

ПИ
T-68/4е3

TRANSACTIONS ON ELECTRON DEVICES

A PUBLICATION OF THE IEEE ELECTRON DEVICES SOCIETY



MAY 2014

VOLUME 61

NUMBER 5

IETDAI

(ISSN 0018-9383)

EDITORIAL

A Stellar Cadre of Retiring T-ED Editors	J. D. Cressler	1220
A Warm Welcome to A New T-ED Editor	J. D. Cressler	1221

REGULAR PAPERS

Silicon and Column IV Semiconductors Devices

7-nm FinFET CMOS Design Enabled by Stress Engineering Using Si, Ge, and Sn	S. Gupta, V. Moroz, L. Smith, Q. Lu, and K. C. Saraswat	1222
Minimized Device Junction Leakage Current at Forward-Bias Body and Applications for Low-Voltage Quadruple-Stacked Common-Gate Amplifier	T.-P. Wang	1231
Effects of Standard Free Energy on NiO Bipolar Resistive Switching Devices	G. Ma, X. Tang, H. Su, Y. Li, H. Zhang, and Z. Zhong	1237
Oxygen-Related Thermal Donor Formation in Dopant-Rich Compensated Czochralski Silicon	F. Tanay, S. Dubois, J. Veirman, N. Enjalbert, J. Stendera, and I. Péricaud	1241
A Novel Programming Technique to Boost Low-Resistance State Performance in Ge-Rich GST Phase Change Memory	A. Kiouseloglou, G. Navarro, V. Sousa, A. Persico, A. Roule, A. Cabrini, G. Torelli, S. Maitrejean, G. Reimbold, B. D. Salvo, F. Clermidy, and L. Perniola	1246
Characterization of Interconnect Process Variation in CMOS Using Electrical Measurements and Field Solver	J. J. Lim, N. A. Johari, S. C. Rustagi, and N. D. Arora	1255
A Simulation Study of Oxygen Vacancy-Induced Variability in HfO ₂ /Metal Gated SOI FinFET	A. R. Trivedi, T. Ando, A. Singhee, P. Kerber, E. Acar, D. J. Frank, and S. Mukhopadhyay	1262
Analysis of Gate-Induced Drain Leakage Mechanisms in Silicon-Germanium Channel pFET	V. A. Tiwari, D. Jaeger, A. Scholze, and D. R. Nair	1270

(Contents Continued on Page 1217)

The Degradation Process of High- <i>k</i> SiO ₂ /HfO ₂ Gate-Stacks: A Combined Experimental and First Principles Investigation	E. Nadimi, G. Roll, S. Kupke, R. Ötting, P. Plöditz, C. Radehaus, M. Schreiber, R. Agaiby, M. Trentzsch, S. Knebel, S. Slesazeck, and T. Mikolajick	1278
A Comparative Study on the Impacts of Interface Traps on Tunneling FET and MOSFET	Y. Qiu, R. Wang, Q. Huang, and R. Huang	1284
Modeling Carrier Mobility in Nano-MOSFETs in the Presence of Discrete Trapped Charges: Accuracy and Issues	S. M. Amoroso, L. Gerrer, M. Nedjalkov, R. Hussin, C. Alexander, and A. Asenov	1292
Evaluation and Solutions for P/E Window Instability Induced by Electron Trapping in High- <i>k</i> Intergate Dielectrics of Flash Memory Cells	B. Tang, W. D. Zhang, R. Degraeve, L. Breuil, P. Blomme, J. F. Zhang, Z. Ji, M. Zahid, M. Toledano-Luque, G. V. den Bosch, and J. V. Houdt	1299
Characterization of Negative-Bias Temperature Instability of Ge MOSFETs With GeO ₂ /Al ₂ O ₃ Stack	J. Ma, J. F. Zhang, Z. Ji, B. Benbakhti, W. D. Zhang, X. F. Zheng, J. Mitard, B. Kaczer, G. Groeseneken, S. Hall, J. Robertson, and P. R. Chalker	1307
Compound Semiconductor Devices		
Gate Bias Dependence of Defect-Mediated Hot-Carrier Degradation in GaN HEMTs	Y. Puzyrev, S. Mukherjee, J. Chen, T. Roy, M. Silvestri, R. D. Schrimpf, D. M. Fleetwood, J. Singh, J. M. Hinckley, A. Paccagnella, and S. T. Pantelides	1316
Bistability Characteristics of GaN/AlN Resonant Tunneling Diodes Caused by Intersubband Transition and Electron Accumulation in Quantum Well	M. Nagase and T. Tokizaki	1321
Impact of Bias and Device Structure on Gate Junction Temperature in AlGaN/GaN-on-Si HEMTs	B. K. Schwitter, A. E. Parker, S. J. Mahon, A. P. Fattolini, and M. C. Heimlich	1327
Strain-Modulated L-Valley Ballistic-Transport in (111) GaAs Ultrathin-Body nMOSFETs	K. Alam, S. Takagi, and M. Takenaka	1335
Effect of GaN Channel Layer Thickness on DC and RF Performance of GaN HEMTs With Composite AlGaN/GaN Buffer	X. Wang, S. Huang, Y. Zheng, K. Wei, X. Chen, H. Zhang, and X. Liu	1341
UV Photodetector of a Homojunction Based on p-Type Sb-Doped ZnO Nanoparticles and n-Type ZnO Nanowires	C.-L. Hsu, K.-C. Chen, and T.-J. Hsueh	1347
High Performance Tri-Gate Extremely Thin-Body InAs-On-Insulator MOSFETs With High Short Channel Effect Immunity and <i>V_{th}</i> Tunability	S.-H. Kim, M. Yokoyama, R. Nakane, O. Ichikawa, T. Osada, M. Hata, M. Takenaka, and S. Takagi	1354
Memory Devices and Technology		
Effects of Dopant-Segregated Profiles on Schottky Barrier Charge-Trapping Flash Memories	C.-H. Shih and Y.-X. Luo	1361
Crossbar RRAM Arrays: Selector Device Requirements During Read Operation	J. Zhou, K.-H. Kim, and W. Lu	1369
3-D Cross-Point Array Operation on AlO _y /HfO _x -Based Vertical Resistive Switching Memory	B. Gao, B. Chen, R. Liu, F. Zhang, P. Huang, L. Liu, X. Liu, J. Kang, H.-Y. (Henry) Chen, S. Yu, and H.-S. P. Wong	1377
Electromechanical Diode Cell Scaling for High-Density Nonvolatile Memory	L. Hutin, W. Kwon, C. Qian, and T.-J. K. Liu	1382
Highly Transparent Dysprosium Oxide-Based RRAM With Multilayer Graphene Electrode for Low-Power Nonvolatile Memory Application	H. Zhao, H. Tu, F. Wei, and J. Du	1388
A Combined <i>Ab Initio</i> and Experimental Study on the Nature of Conductive Filaments in Pt/HfO ₂ /Pt Resistive Random Access Memory	K.-H. Xue, B. Traoré, P. Blaise, L. R. C. Fonseca, E. Vianello, G. Molas, B. D. Salvo, G. Ghibaudo, B. Magyari-Köpe, and Y. Nishi	1394
Thin Film Transistors		
Effect of UV-Ozone Treatment on the Performance of ZnO TFTs Fabricated by RF Sputtering Deposition Technique...J.-L. Wu, H.-Y. Lin, P.-H. Kuo, B.-Y. Su, S.-Y. Chu, Y.-C. Chen, S.-Y. Liu, C.-C. Chang, and C.-J. Wu	1403	
Study of the Characteristics of Solid Phase Crystallized Bridged-Grain Poly-Si TFTs	W. Zhou, S. Zhao, R. Chen, M. Zhang, J. Y. L. Ho, M. Wong, and H.-S. Kwok	1410
Implementation of Film Profile Engineering in the Fabrication of ZnO Thin-Film Transistors	R.-J. Lyu, H.-C. Lin, and T.-Y. Huang	1417
Analog Characteristics of Fully Printed Flexible Organic Transistors Fabricated With Low-Cost Mass-Printing Techniques	B. Kheradmand-Boroujeni, G. C. Schmidt, D. Höft, R. Shabanpour, C. Perumal, T. Meister, K. Ishida, C. Carta, A. C. Hübler, and F. Ellinger	1423

Instability Induced by Ultraviolet Light in ZnO Thin-Film Transistors	1431
..... P. Wu, J. Zhang, J. Lu, X. Li, C. Wu, R. Sun, L. Feng, Q. Jiang, B. Lu, X. Pan, and Z. Ye	
Optoelectronics, Displays, and Imaging	
Thin-Film Transistor V_{th} Shift Model Based on Kinetics of Electron Transfer in Gate Dielectric	1436
..... L. L. Wang, T. C. Liu, Y. Cai, and S. Zhang	
Fabrication of Single Si Nanowire Metal–Semiconductor–Metal Device for Photodetection	1444
..... K. Das, S. Samanta, P. Kumar, K. S. Narayan, and A. K. Raychaudhuri	
Solid-State Power and High Voltage Devices	
Design of a Reliable p-Channel LDMOS FET With RESURF Technology	1451
..... T. Miyoshi, T. Tominari, H. Fujiwara, T. Oshima, and J. Noguchi	
Physics of the Negative Resistance in the Avalanche I – V Curve of Field Stop IGBTs: Collector Design Rules for Improved Ruggedness	1457
..... P. Spirito, G. Breglio, A. Irace, L. Maresca, E. Napoli, and M. Riccio	
Single-Event Burnout Hardening of Power UMOSFETs With Integrated Schottky Diode	1464
..... Y. Wang, C.-H. Yu, Z. Dou, and W. Xue	
Materials, Processing and Packaging	
Significantly Enhanced Inductance and Quality Factor of GHz Integrated Magnetic Solenoid Inductors With FeGaB/Al ₂ O ₃ Multilayer Films	1470
..... Y. Gao, S. Z. Zardareh, X. Yang, T. X. Nan, Z. Y. Zhou, M. Onabajo, M. Liu, A. Aronow, K. Mahalingam, B. M. Howe, G. J. Brown, and N. X. Sun	
Solid State Device Phenomena	
Plasmon Resonance Effects in GaAs/AlGaAs Heterojunction Devices: An Analysis Based on Spectral Element Simulation	1477
..... F. Li, Q. H. Liu, and D. P. Klemer	
Modeling Illumination Effects on n- and p-Type InGaAs MOS at Room and Low Temperatures	1483
..... H.-P. Chen, D. Veksler, G. Bersuker, and Y. Taur	
Band-Edge Steepness Obtained From Esaki/Backward Diode Current–Voltage Characteristics	1488
..... S. Agarwal and E. Yablonovitch	
A 2-D Analytical Model for Double-Gate Tunnel FETs	1494
..... M. Gholizadeh and S. E. Hosseini	
Experimental Evidence Toward Understanding Charge Pumping Signals in 3-D Devices With Poly-Si Channel	1501
..... B. Tang, W. Zhang, M. Toledano-Luque, J. F. Zhang, R. Degraeve, Z. Ji, A. Arreghini, G. V. den Bosch, and J. V. Hoult	
Molecular and Organic Devices	
Submicrometer Organic Thin-Film Transistors: Technology Assessment Through Noise Margin Analysis of Inverters	1508
..... F. Zanella, N. Marjanović, R. Ferrini, F. X. Pengg, C. C. Enz, and J.-M. Salles	
Nanoimprint Lithography-Structured Organic Electrochemical Transistors and Logic Circuits	1515
..... T. Rothländer, P. C. Hütter, E. Renner, H. Gold, A. Haase, and B. Stadlober	
Sensors and Actuators	
Low-Voltage Field Ionization of Gases Up to Torr-Level Pressures Using Massive Arrays of Self-Aligned Gated Nanoscale Tips	1520
..... A. A. Fomani, L. F. Velásquez-García, and A. I. (Tayo) Akinwande	
Analysis of Linearity Deterioration in Multidevice RF MEMS Circuits	1529
..... U. Shah, M. Sterner, and J. Oberhammer	
Vacuum Electron Devices	
Multistage Depressed Collector With Improved Thermal Management for High Efficiency Travelling Wave Tubes	1536
..... A. M. Latha, V. Gahlaut, R. K. Sharma, V. Srivastava, and S. K. Ghosh	
UV Enhanced Field Emission Performance of Mg-Doped ZnO Nanorods	1541
..... Y. H. Liu, S.-J. Young, L. W. Ji, T. H. Meen, C. H. Hsiao, C. S. Huang, and S.-J. Chang	
Accurate Numerical Method for Multipactor Analysis in Microwave Devices	1546
..... J. W. You, H. G. Wang, J. F. Zhang, S. R. Tan, and T. J. Cui	
Emerging Technologies and Devices	
Circuit Simulation of Magnetization Dynamics and Spin Transport	1553
..... P. Bonhomme, S. Manipatruni, R. M. Iraei, S. Rakheja, S.-C. Chang, D. E. Nikonorov, I. A. Young, and A. Naeemi	
Stability of Ionic Liquid-Gated Metal Oxides and Transistors	1561
..... S. Bubel, S. Meyer, and M. L. Chabinyc	
Simulation of the Performance of Graphene FETs With a Semiclassical Model, Including Band-to-Band Tunneling	1567
..... A. Paussa, G. Fiori, P. Palestri, M. Geromel, D. Esseni, G. Iannaccone, and L. Selmi	

(Contents Continued from Page 1218)

Substrate Bias Influence on the Operation of Junctionless Nanowire Transistors	<i>R. Trevisoli, R. T. Doria, M. de Souza, and M. A. Pavanello</i>	1575
Hysteresis-Free Nanosecond Pulsed Electrical Characterization of Top-Gated Graphene Transistors	<i>E. A. Carrion, A. Y. Serov, S. Islam, A. Behnam, A. Malik, F. Xiong, M. Bianchi, R. Sordan, and E. Pop</i>	1583
Ballistic Transport Performance of Silicane and Germanane Transistors	<i>K. L. Low, W. Huang, Y.-C. Yeo, and G. Liang</i>	1590
Engineering the Electron–Hole Bilayer Tunneling Field-Effect Transistor	<i>S. Agarwal, J. T. Teherani, J. L. Hoyt, D. A. Antoniadis, and E. Yablonovitch</i>	1599
<hr/>		
BRIEF PAPERS		
Investigation of Sensor Performance in Accumulation- and Inversion-Mode Silicon Nanowire pH Sensors	<i>J. Lee, B. Choi, S. Hwang, J. H. Lee, B.-G. Park, T. J. Park, D. M. Kim, D. H. Kim, and S.-J. Choi</i>	1607
A New Interface-Trapped-Charge-Degraded Subthreshold Current Model for Quadruple-Gate MOSFETs	<i>C. Te-Kuang</i>	1611
A Novel Quasi-3-D Interface-Trapped-Charge- Induced Threshold Voltage Model for Quadruple-Gate MOSFETs, Including Equivalent Number of Gates	<i>C. Te-Kuang</i>	1615