. Baumann, “Single Event Effects in Advanced Commercial Silicon Technology”, 36th International Test Conf. (ITC), IEEE, Austin, Texas, Nov. 2005.

35. R.C. Baumann, “Single-Event Effects in Advanced CMOS Technology”, Short Course, IEEE 42nd International Nuclear and Space Radiation Effects Conf. (NSREC), Seattle, Washington, July 2005.

36. R.C. Baumann, “Single Event Effects in Advanced SRAM and Logic Components”, SRC Topical Research Conference on Reliability, SEMATECH, Austin, Texas, Oct. 2004.

37. R.C. Baumann, “Ghosts in the Machine: A Tutorial on Single Event Effects in Advanced Commercial Silicon Technology”, 35th International Test Conf. (ITC), IEEE, Charlotte, NC, Oct. 2004.

38. R.C. Baumann, "Accelerator Needs for Characterization of Radiation Effects in Commercial Semiconductor Technologies”, 18th International Conf. on the Application of Accelerators in Research and Industry (CAARI), Fort Worth, Texas, Oct. 2004.

INVITED TALKS / CONFERENCE PAPERS (cont.)

39. R.C. Baumann, “TI Perspective of SEUs in Logic Circuits at Texas Instruments”, IBM Academy on Soft Errors, IBM T. J. Watson Research Center, Yorktown Heights, N.Y., June 2004.

40. R.C. Baumann, “Silicon Amnesia: A Tutorial on Radiation Induced Soft Errors”, Proc. 42nd Annual International Reliability Physics Symposium (IRPS), IEEE, April 2004.

41. R.C. Baumann, “Technology Scaling Trends and Accelerated Testing for Soft Errors in Commercial Silicon Devices”, International On-Line Test Symposium (IOLTS), IEEE, Kos, Greece, July 2003.

42. R.C. Baumann, “SEU Trends in Advanced Commercial Technology”, workshop on Single Event Upsets in Future Computing Systems, Jet Propulsion Lab., JPL NASA, & Cal. Tech., Pasadena, CA, May 2003.

43. R.C. Baumann, “Soft Errors in Commercial Semiconductor Technology: Who should be worried and what can we do about it?”, Single Events Effects Symposium, Long Beach, CA, April 2002.

44. R.C. Baumann, “Soft Errors in Commercial Semiconductor Technology: Overview and Scaling Trends”, Proc. 40th Annual International Reliability Physics Symposium (IRPS), IEEE, April 2002.

45. R.C. Baumann, “Silicon Amnesia: Radiation Induced Soft Errors in Commercial Semiconductor Technology”, European Conf. on Radiation and its Effects on Components and Systems (RADECS), Grenoble, France, Sept. 2001.

46. R.C. Baumann and E.B. Smith, “Call for Improved Ultra-Low Background Alpha-Particle Emission Metrology for the Semiconductor Industry”, International SEMATECH Technology Transfer #01054118A-XFR, June 2001.

47. R.C. Baumann, “Single Event Effects in Advanced Commercial Silicon Technology”, Proc. 39th Annual International Reliability Physics Symposium (IRPS), IEEE, April 2001.

48. R.C. Baumann, “Silicon Amnesia: Why Electronic Memories Forget”, Reliability Society Meeting, IEEE, Dallas, Nov. 1998.

TEXAS INSTRUMENTS TECHNICAL ACTIVITY REPORTS

1. M. Aoki, Y. Fukuda, K. Numata, and R. C. Baumann, “Interim Report on Embedded-Ferroelectric Device”, July 1998.

2. Y. Hirose, M. Matsumura, and R. C. Baumann, “T-Network Feedback Amplifier for Low Current Measurement”, May 1998.

3. M. Aoki, K. Numata, R. C. Baumann, and Y. Fukuda, “Success in Processing of Planar Ir/PZT/Ir on 0.6um W-Plugs”, Feb. 1998.

4. Y. Hirose and R. C. Baumann, “Design and Noise Estimation of a Low Noise Amp”, Jan. 1998.

5. M. Oizumi, M. Hashimoto, Y. Hirose and R. C. Baumann, “Observation of TiSi2 Layer Formation in High Resistance Contacts”, Jan. 1998.

6. M. Matsumura, Y. Ohashi, M. Handa, and R. C. Baumann, “Oxidation Retardation by Nitrogen Implant Prior to Oxidation”, July 1997.

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8. R. C. Baumann and M. Hashimoto, “Prediction of Radiation-Induced System Soft Error Rates in EDRAM”, Feb. 1996.

9. R. C. Baumann, I. Takigasaki, “Unique Structure Providing Dynamic Stress in Submicron MOSFETs”, Dec. 1995.

10. R. C. Baumann and J. M. McPherson, "Impact of Alpha-Emitting Impurities in Phosphoric Acid on DRAM SER", Nov. 1992.

11. R. C. Baumann, "Alpha-Particle Induced Soft Error Phenomena in the 16Mb DRAM", Mar. 1992.

12. R. C. Baumann, "Effectiveness of Polyimide for Stopping of Alphas in Memory Devices", Sept. 1991.

13. R. C. Baumann and T. Z. Hossain, "Investigation of Uranium and Thorium Content in 16 Mb DRAM Metals by NAA", May 1991.