

Glenn B. Alers

October, 2007

ADDRESS

Department of Physics
University of California
Santa Cruz, CA 95064
(831)234-6056
galers@ucsc.edu

EDUCATION

Ph.D. in Physics, University of Illinois, Urbana, IL (1991).
M.S. in Physics, University of Illinois, Urbana, IL (1986).
B.S. in Engineering Physics, University of Colorado, Boulder, CO (1985).

TECHNICAL EXPERIENCE

- **Copper / low k interconnect integration, yield and reliability:**
 - Deposition and integration of thin films for back end of line interconnects
 - PECVD deposition of low-k dielectrics, PVD deposition of liner/seed and electrochemical deposition of copper
 - Electromigration, stress migration and dielectric reliability in copper / low k dielectric interconnects.
 - Failure analysis and defect inspection using high resolution SEM and FIB/SEM.
- **Electrical characterization of nanoscale materials:**
 - Ultra-thin and high dielectric constant oxide characterization, trap assisted tunneling and stress induced currents.
 - High precision electrical measurements in nanostructures ($\delta R < 10^{-9} \Omega$, $\delta C < 10^{-15} F$).
- **Magnetic Materials:** Integrated inductors and magnetic field sensors.

PROFESSIONAL EXPERIENCE

- **University of California, Department of Physics, Santa Cruz, CA (7/2006 – present)**
 - Adjunct Professor of Physics
- **Novellus Systems, San Jose, CA (1/2005 – 1/2007)**
 - Principal Engineer, Integration group
 - Deposition, characterization and integration of copper / low k dielectric films
- **Novellus Systems, Integration, San Jose, CA (1/2000 – 1/2005)**
 - Senior Process Manager, Integration Group.
 - Responsible for electrical and reliability characterization of new copper / low k dielectric processes.
- **Bell Laboratories, Lucent Technologies, Murray Hill, NJ (8/1993 - 1/2000)**
 - Member of Technical Staff, Physical Research Laboratory
 - Thin gate oxide reliability, diffusion in sub-micron interconnects, high -k dielectrics.
- **Lucent Technologies, Microelectronics, Orlando FL (1/1996 -11/97)**
 - Management of joint development program with Applied Materials for CVD deposited high-k materials
- **SEMATECH:** Assignee to advanced gate stack working group (6/1997 – 1/2000).
- **Semiconductor Research Corporation:** Mentor for interconnect thrust area (6/1994 - 6/1996)
- **Adjunct Professor of Physics, Stevens Institute of Technology, Hoboken NJ (1/1995 - 1/1997)**
- **Michigan State University, E. Lansing, MI - Postdoctoral Research Assoc.(6/91 - 8/93).**
- **University of Illinois, Urbana, Il - Research Assistant (8/85-6/91).**

PROFESSIONAL ACTIVITIES

- **Management Committee**, IEEE International Reliability Physics Symposium (4/02 - present)
- **Advising:** Advisor or co-advisor for graduate students from MIT (2), Univ. of Texas (1) and Stevens Inst. of Tech. (1)

INVITED TALKS (5 years)

Tutorial or invited talk at the following conferences

International Integrated Reliability Workshop, Lake Tahoe, CA (October 2005)
Advanced Metallization Conference, Colorado Springs, CO (October 2004)
IEEE International Interconnect Technology Conference, Burlingame, CA (June, 2005)
Advanced Metallization Conference, San Diego, CA (October 2004)
Freescale Semiconductor Symposium, Austin, TX (November, 2004)
Japanese Workshop on Stress Induced Phenomena, Tokyo, Japan (July, 2004)
IEEE International Reliability Physics Symposium, Tutorial, Dallas, TX (April, 2004)
Advanced Metallization Conference, Montreal, (October 2003)
IEEE International Reliability Physics Symposium, Tutorial, Dallas, TX (April, 2003)
7th Workshop on Atomic Migration and Stress Induced Phenomena, Chigasaki, Japan (July, 2001)

PATENTS

- (1) 6,830,942 Method for processing silicon workpieces using hybrid optical thermometer system
- (2) 6,750,495 Damascene capacitors for integrated circuits
- (3) 6,590,241 MOS transistors with improved gate dielectrics
- (4) 6,559,499 Process for fabricating an integrated circuit device having capacitors with a multilevel metallization
- (5) 6,500,499 Deposition and annealing of multicomponent ZrSnTi and HfSnTi oxide thin films....
- (6) 6,403,415 Semiconductor device having a metal barrier layer for a dielectric material having a high dielectric...
- (7) 6,320,244 Integrated circuit device having dual damascene capacitor
- (8) 6,303,426 Method of forming a capacitor having a tungsten bottom electrode in a semiconductor wafer
- (9) 6,284,663 Method for making field effect devices and capacitors with thin film dielectrics and resulting devices
- (10) 6,271,596 Damascene capacitors for integrated circuits
- (11) 6,265,260 Method for making an integrated circuit capacitor including tantalum pentoxide
- (12) 6,060,406 MOS transistors with improved gate dielectrics
- (13) 6,046,657 Magnetostrictive surface acoustic wave device and microelectronic circuit including same
- (14) 6,043,662 Detecting defects in integrated circuits
- (15) 6,002,113 Apparatus for processing silicon devices with improved temperature control
- (16) 6,001,741 Method for making field effect devices and capacitors with improved thin film dielectrics
- (17) 5,804,975 Detecting breakdown in dielectric layers

PUBLICATIONS (10 years)

“Alers Visits Interconnect Reliability Concerns”, Semiconductor International, September 2005, <http://www.reed-electronics.com/semiconductor/article/CA6252222>

“Stress migration and the mechanical properties of copper”. G.B. Alers, J. Sukamto, P. Woytowicz, X. Lu, S. Kailasam, J. Reid, Proc. Int'l Reliability Physics Symp. Pg. 36 (2005)

“Interlevel dielectric failures in copper/low-k structures” G.B. Alers, K. Jow, R. Shaviv, G. Kooi, G.; G. Ray. IEEE Trans. On Device and Materials Reliability 4(2) pg 148 (2004)

“Copper Purity and Interface Integrity for Electromigration Reliability”. G.B. Alers, X. Lu, J.H. Sukamto, S.K. Kailasam, J. Reid, G. Harm; IEEE Int'l Interconnect Tech. Conf. (2004).

“Improved Sensitivity For Via Stress Migration Using A Cyclical Test”. G.B. Alers, J. Kuo, S. Weinzerel and G. Harm; MRS Advanced Metallization Conference 2003, pg 283 (2003).

"Barrier First Integration For Improved Reliability In Coper Dual Damascene Interconnects". G.B. Alers, R.T. Rozbicki, G.J.Harm, S.K. Kailasam, G.W. Ray and M. Danek. IEEE Int'l Interconnect Tech. Conf. (2003).

- "Electromigration Improvement With CVD TiN(Si) Barrier In Copper Dual Damascene Structures". G.B. Alers, A. Vijayendran, P. Gillespie, L. Chen, H. Cox, K. Lam, R. Auger, K. Shannon, K. Pfeifer and M. Danek. IEEE Int'l Reliability Physics Symp., pg. 151 (2003).
- "TDDB And Voltage Ramp Reliability Of SiC Based Dielectric Diffusion Barriers In Cu / Low-K Interconnects". K. Jow, G.B. Alers, M. Sangneria, G. Harm, H. Fu, X. Tang, G. Kooi, G. Ray and M. Danek. IEEE Int'l Reliability Physics Symp., pg. 598 (2003).
- "Ramped Current Stress For Fast And Reliable Wafer Level Reliability Monitoring Of Thin Gate Oxide Reliability". A. Martin, J. von Hagen, G.B. Alers, Microelectronic Reliab. 43 (8): 1215-1220 (2003).
- "Experimental Determination Of The Relative Permittivity Of Copper Low K Dual Damascene Interconnect Structures". R. Shaviv, Y. Yu, T. Mojuntsier, G. Alers, M. Sangneria, N. Shoda, G. Ray and B. van Schravendijk. MRS Advanced Metallization Conf. 2002, pg. 613 (2002).
- "Tradeoff Between Reliability And Post-CMP Defects With Recrystallization Anneal In Copper Damascene Interconnects". G.B. Alers, D. Dornisch, J. Siri, K. Kattige, L. Tam, E. Broadbent and G.W. Ray. IEEE Int'l Reliability Physics Symp., pg 350 (2001).
- "Low Resistance Copper Interconnects With MOCVD TiN(Si) Barrier For Sub-0.18 μ m Applications". T. Suwwan de Felipe, D. Ganesan, G. Alers, E. Klawuhn, A. Vijayendran, M. Danek, K. Pfeifer. MRS Advanced Metallization Conf. 2001, pg 549 (2001).
- "Effects Of High-Temperature Annealing On The Dielectric Function Of Ta₂O₅ Films Observed By Spectroscopic Ellipsometry" N.V. Nguyen, C.A. Richter, Y.J. Cho, G.B. Alers, Appl. Phys Lett 77 (19): 3012-3014 (2000).
- "CVD of Zr-Sn-Ti-O Thin Films By Direct Injection Of Solventless Liquid Precursor Mixtures". Y. Senzaki, G.B. Alers, A.K. Hochberg AK, et al. Electrochem. Solid St. 3 (9): 435-436 (2000).
- "Defect Dominated Charge Transport In Amorphous Ta₂O₅ Thin Films" R.M. Fleming, D.V. Lang DV, C.D.W. Jones, G.B. Alers et al. J Appl. Phys. 88 (2): 850-862 (2000)
- "Magnetically Transduced Surface Acoustic Wave Devices". K.A. Ellis, R.B. van Dover, T.J. Klemmer, G.B. Alers, et al. J Appl. Phys. 87 (9): 6304-6306 (2000).
- "1/f Noise Through The Metal-Nonmetal Transition In Percolating Composites". A.J. Breeze, S.A. Carter SA, G.B. Alers, et al., Appl Phys. Lett. 76 (5): (2000).
- "Interfacial Reaction And Thermal Stability Of Ta₂O₅/Tin For Metal Electrode Capacitors". J.P. Chang, R.L. Opila, G.B. Alers, M.L. Steigerwald, R.M. Fleming; Solid State Technology V42, 2, 43 (1999) .
- "Thermal Stability Of Ta₂O₅ In Metal Oxide Metal Capacitor Structures". J.P. Chang, M.L. Steigerwald, R.M. Fleming, R.L. Opila, G.B. Alers. Applied Physics Letters V74, 24, 3705, (1999) .
- "Effect Of Thermal Stability And Roughness On Electrical Properties Of Tantalum Oxide Gates". G.B. Alers, L.A. Stirling, R.B. VanDover, J.P. Chang, D.J. Werder, R Urdahl, R Rajogopalan. Materials Research Society Proceedings (Spring, 1999).
- "Soft Breakdown In Ultra-Thin Oxides". BE Weir, PJ Silverman, G.B. Alers, D. Monroe, M.A. Alam, T.W. Sorsch, M.L. Green, G.L. Timp, Y Ma, M Frei, C.T. Liu, J.D. Bude, K.S. Krisch; Materials Research Society Proceedings (Spring, 1999)..
- "J-Ramp On Sub-3nm Dielectrics: Noise As A Breakdown Criterion" G.B. Alers, B.E. Weir, M.R. Frei, D. Monroe; International Reliability Physics Symposium Proceedings (Spring, 1999)
- "Advanced Dielectrics For Gate Oxide, DRAM And RF Capacitors". R.B. VanDover, R.M. Fleming, L.F. Schneemeyer, G.B. Alers, D.J. Werder; IEDM Technical Digest (December, 1998)

- "Intermixing At The Ta₂O₅/Silicon Interface In Gate Dielectric Structures" G.B.Alers, D. Werder, Y. Chabal, H.C.Lu, E.P.Gusev, E.Garfunkel, T. Gustafsson and R. Urdahl. Appl. Phys. Lett. **73** (11) (1998).
- "Nitrogen Plasma Annealing For Low Temperature Ta₂O₅ Films" G. B. Alers, R. M. Fleming, Y. H. Wong, B. Dennis, A. Pinczuk, G. Redinbo, G. Urdahl, E. Ong and Z. Hasan. Appl. Phys. Lett. **72** (11), 1308 (1998).
- "Trap Assisted Tunneling As A Mechanism Of Degradation And Noise In 2-5 Nm Oxides" G. B. Alers, B. E. Weir, M. A. Alam, G. L. Timp and T. Sorsch. IEEE International Reliability Physics Symposium Proceedings (1998).
- "Electric Field Corrections For Ultra-Thin Oxide Reliability" G. B. Alers, B. E. Weir, P. J. Silverman, D. Monroe, K. Krisch, Proceedings of IEEE Reliability Physics Workshop (1997).
- "Ultra-Thin Gate Dielectrics: They Break But Do They Fail?" B. E. Weir, P. J. Silverman, D. Monroe, K. S. Krisch, M. A. Alam, G. B. Alers, T. W. Sorsch, G. L. Timp, F. Baumann, C. T. Liu, D. Hwang. IEEE IEDM Tech. Digest (1997).
- "Intrinsic And Stress Induced Traps In The Direct Tunneling Current Of 2.3-3.8 Nm Oxides And Unified Characterization Methodologies Of Sub 3nm Oxides." C. T. Liu, A. Ghetti, Y. Ma, G. Alers, C.P. Chang, J.I. Colonell, W.Y.C. Lai, C.S. Pai, R. Liu, H. Vaidya, J. T. Clemens, IEEE IEDM Tech. Digest (1997).
- "Effect Of Electronic Corrections To The Thicknes Dependence Of Thin Oxide Reliability" G. B. Alers, K. S. Krisch, D. Monroe and B. Weir. Appl. Phys. Lett. **71**, (17) 2478 (1997).
- "Reduced 1/F Noise And Gm Degradation For Sub-0.25mm MOSFETS With 25 A - 50 A Gate Oxides Grown On Nitrogen Implanted Si Substrates" C.T. Liu, D. Misra, K.P. Cheung, G.B. Alers, C.P. Chang, J.I. Colonell, W.Y.C. Lai, C.S. Pai, R. Liu., J.T. Clemens. 55th Anual Device Research Conference Digest (1997).
- "Tunneling current noise and reliablilty of thin MOS oxides", G. B. Alers, B. E. Weir, K. S. Krisch, D. Monroe. Noise in Physical Systems and 1/f fluctuations. Ed. C. Claeys and E. Simoen, World Scientific (New Jersey), (1997).
- "Tunneling current noise in thin gate oxides" G. B. Alers, K. S. Krisch, D. Monroe, B. E. Weir and A. M. Chang. Appl. Phys. Lett. **69** (19) (1996).
- "1/f resistance noise in the large magnetoresistance manganites" G. B. Alers, A. P. Ramirez, S. Jin; Appl. Phys. Lett. **68**, 3644 (1996).
- "The effect of stress on the resistivity of submicron aluminum lines" N. L. Beverly, G. B. Alers and J. A. Prybyla; Appl. Phys. Lett. **68**, 2372 (1996).
- "Electromigration induced resistance changes and noise in an isolated aluminum via" G. B. Alers, N. L. Beverly, A. S. Oates; J. Appl. Phys. **79**, 7596 (1996).