

IEEE TRANSACTIONS ON ELECTRON DEVICES

A PUBLICATION OF THE IEEE ELECTRON DEVICES SOCIETY



APRIL 2016

VOLUME 63

NUMBER 4

IETDAI

(ISSN 0018-9383)

EDITORIAL

- Changes in the Editorial Board *G. Ghione* 1400
-

REGULAR PAPERS

Silicon and Column IV Semiconductors Devices

- Dual-Gate JFET Modeling I: Generalization to Include MOS Gates and Efficient Method to Calculate Drain-Source Saturation Voltage *K. Xia, C. C. McAndrew, and B. Grote* 1408

- Dual-Gate JFET Modeling II: Source Pinchoff Voltage and Complete I_{ds} Modeling Formalism *K. Xia, C. C. McAndrew, and B. Grote* 1416

- The Work Function Behavior of Aluminum-Doped Titanium Carbide Grown by Atomic Layer Deposition *J. Moon, H. J. Ahn, Y. Seo, T. I. Lee, C.-K. Kim, I. C. Rho, C. H. Kim, W. S. Hwang, and B. J. Cho* 1423

- A Stand-Alone, Physics-Based, Measurement-Driven Model and Simulation Tool for Random Telegraph Signals Originating From Experimentally Identified MOS Gate-Oxide Defects *M. Nour, Z. Çelik-Butler, A. Sonnet, F.-C. Hou, S. Tang, and G. Mathur* 1428

- Solution-Based CdS on HfO₂ Thin Films for High-Gain and Low-Voltage Unipolar Inverters *I. Mejia, G. Gutierrez-Heredia, A. L. Salas-Villasenor, C. G. Alvarado-Beltran, C. Avila-Avendano, and M. A. Quevedo-Lopez* 1437

Compound Semiconductor Devices

- Reverse Gate-Current of AlGaN/GaN HFETs: Evidence of Leakage at Mesa Sidewalls *H. Rahbardar Mojaver and P. Valizadeh* 1444

- Effect of Sputtered-Al₂O₃ Layer Thickness on the Threshold Voltage of III-Nitride MIS-HEMTs *G. Dutta, N. DasGupta, and A. DasGupta* 1450

- Electroluminescence Microscopy of Cross-Sectioned AlGaN/GaN High-Electron Mobility Transistors *A. M. Hilton, E. R. Heller, and D. L. Dorsey* 1459
-

(Contents Continued on Page 1397)



Analysis of Resistance and Mobility in InGaAs Quantum-Well MOSFETs From Ballistic to Diffusive Regimes	1464
..... <i>J. Lin, Y. Wu, J. A. del Alamo, and D. A. Antoniadis</i>	
Effect of Polarization Coulomb Field Scattering on Parasitic Source Access Resistance and Extrinsic Transconductance in AlGaN/GaN Heterostructure FETs	1471
..... <i>M. Yang, Z. Lin, J. Zhao, P. Cui, C. Fu, Y. Lv, and Z. Feng</i>	
A Comprehensive Compact Model for GaN HEMTs, Including Quasi-Steady-State and Transient Trap-Charge Effects	1478
..... <i>B. Syamal, X. Zhou, S. B. Chiah, A. M. Jesudas, S. Arulkumaran, and G. I. Ng</i>	
Hot-Carrier Degradation in GaN HEMTs Due to Substitutional Iron and Its Complexes	1486
..... <i>S. Mukherjee, Y. Puzyrev, J. Chen, D. M. Fleetwood, R. D. Schrimpf, and S. T. Pantelides</i>	
Memory Devices and Technology	
Array Operation Mode Characterization of Select Gate Lateral Coupling Single-Poly Embedded Nonvolatile Memory	1495
..... <i>S.-K. Park, N.-Y. Kim, and K.-I. Choi</i>	
Analysis of 7/8-nm Bulk-Si FinFET Technologies for 6T-SRAM Scaling	1502
..... <i>X. Zhang, D. Connelly, P. Zheng, H. Takeuchi, M. Hytha, R. J. Mears, and T.-J. K. Liu</i>	
Neuromorphic Learning and Recognition With One-Transistor-One-Resistor Synapses and Bistable Metal Oxide RRAM	1508
..... <i>S. Ambrogio, S. Balatti, V. Milo, R. Carboni, Z.-Q. Wang, A. Calderoni, N. Ramaswamy, and D. Ielmini</i>	
Compact Modeling of Negative V_t Shift Disturb in NAND Flash Memories	1516
..... <i>C. Zambelli, F. Andrian, S. Aritome, and P. Olivo</i>	
Modeling and Optimization of Bilayered TaO_x RRAM Based on Defect Evolution and Phase Transition Effects	1524
..... <i>Y. Zhao, P. Huang, Z. Chen, C. Liu, H. Li, B. Chen, W. Ma, F. Zhang, B. Gao, X. Liu, and J. Kang</i>	
Diode-Type NAND Flash Memory Cell String Having Super-Steep Switching Slope Based on Positive Feedback	1533
..... <i>S.-M. Joe, H.-J. Kang, N. Choi, M. Kang, B.-G. Park, and J.-H. Lee</i>	
Effect of Ti Content on the Structural and Electrical Characteristics of $ErTi_xO_y$ Charge Storage Layer in InGaZnO Thin-Film Transistor Nonvolatile Memories	1539
..... <i>T.-M. Pan, C.-H. Chen, Y.-H. Hu, and J.-L. Her</i>	
Thin Film Transistors	
Mobility Enhancement in RF-Sputtered MgZnO/ZnO Heterostructure Thin-Film Transistors	1545
..... <i>B.-S. Wang, Y.-S. Li, and I.-C. Cheng</i>	
Wavy Channel TFT-Based Digital Circuits	1550
..... <i>A. N. Hanna, A. Hussain, H. Omran, S. M. Alsharif, K. N. Salama, and M. M. Hussain</i>	
High Performance and Stable Flexible Memory Thin-Film Transistors Using In-Ga-Zn-O Channel and ZnO Charge-Trap Layers on Poly(Ethylene Naphthalate) Substrate	1557
..... <i>S.-J. Kim, M.-J. Park, D.-J. Yun, W.-H. Lee, G.-H. Kim, and S.-M. Yoon</i>	
Mechanism of Hysteresis for a-IGZO TFT Studied by Changing the Gate Voltage Waveform in Measurement	1565
..... <i>Y.-J. Chen, Y.-H. Tai, and C.-Y. Chang</i>	
Investigations on the Gate-Induced Drain Leakage Current of Polycrystalline-Silicon Thin-Film Transistor and Its Suppression With Drain Bias Sweep	1572
..... <i>D. Zhang, M. Wang, H. Wang, and Q. Shan</i>	
Photoluminescence and Reliability Study of ZnO Cospattered IGZO Thin-Film Transistors Under Various Ambient Conditions	1578
..... <i>N. Tiwari, R. N. Chauhan, H.-P. D. Shieh, P.-T. Liu, and Y.-P. Huang</i>	
Optoelectronics, Displays, and Imaging	
Intrinsic Photoconductive Switches Based on Semi-Insulator 4H-SiC	1582
..... <i>S. Jiang, C. Song, L. Zhang, Y. Zhang, W. Huang, and H. Guo</i>	
Vertical LEDs on Rigid and Flexible Substrates Using GaN-on-Si Epilayers and Au-Free Bonding	1587
..... <i>X. Zou, X. Zhang, W. C. Chong, C. W. Tang, and K. M. Lau</i>	
Te Doping Effect of InGaP in Tunnel Junction on the Performance of InGaP/InGaAs/Ge Triple-Junction Solar Cells	1594
..... <i>S. H. Jung, C. Z. Kim, Y. Kim, D. H. Jun, H. Kim, and H. K. Kang</i>	
Effects of Internal Gain and Illumination-Induced Stored Charges in MgZnO Metal–Semiconductor–Metal Photodetectors	1600
..... <i>P. Wang, Z. Song, J. He, X. Guo, Y. Wang, L. Qiu, L. Guo, and Y. Yang</i>	
Scaling Analysis of High Gain Monolayer MoS ₂ Photodetector for Its Performance Optimization	1608
..... <i>W. Chen, W.-Y. Yin, W.-S. Zhao, R. Hao, E. Li, K. Kang, and J. Guo</i>	
Performance of Flexible Photovoltaic Modules Encapsulated by Silicon Oxide/Organic Silicon Stacked Layers	1615
..... <i>S.-Y. Lien, Y.-S. Lin, Y.-S. Cho, and D.-S. Wuu</i>	
Solid-State Power and High Voltage Devices	
On the Geometrically Dependent Quasi-Saturation and g_m Reduction in Advanced DeMOS Transistors	1621
..... <i>P. S. Swain, M. Shrivastava, M. S. Baghini, H. Gossner, and V. R. Rao</i>	

Area-Efficient Bevel-Edge Termination Techniques for SiC High-Voltage Devices	W. Sung, B. J. Baliga, and A. Q. Huang	1630
High-Voltage Thin-SOI LDMOS With Ultralow ON-Resistance and Even Temperature Characteristic	J. Wei, X. Luo, Y. Zhang, P. Li, K. Zhou, B. Zhang, and Z. Li	1637
Electrical Parameters Degradations and Optimizations of SOI-LIGBT Under Repetitive Unclamped-Inductive-Switching Conditions	S. Liu, R. Ye, W. Sun, C. Zhang, J. Wei, W. Su, A. Zhang, and S. Ma	1644
Materials, Processing and Packaging		
Effects of Deposition Process on Poly-Si Microscale Energy Harvesting Systems: A Simulation Study	E. S. Mungan, C. Lu, C.-H. Ho, and K. Roy	1650
Solid State Device Phenomena		
Low-Frequency Noise Analysis and Modeling in Vertical Tunnel FETs With Ge Source	F. S. Neves, P. G. D. Agopian, J. A. Martino, B. Cretu, R. Rooyackers, A. Vandooren, E. Simoen, A. V-Y. Thean, and C. Claeys	1658
Molecular and Organic Devices		
A Frequency-Dependent Capacitance–Voltage Model for Thin-Film Transistors	X. Guo, M. Wang, and Z. Han	1666
Sensors and Actuators		
Magnetic Pattern Recognition Using Injection-Locked Spin-Torque Nano-Oscillators	K. Yogendra, D. Fan, B. Jung, and K. Roy	1674
Steep Subthreshold Switching With Nanomechanical FET Relays	D. Unluer and A. W. Ghosh	1681
Restraining IPMC Back Relaxation in Large Bending Displacements: Applying Non-Feedback Local Gaussian Disturbance by Patterned Electrodes	M. Annabestani, M. Maymandi-Nejad, and N. Naghavi	1689
Design Optimization of Thin-Film Transistors Based on a Metal–Substrate–Semiconductor Architecture for High DC Voltage Sensing	S. R. Udatha, A. Ruhela, G. Saravanel, V. Yaswant, J. Singh, and S. Sambandan	1696
Vacuum Electron Devices		
Generation and Formation of Axially Symmetrical Tubular Electron Beam in a Cold Metal Secondary-Emission Cathode Magnetron Gun—Part I: Experiment	N. I. Aizatsky, G. I. Churyumov, A. N. Dovbnya, V. V. Zakutin, N. G. Reshetnyak, and Y. L. Starchevskiy	1704
Generation and Formation of Axially Symmetrical Tubular Electron Beam in a Cold Metal Secondary-Emission Cathode Magnetron Gun—Part II: Computer Modeling	N. I. Aizatsky, G. I. Churyumov, A. N. Dovbnya, V. V. Zakutin, N. G. Reshetnyak, and Y. L. Starchevskiy	1710
Development of Nanoparticle-Based High Current Density Cathode for THz Devices Application	R. K. Barik, A. K. Singh, S. Shukla, T. P. Singh, R. S. Raju, and G.-S. Park	1715
H-Plane and E-Plane Loaded Rectangular Slow-Wave Structure for Terahertz TWT Amplifier	L. R. Billa, M. N. Akram, and X. Chen	1722
Investigation of Nanosized-Scandia-Doped Dispenser Cathodes With Machined Surfaces	F. Yang, J. Wang, Y. Wang, W. Liu, and X. Zhu	1728
A Numerical Model for Mode Characteristic Analyses of a Rectangular Cavity Loaded With Two Parallel Ladders	C. Zhang, S. Lü, and D. Zhao	1734
Emerging Technologies and Devices		
High-Performance Plasmonic THz Detector Based on Asymmetric FET With Vertically Integrated Antenna in CMOS Technology	M. W. Ryu, J. S. Lee, K. S. Kim, K. Park, J.-R. Yang, S.-T. Han, and K. R. Kim	1742
Improving FET Properties of Semiconducting Single-Walled Carbon Nanotubes by Selective Extraction	Z.-D. Lin, S.-J. Young, and S.-J. Chang	1749
Design Requirements for a Spintronic MTJ Logic Device for Pipelined Logic Applications	Y. Kang, J. Bokor, and V. Stojanović	1754
Compact Model of Dielectric Breakdown in Spin-Transfer Torque Magnetic Tunnel Junction	Y. Wang, H. Cai, L. A. B. Naviner, Y. Zhang, X. Zhao, E. Deng, J.-O. Klein, and W. Zhao	1762
Demonstration of a Highly Tunable Hybrid nMOS-Magnetic-Tunnel-Junction Ring Oscillators	R. Choi, J. J. Kan, S. H. Kang, and E. E. Fullerton	1768
BRIEF PAPERS		
Demonstration of L-Shaped Tunnel Field-Effect Transistors	S. W. Kim, J. H. Kim, T.-J. K. Liu, W. Y. Choi, and B.-G. Park	1774
A Low-Power High-Stability Flexible Scan Driver Integrated by IZO TFTs	L.-R. Zhang, C.-Y. Huang, G.-M. Li, L. Zhou, W.-J. Wu, M. Xu, L. Wang, H.-L. Ning, R.-H. Yao, and J.-B. Peng	1779

(Contents Continued from Page 1398)

Modeling of the SiO ₂ /SiC Interface-Trapped Charge as a Function of the Surface Potential in 4H-SiC Vertical-DMOSFET	<i>G. D. Licciardo, L. Di Benedetto, and S. Bellone</i>	1783
Investigation Into Gate-to-Source Capacitance Induced by Highly Efficient Band-to-Band Tunneling in p-Channel Ge Epitaxial Tunnel Layer Tunnel FET	<i>P.-Y. Wang and B.-Y. Tsui</i>	1788
A CCCS-Based Approach to Modeling of Thermal Coupling	<i>Y. Li and G. Niu</i>	1791
CORRESPONDENCE		
Low Interface Trap Density and High Breakdown Electric Field SiN Films on GaN Formed by Plasma Pretreatment Using Microwave-Excited Plasma-Enhanced Chemical Vapor Deposition	<i>T. Watanabe, A. Teramoto, Y. Nakao, S. Sugawa, and T. Ohmi</i>	1795
ANNOUNCEMENTS		
Call for Papers—2016 IEEE International Interconnect Technology Conference/Advanced Metallization Conference (IITC/AMC)		1802
Call for Papers—2016 IEEE 43rd Photovoltaic Specialists Conference (PVSC) Plenary Speakers		1803
Call for Papers—2016 IEEE PVSC Women in PV		1804
