

# **2007 IEEE International Reliability Physics Symposium**

**Phoenix, AZ  
15-19 April 2007**

**Volume 1 of 2**



**IEEE Catalog Number:  
ISBN:**

**07CH37867  
1-4244-0918-7**

# Table of Contents

<b>On the physical mechanism of NBTI in silicon oxynitride p-MOSFETs: can differences in insulator processing conditions resolve the interface trap generation versus hole trapping controversy?.....</b>	<b>1</b>
<i>S. Mahapatra, K. Ahmed, D. Varghese, A.E. Islam, G. Gupta, L. Madhav, D. Saha, and M.A. Alam</i>	
<b>Estimation of NBTI degradation using on-chip IDDQ measurement.....</b>	<b>10</b>
<i>K.Kang, M.A. Alam, and K. Roy</i>	
<b>On the interaction of ESD, NBTI and HCI in 65nm technology .....</b>	<b>17</b>
<i>R. Mishra, S. Mitra, R. Gauthier, D.E. Ioannou, D. Kontos, K. Chatty, C. Seguin, and R. Halbach</i>	
<b>(Invited) SRAM variability and supply voltage scaling challenges .....</b>	<b>23</b>
<i>R. Kapre, K. Shakeri, H. Puchner, J. Tandigan, T. Nigam, K. Jang, M.V.R. Reddy, S. Lakshminarayanan, D. Sajoto, and M. Whately</i>	
<b>Quantitative Analysis Of Random Telegraph Signals As Fluctuations Of Threshold Voltages In Scaled Flash Memory Cells.....</b>	<b>29</b>
<i>H. Miki, T. Osabe, N. Tega, A. Kotabe, H. Kurata, K. Tokami, Y. Ikeda, S. Kamohara, and R. Yamada</i>	
<b>(Invited) Dielectric breakdown in high-k gate dielectrics: Mechanism and lifetime assessment.....</b>	<b>36</b>
<i>K. Okada, H. Ota, T. Nabatame, and A. Toriumi</i>	
<b>New understanding on the breakdown of high K dielectric stacks using multi-vibrational hydrogen release model.....</b>	<b>44</b>
<i>M. Rafik, G. Ribes, D. Roy, and G. Ghibaudo</i>	
<b>Progressive breakdown characteristics of high-k/metal gate stack.....</b>	<b>49</b>
<i>G. Bersuker, N. Chowdhury, C. Young, D. Heh, D. Misra, and R. Choi</i>	
<b>Defects generation in SiO<sub>2</sub>/HfO<sub>2</sub> studied with variable tcharge-tdischarge charge pumping (VT2CP).....</b>	<b>55</b>
<i>M.B. Zahid, R. Degraeve, L. Pantisano, J.F. Zhang, and G. Groeseneken</i>	
<b>In depth analysis of VT instabilities in HFO<sub>2</sub> technologies by charge pumping measurements and electrical modeling .....</b>	<b>61</b>
<i>X. Garros, J. Mitard, C. Leroux, G. Reimbold, and F. Boulanger</i>	
<b>Comparison of plasma-induced damage in SiO<sub>2</sub>/TiN and HfO<sub>2</sub>/TiN gate stacks .....</b>	<b>67</b>
<i>C.D. Young, G. Bersuker, F. Zhu, K. Matthews, R. Choi, S.C. Song, H.K. Park, J.C. Lee, and B.H. Lee</i>	
<b>Kinetic analysis of X-ray irradiation induced static refresh failure mechanism in DRAM.....</b>	<b>71</b>
<i>A. Ditali, M. Ma, B. Black, S.-J. Wen, and S. Chung</i>	
<b>Macro-model for post-breakdown 90nm and 130nm transistors and its applications in predicting chip-level function failure after ESD-CDM events.....</b>	<b>78</b>
<i>T.W. Chen, C. Ito, W. Loh, W. Wang, S. Mitra, and R.W. Dutton</i>	
<b>Degradation mechanisms in CMOS power amplifiers subject to radio-frequency stress and comparison to the DC case.....</b>	<b>86</b>
<i>C.D. Presti, F. Carrara, A. Scuderi, S. Lombardo, and G. Palmisano</i>	
<b>(late) Realistic projections of product Fmax shift and statistics due to HCI and NBTI.....</b>	<b>93</b>
<i>A. Haggag, M. Lemanski, G. Anderson, P. Abramowitz, and M. Moosa</i>	
<b>The impact of Ball-Bonding (BB) induced voltage transient on sub-90nm CMOS technology .....</b>	<b>97</b>
<i>J.-H. Lee, J.R. Shih, B.L. Lin, C.H. Lin, P.-K. Niu, J. Wang, C.-H. Tang, A.S. Oates, and K. Wu</i>	
<b>On the physics of failure in the case of moisture induced delamination in plastic encapsulated microelectronic devices.....</b>	<b>102</b>
<i>K.C. Lee and P. Alpern</i>	
<b>Identification of brittle solder joints using high strain rate testing of BGA solder joints .....</b>	<b>107</b>
<i>R. Pandher and M. Boureghda</i>	

# Table of Contents

<b>A study on wire ball/pad open failure mechanism of a multi-stack package (MSP) under high temperature storage (HTS) condition .....</b>	<b>113</b>
<i>S.Y. Yang, H.-J. Byun, S.-W. Park, and W.-J. Lee</i>	
<b>Analytical study of impurity doping effects on electromigration of Cu interconnects by employing comprehensive scattering model.....</b>	<b>117</b>
<i>S. Yokogawa, Y. Kakuhara, H. Tsuchiya, and K. Kikuta</i>	
<b>Plasticity-amplified diffusivity: Dislocation cores as fast diffusion paths in Cu interconnects.....</b>	<b>122</b>
<i>A.S. Budiman, C.S. Hau-Riege, P.R. Besser, A. Marathe, Y.-C. Joo, N. Tamura, J.R. Patel, and W.D. Nix</i>	
<b>Cu interconnect width effect, mechanism and resolution on down-stream stress electromigration .....</b>	<b>128</b>
<i>Y.L.Cheng, B.L. Lin, S.Y. Lee, C.C. Chiu, and K. Wu</i>	
<b>Design for manufacturability and its role in enhancing stress migration reliability of porous ultra low-k copper interconnects.....</b>	<b>134</b>
<i>Y.K. Lim, K.L. Pey, P.S. Lee, Y.H. Lee, N.R. Kamat, J.B. Tan, T. Fu, and L.C. Hsia</i>	
<b>(Invited) SiGe BiCMOS technology: An IC design platform for extreme environment electronics applications.....</b>	<b>141</b>
<i>J.D. Cressler</i>	
<b>(Invited) Understanding tin plasmas: A new approach to tin whisker risk assessment .....</b>	<b>150</b>
<i>M. Mason and G. Eng</i>	
<b>Cryogenic reliability impact on analog circuits at extreme low temperatures .....</b>	<b>156</b>
<i>Y. Chen, L. Westergard, C. Billman, R. Leon, T. Vo, M. White, M. Mojarradi, and E. Kolawa</i>	
<b>Statistical investigation of random telegraph noise ID instabilities in flash cells at different initial trap-filling conditions.....</b>	<b>161</b>
<i>C.M. Compagnoni, R. Gusmeroli, A.S. Spinelli, A.L. Lacaita, M. Bonanomi and A. Visconti</i>	
<b>Effects of lateral charge spreading on the reliability of TANOS (TaN/AIO/SiN/Oxide/Si) NAND flash memory .....</b>	<b>167</b>
<i>C. Kang, J. Choi, J. Sim, C. Lee, Y. Shin, J. Park, J. Sel, S. Jeon, Y. Park, and K. Kim</i>	
<b>Reliability and processing effects of Bandgap Engineered SONOS (BESONOS) flash memory .....</b>	<b>171</b>
<i>S.-Y. Wang, H.-T. Lue, E.-K. Lai, L.-W. Yang, T. Yang, K.-C. Chen, J. Gong, K.-Y. Hsieh, R. Liu, and C.-Y. Lu</i>	
<b>A novel gate-sensing and channel-sensing transient analysis method for real-time monitoring of charge vertical location in SONOS-type devices and its applications in reliability studies .....</b>	<b>177</b>
<i>H.-T. Lue, P.-Y. Du, S.-Y. Wang, E.-K. Lai, K.-Y. Hsieh, R. Liu, and C.-Y. Lu</i>	
<b>Development and Optimization of Re-oxidized Tunnel oxide with nitrogen incorporation for the flash memory application .....</b>	<b>184</b>
<i>J.-G. Jee, W.H. Kwon, W. Lee, J.-H. Park, H.-K. Kim, H.-M. Son, W.-J. Chang, J.-J. Han, Y.-W. Hyung, and H.-D. Lee</i>	
<b>influence of hydrogen permeability of liner nitride film on program/erase endurance of split-gate type Flash EEPROMs.....</b>	<b>190</b>
<i>Z. Liu, S. Fujieda, F. Hayashi, M. Shimizu, M. Nakata, H. Ishigaki, M. Wilde, and K. Fukutani</i>	
<b>The current understanding of the trap generation mechanisms that lead to the power law model for gate dielectric breakdown .....</b>	<b>197</b>
<i>P. E. Nicollian, A. T. Krishnan, C. A. Chancellor, R. B. Khamankar, S. Chakravarthi, C. Bowen, and V. K. Reddy</i>	
<b>Quantum mechanical treatment of Si-O bond breakage in Silica under time dependent dielectric breakdown testing.....</b>	<b>209</b>
<i>J.W. McPherson</i>	
<b>Lifetime prediction for CMOS devices with ultra thin gate oxides based on progressive breakdown.....</b>	<b>217</b>
<i>A. Kerber, M. Röhner, T. Pompl, R. Duschl, and M. Kerber</i>	

# Table of Contents

<b>Significance of breakdown location on post-breakdown transient and MOSFET degradation .....</b>	<b>221</b>
<i>K.L. Pey, T.A.L Selvarajoo, C.H. Tung, D.S. Ang, and V.L. Lo</i>	
<b>Reconsideration of hydrogen-related degradation mechanism in gate oxide .....</b>	<b>226</b>
<i>Y. Mitani, T.Yamaguchi, H.Satake, and A.Toriumi</i>	
<b>Analytic extension of the cell-based oxide breakdown model to full percolation and its implications.....</b>	<b>232</b>
<i>A.T. Krishnan and P.E. Nicollian</i>	
<b>Defects in organic molecular crystals: spectroscopy and effects on electronic and optical properties .....</b>	<b>240</b>
<i>O. Mitrofanov, T. Siegriest, D.V. Lang, C. Kloc, W.-Y. So, M.A. Sergent, and A.P. Ramirez</i>	
<b>Bias stress effects in organic thin film transistors.....</b>	<b>243</b>
<i>T.N. Ng, M.L. Chabinye, R.A. Street, and A. Salleo</i>	
<b>Mechanisms of operation and degradation in solution-processable organic photovoltaics.....</b>	<b>248</b>
<i>S. Shaheen</i>	
<b>OLED device operational lifetime: insights and challenges .....</b>	<b>253</b>
<i>S. Xia, R.C. Kwong, V. Adamovich, M.S. Weaver, and J.J. Brown.</i>	
<b>Ballistic phonon enhanced NBTI.....</b>	<b>258</b>
<i>Y. Wang, K.P. Cheung, A.S. Oates, and P. Mason</i>	
<b>Mechanism and modeling of PMOS NBTI degradation with drain bias .....</b>	<b>264</b>
<i>Y. Luo, J. Orona, D. Nayak, and D. Gitlin</i>	
<b>The universality of NBTI relaxation and its implications for modeling and characterization .....</b>	<b>268</b>
<i>T. Grasser, W. Gos, V. Sverdlov, and B. Kaczer</i>	
<b>Correction of self-heating for HCI lifetime prediction.....</b>	<b>281</b>
<i>J.M. Roux, X. Federspiel, D. Roy, and P. Abramowitz</i>	
<b>Consideration of recovery effects during NBTI measurements for accurate lifetime predictions of state-of-the-art pMOSFETs.....</b>	<b>288</b>
<i>W. Heinrichs, H. Reisinger, W. Gustin, and C. Schlünder</i>	
<b>(Invited) SEU and SET modeling and mitigation in deep submicron technologies .....</b>	<b>293</b>
<i>D.G. Mavis and P.H. Eaton</i>	
<b>Single event upsets in a 130 nm hardened latch design due to charge sharing .....</b>	<b>306</b>
<i>O.A. Amusan, A.L. Sternberg, A.F. Witulski, B.L. Bhuvu, J.D. Black, M.P. Baze, and L.W. Massengill</i>	
<b>Experimental characterization and application of circuit architecture level single event transient mitigation.....</b>	<b>312</b>
<i>K.C. Mohr and L.T. Clark</i>	
<b>Random dopant effect on VT variations affecting the soft-error rates of nanoscale CMOS memory cells.....</b>	<b>318</b>
<i>A. Balasubramanian, A.L. Sternberg, P.R. Fleming, B.L. Bhuvu, S. Kalemeris, and L.W. Massengill</i>	
<b>(Invited) Survey on very fast TLP and ultra fast repetitive pulsing for characterization in the CDM-Domain.....</b>	<b>324</b>
<i>H.A. Gieser and H. Wolf</i>	
<b>Effects of background doping concentration on ESD protection properties of high voltage operation extended drain N-type MOSFET device.....</b>	<b>334</b>
<i>K.-H. Kim, Y.-J. Seo, and W.-J. Choi</i>	
<b>Drain extended nMOS high current behavior and ESD protection strategy for HV applications in sub-100nm CMOS technologies.....</b>	<b>342</b>
<i>G. Boselli, V. Vassilev, and C. Duvvury</i>	
<b>Evaluation of SCR-based ESD protection devices in 90nm and 65nm CMOS technologies.....</b>	<b>348</b>
<i>J. Di Sarro, K. Chatty, R. Gauthier, and E. Rosenbaum</i>	

# Table of Contents

<b>External Latchup Characteristics Under Static And Transient Conditions In Advanced Bulk Cmos Technologies .....</b>	<b>358</b>
<i>D. Kontos, R. Gauthier, K. Chatty, K. Domanski, M. Muhammad, C. Seguin, and R. Halbach</i>	
<b>A comprehensive model for plasma damage enhanced transistor reliability degradation.....</b>	<b>364</b>
<i>W.T. Weng, A.S. Oates, and T.-Y. Huang</i>	
<b>Study of plasma damage at recess-channel gate (RG) structure during plasma nitridation .....</b>	<b>370</b>
<i>H.-J. Cho, T.-Y. Kim, S.-A. Jang, H. Ahn, Y.S. Kim, K.-Y. Lim, M.G. Sung, H.-S. Yang, S.-H. Phy, and J.W. Kim</i>	
<b>Impact of bottom interfacial layer on the threshold voltage and device reliability of fluorine incorporated PMOSFETs with high-k/metal gate .....</b>	<b>374</b>
<i>K. Choi, T. Lee, J. Barnett, H.R. Harris, S. Kweon, C.D. Young, G. Bersuker, R. Choi, S.C. Song, B.H. Lee, and R. Jammy</i>	
<b>Reliability investigations for bulk-FinFETs implementing partially-insulating layer.....</b>	<b>378</b>
<i>J. Park, J.-M. Park, S.-O. Sohn, J.- B. Lee, C.-H. Jeon, S.Y. Han, S. Yamada, W. Yang, Y. Roh, and D. Park</i>	
<b>The effect of metal area and line spacing on TDDDB characteristics of 45nm low-k SiCOH dielectrics .....</b>	<b>382</b>
<i>F. Chen, P. McLaughlin, J. Gambino, E. Wu, J. Demarest, D. Meatyard, and M. Shinosky</i>	
<b>Modeling of interconnect dielectric lifetime under stress conditions and new extrapolation methodologies for time-dependent dielectric breakdown.....</b>	<b>390</b>
<i>G.S. Haase and J.W. McPherson</i>	
<b>Time dependent dielectric breakdown characteristics of low-k dielectric (SIOC) over a wide range of test areas and electric fields .....</b>	<b>399</b>
<i>J. Kim, E.T. Ogawa, and J.W. McPherson</i>	
<b>Moisture related low-k dielectric reliability before and after thermal annealing.....</b>	<b>405</b>
<i>Y. Li, I. Ciofi, L. Carbonell, G. Groeseneken, K. Maex, and Z. Tokei</i>	
<b>Role of Cu in TDDDB of low-k dielectrics.....</b>	<b>410</b>
<i>J.R. Lloyd, S. Ponoth, E. Liniger, and S. Cohen</i>	
<b>Effect of scratch stress on the surface hardness and inner structures of a capacitive fingerprint sensor LSI .....</b>	<b>412</b>
<i>N. Shimoyama, S. Shigematsu, H. Morimura, T. Shimamura, T. Kumazaki, M. Nakanishi, H. Ishii, and K. Machida</i>	
<b>Time and voltage dependence of dielectric charging in RF MEMS capacitive switches.....</b>	<b>417</b>
<i>R.W. Herfst, P.G. Steeneken, and J. Schmitz</i>	
<b>A critical enhancement in the yield analysis of microsystems .....</b>	<b>422</b>
<i>P. Vudathu, D. Boning, and R.Laur</i>	
<b>Failure mechanisms in MEMS based silicon carbide high temperature pressure sensors.....</b>	<b>429</b>
<i>R.S. Okojie, P. Nguyen, V. Nguyen, E. Savrun, D. Lukco, J. Buehler, and T. McCue</i>	
<b>Extended reliability study of high density PZT capacitors: intrinsic lifetime determination and wafer level screening strategy .....</b>	<b>433</b>
<i>E. Bouyssou, G. Guégan, S. Bruyère, R. Pezzani, L. Berneux, L. Dantas de Morais, J.-P. Rebrassé, C. Anceau, and C. Nopper</i>	
<b>Time dependent Vccmin degradation of SRAM fabricated with high-k gate dielectrics .....</b>	<b>439</b>
<i>J.C. Lin, A.S. Oates, and C.H. Yu</i>	
<b>Erratic bit errors in latches.....</b>	<b>445</b>
<i>P. Relangi and S. Mitra</i>	
<b>Understanding SRAM high-temperature-operating-life NBTI: statistics and permanent vs recoverable damage.....</b>	<b>452</b>
<i>A. Haggag, G. Anderson, S. Parihar, D. Burnett, G. Abeln, J. Higman, and M. Moosa</i>	

# Table of Contents

<b>Reversible degradation of GaN LEDs related to passivation.....</b>	<b>457</b>
<i>M. Meneghini, L. Trevisanello, R. Penzo, M. Benedetti, U. Zehnder, U. Strauss, G. Meneghesso, and E. Zanoni</i>	
<b>Ultra-fast characterization of transient gate oxide trapping in SiC MOSFETs.....</b>	<b>462</b>
<i>M. Gurfinkel, J.S. Suehle, J.B. Bernstein, Y. Shapira, A.J. Lelis, D. Habersat, and N. Goldsman</i>	
<b>Investigating the stability of thin film transistors with zinc oxide as the channel layer .....</b>	<b>467</b>
<i>R.B.M. Cross and M.M. De Souza</i>	
<b>Accelerated RF life testing of GaN HFETs.....</b>	<b>472</b>
<i>A.M. Conway, M. Chen, P. Hashimoto, P.J. Willadsen, and M. Micovic</i>	
<b>Reliability assessment of 1.55-<math>\mu</math>m vertical cavity surface emitting lasers for optical communication systems .....</b>	<b>476</b>
<i>K.H. Rhew, S.C. Jeon, O-K. Kwon, D.H. Lee, B.S. Yoo, and I. Yun</i>	
<b>(Invited) Reliability of high power IGBT modules for traction applications .....</b>	<b>480</b>
<i>M. Ciappa and A. Castellazzi</i>	
<b>Investigation and improvement of fast temperature-cycle reliability for DMOS-related conductor path design .....</b>	<b>486</b>
<i>T. Smorodin, J. Wilde, P. Alpern, and M. Stecher</i>	
<b>A comprehensive model for hot carrier degradation in LDMOS transistors.....</b>	<b>492</b>
<i>P. Moens, J. Mertens, F. Bauwens, P. Joris, W. De Ceuninck, and M. Tack</i>	
<b>Photo misalignment impact on the hot carrier device reliability of lateral DMOS devices .....</b>	<b>498</b>
<i>D. Brisbin, P. Lindorfer, and P. Chaparala</i>	
<b>(Late) Location structure and density of states of NBTI-induced defects in plasma-nitrided pMOSFETs .....</b>	<b>503</b>
<i>J.P. Campbell, P.M. Lenahan, A.T. Krishnan, and S. Krishnan</i>	
<b>(Late) Reliability challenges in copper metallizations arising with the PVD resputter liner engineering for 65nm and beyond.....</b>	<b>511</b>
<i>A.H. Fischer, O. Aubel, J. Gill, T.C. Lee, B. Li, C. Christiansen, F. Chen, M. Angyal, T. Bolom, and E. Kaltalioglu</i>	
<b>High-resolution characterization of ultra-shallow junctions by scanning spreading resistance microscopy .....</b>	<b>516</b>
<i>L. Zhang, K. Adachi, H. Tanimoto, and A. Nishiyama</i>	
<b>Picosecond timing analysis in integrated circuits with pulsed laser stimulation.....</b>	<b>520</b>
<i>A. Douin, V. Pouget, D. Lewis, P. Fouillat, and P. Perdu</i>	
<b>Investigation of laser voltage probing signals in CMOS transistors .....</b>	<b>526</b>
<i>U. Kindereit, G. Woods, J. Tian, U. Kerst, and C. Boit</i>	
<b>(late) Phase variation mapping, a dynamic laser stimulation technique with picosecond timing resolution.....</b>	<b>534</b>
<i>K. Sanchez, P. Perdu, and F. Beaudoin</i>	
<b>(Invited) Data retention characterization of phase-change memory arrays.....</b>	<b>542</b>
<i>R. Gleixner and A. Pirovano, J. Sarkar, F. Ottogalli, E. Tortorelli, M. Tosi, and R. Bez</i>	
<b>A physics-based crystallization model for retention in phase-change memories .....</b>	<b>547</b>
<i>U. Russo, D. Ielmini, and A.L. Lacaita</i>	
<b>A Highly Reliable FRAM (Ferroelectric Random Access Memory) .....</b>	<b>554</b>
<i>J.-H. Kim, D. J. Jung, Y. M. Kang, H. H. Kim, W. W. Jung, J. Y. Kang, E. S. Lee, H. Kim, J. Y. Jung, S. K. Kang, Y. K. Hong, S. Y. Kim, H. K. Koh, D. Y. Choi, J. H. Park, S. Y. Lee, H. S. Jeong and K. Kim</i>	
<b>Novel cycling-induced program disturb of split gate flash memory.....</b>	<b>558</b>
<i>Y.-H. Wang, Y.-S. Tsair, A.-C. Kang, W.-T. Chu, E. Chen, J.R. Shih, H.W. Chin, and K. Wu</i>	
<b>An efficient certification approach for new Sn-Ag-Cu solder alloy .....</b>	<b>564</b>
<i>J. Masicat, C. Kumar, and M. Nuda</i>	

# Table of Contents

<b>The mixed-mode damage spectrum of SiGe HBTs .....</b>	<b>566</b>
<i>P. Cheng, C. Zhu, J.D. Cressler, and A. Joseph</i>	
<b>Temperature and voltage dependent RF degradation study in AlGaIn/GaN HEMTs.....</b>	<b>568</b>
<i>R. Coffie, Y. Chen, I. Smorchkova, B. Heying, V. Gambin, W. Sutton, Y.-C. Chou, W.-B. Luo, M. Wojtowicz, and A. Oki</i>	
<b>Correlating wafer-level TDDB lifetime projections to HTOL gate oxide failures .....</b>	<b>570</b>
<i>A. Ditali, H.A. Le, D.L. Butler, M. Ingram, and M. Ma</i>	
<b>The role of power dissipation on the progressive breakdown dynamics of ultra-thin gate oxides .....</b>	<b>572</b>
<i>E. Miranda</i>	
<b>A new “Multi-step” power-law TDDB lifetime model and boron penetration effect on TDDB of ultra thin oxide.....</b>	<b>574</b>
<i>P.J. Liao, C.L. Chen, C.J.Wang, and K. Wu</i>	
<b>A critical gate voltage triggering irreversible gate dielectric degradation .....</b>	<b>576</b>
<i>V.L. Lo, K.L. Pey, C.H. Tung, and D.S. Ang</i>	
<b>New insights on percolation theory and the origin of oxide breakdown thickness and process deposition dependence .....</b>	<b>578</b>
<i>G. Ribes, M. Rafik, D. Barge, S. Kalpat, M. Denais, V. Huard, and D. Roy</i>	
<b>Methodology for word line-contact dielectric characterization in flash NOR memories.....</b>	<b>580</b>
<i>G. Ghidini, R. Bottini, M. Brambilla, D. Brazzelli, N. Galbiati, A. Ghetti, A. Mauri, C. Scozzari and A. Sebastiani</i>	
<b>Reverse-body biasing for radiation-hard by design logic gates .....</b>	<b>582</b>
<i>L.T. Clark, K.C. Mohr, and K.E. Holbert</i>	
<b>Power performance characteristics of SiGe power HBTs at extreme temperatures .....</b>	<b>584</b>
<i>G. Wang, G. Qin, Z. Ma, P. Ma, M. Racanelli, and G.E. Ponchak</i>	
<b>ESD testing of aluminum and copper vertical parallel plate (VPP) capacitor structures.....</b>	<b>586</b>
<i>S.H. Voldman, E.G. Gebreselasie, and Z.-X. He</i>	
<b>A simple and useful layout scheme to achieve uniform current distribution for multi-finger silicided grounded-gate NMOS .....</b>	<b>588</b>
<i>J.-H. Lee, Y.-H. Wu, C.-H. Tang, T.-C. Peng, S.-H. Chen, and A.S. Oates</i>	
<b>Board level ESD of driver ICs on LCD panels.....</b>	<b>590</b>
<i>C.T. Hsu, J.C. Tseng, Y.L. Chen, F.Y. Tsai, S.H. Yu, P.A. Chen, and M.D. Ker</i>	
<b>Leakage suppression of low voltage transient voltage suppressor.....</b>	<b>592</b>
<i>S.-H. Dai, H.-N. Wang, M.-T. Chiang, C.-J. Lin, and Y.-C. King</i>	
<b>Design of high-voltage-tolerant power-rail ESD clamp circuit in low-voltage CMOS processes .....</b>	<b>594</b>
<i>M.-D. Ker, C.-T. Wang, T.-H. Tang, and K.-C. Su</i>	
<b>Novel Robust High Voltage ESD Clamps for LDMOS Protection .....</b>	<b>596</b>
<i>A.J. Walker, S.T. Ward, and H. Puchner</i>	
<b>Failure of on-chip power-rail ESD clamp circuits during system-level ESD test.....</b>	<b>598</b>
<i>C.-C. Yen and M.-D. Ker</i>	
<b>An investigation of external latchup .....</b>	<b>600</b>
<i>F. Farbiz and E. Rosenbaum</i>	
<b>Mixed device-circuit solution for ESD protection of high-voltage fast pins .....</b>	<b>602</b>
<i>V.A. Vashchenko, N. Olson, D. Farrenkopf, V. Kuznetsov, P. Hopper, and E. Rosenbaum</i>	
<b>25v ESD NPN transistor optimized by distributed emitter ballasting using emitter contact area segmentation.....</b>	<b>604</b>
<i>M. Denison, S. Murtaza, R. Steinhoff, S. Merchant, S. Pendharkar, S. Bychikhin, and D. Pogany</i>	

# Table of Contents

<b>A novel method for Guard ring efficiency assessment and its applications for ESD protection design and optimization</b> .....	606
<i>D. Trémouilles, M.I. Natarajan, M. Scholz, N. Azilah, M. Bafleur, M. Sawada, T. Hasebe, and G. Groeseneken</i>	
<b>An insight into the high current ESD behavior of drain extended NMOS (DENMOS) devices in nanometer scale CMOS technologies</b> .....	608
<i>A. Chatterjee, S. Pendharkar, Y.-Y. Lin , C. Duvvury, and K. Banerjee</i>	
<b>Limitation of WSix/WN diffusion barrier for tungsten dual polymetal gate memory devices</b> .....	610
<i>K.-Y. Lim, M.G. Sung, Y.S. Kim, H.-J. Cho, S.-R. Lee, S.-A. Jang, S.-G. Choi, Y.-J. Lee, T.-K. Oh, Y.-S. Chun, Y.-H. Kim, K.-S. Choi, K.O. Kim, Y.-K. Jung, S.-Y. Koo, W.-K. Ma, J.-H. Han, G.-H. Kim, S.-J. Kim, S.-R. Won, S.-A. Shin, J.-K. Lee, et al.</i>	
<b>Failure analysis of an anomalous subthreshold current in nano -scale NAND flash memory</b> .....	612
<i>D.-H. Lee, S.-W. Shin, C.-K. Ryu, J.-H. Choi, C.-M. Lim, N.-Y. Kwak, H.-S. Shon, J. Koo, K. Hong, B.-S. Lee, S.-K. Park, and S.-W. Park</i>	
<b>A new method for failure analysis with probing system based on a scanning electron microscope</b> .....	614
<i>T. Nokuo, Y. Eto, and Z. Marek</i>	
<b>Failure analysis and optimization of metal fuses for post package trimming</b> .....	616
<i>Y.-H. Cheng and C.E. Kendrick</i>	
<b>Maximum permissible EB acceleration voltage for SEM-based inspection before electrical characterization of advanced MOS</b> .....	618
<i>T. Mizuno, M. Takahashi, Y. Azuma, H. Yanagita, K. Asayama, and K. Nakamae</i>	
<b>Determination of intrinsic spectra from frontside &amp; backside photon emission spectroscopy</b> .....	620
<i>S.L. Tan, K.H. Toh, D.S.H. Chan, J.C.H. Phang, C.M. Chua, and L.S. Koh</i>	
<b>Investigation of hot carrier effects in n-MOSFETs thick oxide with HfSiON and SiON gate dielectrics</b> .....	622
<i>K.J. Nam, S.H. Lee, D.C. Kim, S.J. Hyun, J.H. Kim, I.S. Jeon, S.B. Kang, S.Y. Choi, U.I. Chung, and J.T. Moon</i>	
<b>BTI and electron trapping in Hf-based dielectrics with dual metal gates</b> .....	624
<i>Y.T. Hou, J.C. Liao, P.F. Hsu, C.L. Hung, K.C. Lin, K.T. Huang, T.L. Lee, Y.K. Fang, and M.S. Liang</i>	
<b>Hot carrier degradation of p-LDMOS transistors for RF applications</b> .....	626
<i>J. Kraft, B. Löffler, M. Knaipp, and E. Wachmann</i>	
<b>Leakage current characteristic of pre-damaged interlayer dielectric during voltage ramp method</b> .....	628
<i>S.-S. Hwang, S.-Y. Jung, and Y.-C. Joo</i>	
<b>New understanding of Metal-Insulator-Metal (MIM) capacitor degradation behavior</b> .....	630
<i>C.-C. Hung, A.S. Oates, H.C. Lin, P. Chang, J.L. Wang, C.C. Huang, and Y.W. Yau</i>	
<b>Test structure design for precise understanding of Cu/low-k dielectric reliability</b> .....	632
<i>T.L. Tan, C.L. Gan, A. Du, C.K. Cheng, C.M. Ng, and L. Chan</i>	
<b>Theoretical analysis of vacancy transportation combined with electromigration and stress induced voiding</b> .....	634
<i>T. Nemoto, A.T. Yokobori Jr., and T. Murakawa</i>	
<b>Characterization of electromigration parameters on single device</b> .....	636
<i>L. Doyen, X. Federspiel, D. Ney, E. Petitprez, V. Girault, L. Arnaud, and Y. Wouters</i>	
<b>New Degradation Phenomena Of Stress-Induced Voiding Inside ViaIn Copper Interconnects</b> .....	638
<i>H.Matsuyama, M.Shiozu, T.Kouno, T.Suzuki, H.Ehara, S.Otsuka, T.Hosoda, T.Nakamura, Y.Mizushima, M.Miyajima, K.Shono</i>	
<b>Characterization of degradation of 65nm node via chains and single vias</b> .....	640
<i>X.Federspiel, S.Courtas, and M. Gregoire</i>	
<b>On the interaction between inter-metal dielectric reliability and electromigration stress</b> .....	642
<i>Y. Li, C. Bruynseraede, G. Groeseneken, K. Maex, and Z. Tokei</i>	

# Table of Contents

<b>Hybrid grain-continuum model for thermo-mechanical stresses in polycrystalline Cu 3D IC vias</b> .....	644
<i>M.O. Bloomfield, D.N. Bentz, V. Sukharev, and T.S. Cale</i>	
<b>Influence of surface cleaning on stressvoiding and electromigration of CU damascene interconnection</b> .....	646
<i>J.-P. Wang, Y.-K. Su, and J.F. Chen</i>	
<b>Investigation of via bottom barrier integrity impact on electromigration</b> .....	648
<i>O. Aibel, S. Thierbach, F. Koschinsky, F. Feustel, C.S. Hau-Riege, and C. Zistl</i>	
<b>Effect of interface buffer layer on the reliability of ultra-thin MgO magnetic tunnel junctions for spin transfer switching MRAM</b> .....	650
<i>K. Hosotani, Y. Asao, M. Nagamine, T. Ueda, H. Aikawa, N. Shimomura, S. Ikegawa, T. Kajiyama, S. Takahashi, A. Nitayama, and H. Yoda</i>	
<b>Improving the endurance characteristics through boron implant at active edge in 1 G NAND flash</b> .....	652
<i>D. Kang, S. Chang, S. Seo, Y. Song, H. Yoon, E. Lee, D. Chang, W. Lee, B.-G. Park, J. D. Lee, I. H. Park, S. Kang, and H. Shin</i>	
<b>Hole distributions in NROM devices: profiling technique and correlation to memory retention</b> .....	654
<i>A. Padovani, L. Larcher, and P. Pavan</i>	
<b>Measurement technique of carrier mobility in silicon nitride and its application to data retention in MONOS memories</b> .....	656
<i>K. Katayama</i>	
<b>Role of oxide/nitride interface traps on the nanocrystal memory characteristics</b> .....	658
<i>A. Gasperin, A. Cester, N. Wrachien, A. Paccagnella, C. Gerardi, and V. Ancarani</i>	
<b>Reliability studies on non planar DRAM cell transistor</b> .....	660
<i>M.J. Lee, S. Jin, C.-K. Baek, S.-M. Hong, S.-Y. Park, H.-H. Park, S.-D. Lee, S.-W. Chung, J.-G. Jeong, S.-J. Hong, S.-W. Park, I.-Y. Chung, Y.J. Park, and H.S. Min</i>	
<b>Reliability of a 90nm embedded multi-time programmable logic NVM using work-function engineered tunneling device</b> .....	662
<i>B. Wang, Y. Ma, A. Horch, and R. Paulsen</i>	
<b>Impact of gate tunneling leakage on performances of phase locked loop circuit in nanoscale CMOS technology</b> .....	664
<i>J.-S. Chen and M.-D. Ker</i>	
<b>Product burn-in stress impacts on SRAM array performance</b> .....	666
<i>L. Wang, Q. Ye, R. Wong, and M. Liehr</i>	
<b>On the 6T-SRAM cells degradation characterization in ultra-scaled CMOS technologies</b> .....	668
<i>E. Nowak, M. Denais, and N. Gierczynski</i>	
<b>Improved hot carrier reliability in strained-channel NMOSFETs with TEOS buffer layer</b> .....	670
<i>C.-S. Lu, H.-C. Lin, Y.-J. Lee, and T.-Y. Huang</i>	
<b>Effect of in situ plasma treatment on high-k films after high-k removal with plasma etching from the S/D region</b> .....	672
<i>B.S. Ju, S.C. Song, T.H. Lee, B. Sassman, C.Y. Kang, B.H. Lee, and R. Jammy</i>	
<b>High pressure deuterium annealing effect on nano-scale strained CMOS devices</b> .....	674
<i>S.-M. Cho, J.-H. Lee, M. Chang, M.-S. Jo, H.-S. Hwang, J.-k. Lee, S.-B. Hwang, and J.-H. Lee</i>	
<b>Quantifying the effectiveness of guard bands in reducing the collected charge leading to soft errors</b> .....	676
<i>B. Narasimham, R.L. Shuler, J.D. Black, B.L. Bhuvu, R.D. Schrimpf, A.F. Witulski, W.T. Holman, and L.W. Massengill</i>	
<b>A quantitative analysis of neutron-induced multi-cell upset in deep submicron SRAMs and of the impact due to anomalous noise</b> .....	678
<i>H. Kameyama, Y. Yahagi, and E. Ibe</i>	

# Table of Contents

<b>The influence of gate poly-silicon oxidation on negative bias temperature instability in 3D FinFET.....</b>	<b>680</b>
<i>H. Lee, C.-H. Lee, D. Park, and Y.-K. Choi</i>	
<b>Degradation dependent on channel width in sequential lateral solidified poly-si thin film transistors .....</b>	<b>682</b>
<i>H.-Y. Liang, S.-I. Hsieh, H.-T. Chen, C.-J. Lin, and Y.-C. King</i>	
<b>Hot carrier reliability of strained N-MOSFET with lattice mismatched source/drain stressors.....</b>	<b>684</b>
<i>K.-W. Ang, C. Wan, K.-J. Chui, C.-H. Tung, N. Balasubramanian, M.-F. Li, G. Samudra, and Y.-C. Yeo</i>	
<b>Novel positive bias temperature instability (PBTI) of n-channel MOSFETs with plasma-nitrided oxide.....</b>	<b>686</b>
<i>V. Huard, C. Guerin, and C. Parthasarthy</i>	
<b>The impact of nitrogen on the frequency dependence of negative-bias temperature instability .....</b>	<b>688</b>
<i>S. Wang, D.S. Ang, and G.A. Du</i>	
<b>History dependent recovery of NBTI under alternating DC and AC stress.....</b>	<b>690</b>
<i>H. Kufluoglu, C. Prasad, and M. Agostinelli</i>	
<b>The energy-driven hot carrier degradation modes.....</b>	<b>692</b>
<i>C. Guerin, V. Huard, and A. Bravaix</i>	
<b>An investigation of self-heating degradation of metal induced laterally crystallized n-type polysilicon thin film transistors .....</b>	<b>694</b>
<i>H. Wang, M. Wang, Z. Yang, and M. Wong</i>	
<b>Unified perspective of NBTI and hot-carrier degradation in CMOS using on-the-fly bias patterns .....</b>	<b>696</b>
<i>C.R. Parthasarathy, M. Denais, V. Huard, C. Guerin, G. Ribes, E. Vincent, and A.Bravaix</i>	