# 2019 IEEE Workshop on Wide **Bandgap Power Devices and Applications in Asia** (WiPDA Asia 2019)

Taipei, Taiwan 23-25 May 2019



**IEEE Catalog Number: CFP19O09-POD ISBN**:

978-1-7281-2146-8

#### Copyright $\odot$ 2019 by the Institute of Electrical and Electronics Engineers, Inc. All Rights Reserved

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

\*\*\* This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.

 IEEE Catalog Number:
 CFP19009-POD

 ISBN (Print-On-Demand):
 978-1-7281-2146-8

 ISBN (Online):
 978-1-7281-2145-1

#### **Additional Copies of This Publication Are Available From:**

Curran Associates, Inc 57 Morehouse Lane Red Hook, NY 12571 USA Phone: (845) 758-0400

Fax: (845) 758-2633

E-mail: curran@proceedings.com Web: www.proceedings.com



## **Technical Sessions (Oral Sessions)**

16:00-17:20

Friday, May 24

	ORAL I DEVICE
Conference Room	• • • • • • • • • • • • • • • • • • • •
	Prof. Chih-Fang Huang, National Tsing-Hua University, Taiwan
	Invited Paper: Vertical leakage in GaN-on-Si high-voltage transistors: Phenomena
A1-1	involved, TCAD modelling and suppression technique N/A
Al-i	Giorgia Longobardi
	Cambridge Graphene Centre, Engineering Department, University of Cambridge, UK
	Oxide Breakdown Reliability of SiC MOSFET 1
A1-2	Cheng-Tyng Yena, H.Y. Leeb, C. C.Hunga, C. Y. Lee, L. S. Lee F. J. Hsu, K. T. Chu
	₃ Hestia Power Inc., Hsinchu, Taiwan
	₀ Industrial Technology Research Institute, Hsinchu, Taiwan
	Invited Paper: Advanced tools which applicate in Compound Semiconductor N/A
A1-3	Richard Teng
	Scientech Corporation
	Diode-Integrated SiC DMOSFETs N/A
	Siddarth Sundaresana, Stanley Atcittyb, Vamsi Mulpuria and Ranbir Singha
	a GeneSiC Semiconductor, Dulles, VA, USA
	Sandia National Laboratories, Albuquerque, NM, USA

Room 101	ORAL I APPLICATION Chairs: Prof. Katherine Kim, National Taiwan University, Taiwan
	Prof. Laili Wang, Xi'an Jiaotong University, China
	Accuracy Analysis of Calorimetric Loss Measurement for Benchmarking Wide
	Bandgap Power Transistors under Soft-Switching Operation 18
B1-1	Dominik Koch₄, Samuel Araujo₅, and Ingmar Kallfass₄
	Institute of Robust Power Semiconductor Systems, University of Stuttgart, Germany
	Robert Bosch GmbH, Renningen, Germany
	A Temperature-dependent PSpice Short-circuit Model of SiC MOSFET 24
	Xingran Zhaoa, Hong Li a, Chao Feng a, Zhe Zhou b, Kai Sun c and Zhengming Zhao c
B1-2	School of Electrical Engineering, Beijing Jiaotong University, Beijing, China,
	Global Energy Interconnection Research Institute, Beijing, China,
	c Department of Electrical Engineering, Tsinghua University, Beijing, China
	Modulation strategy of Three Phase Dual Acitve Bridge Converter using the SiC
	MOSFET for improving light load condition 29
B1-3	Hyunjun Choi 1, Hwapyeong Park 1, and Jeehoon Jung 1
	1 Electrical Engineering, Ulsan National Institute of Science and Technology (UNIST),
	Ulsan, Republic of Korea.
	Loss Analysis of T-type NPC Inverter with Active Power Decoupling Capability
	Operated in Discontinuous Current Mode 34
B1-4	Akiyoshi Omomo, Jun-ichi Itoh, and Keisuke Kusaka
	Dept. of Energy and Environmental Science, Nagaoka University of Technology,
	Nagaoka, Niigata, Japan

Room 103	ORAL I APPLICATION Chairs: Prof. Chang-Hua Lin, National Taiwan University of S&T, Taiwan
1.00.111100	Prof. Cheng-Yu Tang, National Taipei University of Technology, Taiwan
C1-1	High Resolution Dynamic Rdson Measurement of GaNFET using Optimized Vdson
	Measurement Circuit 74
	Dominik Kocha, Samuel Araujo₀, and Ingmar Kallfassa
	Arief Noor Rahman, Meng Yang Li, Marojahan Tampubolon, Huang Jen Chiu
	Department of Electronics and Computer Engineering, NTUST, Taipei, Taiwan
C1-2	A 10MHz GaN Driver with Gate Ringing Suppression and Active Bootstrap Control 78
	Sheng Teng Li, Pin Ying Wang, and Ching Jan Chen
	Power Electronics Laboratory, National Taiwan University, Taipei, Taiwan
	Layout Optimization of 2.2kW Motor Drive Inverter with GaN Device Application by
	the assistance of CAD Software Simulation N/A
C1-3	Shiang-Ren Jeng a, Yaow-Ming Chen a, and Chih-Chao Hsu b
C1-3	a Electric Energy Processing Laboratory, Graduate Institute of Electrical Engineering,
	National Taiwan University, Taipei, Taiwan
	<sub>o</sub> National Chung-Shan Institute of Science and Technology Taoyuan, Taiwan







### **Technical Sessions (Oral Sessions)**

15:10-16:30

Saturday, May 25

Room 101	ORAL II DEVICE Chairs: Dr. Tomohide Terashima, Mitsubishi Electric Corporation, Japan
	Prof. Chih-Fang Huang, National Tsing-Hua University, Taiwan
	Invited Paper: Joint Material for power semiconductors by Cu-Sn Intermetallic
A2-1	Compound (IMC) 4
ΑΖ-1	Hiroaki Ikeda
	Napra, Japan
A2-2	Demonstration of Annealing-free Metal-Insulator-Semiconductor (MIS) Ohmic Contacts on a GaN Substrate using Low Work-function Metal (Yb) and Al2O3 Interfacial Layer 10  Tian-Li Wu a, Yang-Yan Tseng a, Chih-Fang Huang b, Zih-Sin Chen c, Chih-Chien Lin c, Chung-Jen Chung c, Po-Kai Huang d, and Kuo-Hsing Kao d a International College of Semiconductor Technology, National Chiao Tung University, Taiwan. b Institute of Electronics Engineering, National Tsing Hua University, Taiwan. c Center for Micro/Nano Science and Technology, National Cheng Kung University, Taiwan. d Department of Electrical Engineering, National Cheng Kung University, Taiwan.
A2-3	RF Performance of HfO₂ SiNx Dual-Layer Passivation of AlGaN GaN MIS-HEMT N/A Chia-Jui Yu, Bo-Kang Lai, Chien-Ju Chen, Jyun-Hao Liao, Meng-Chyi Wu
	Institute of Electronics Engineering, National Tsing-Hua University, Hsinchu, Taiwan
A2-4	Defect Inspection and Characterization for WBG Epitaxy Applications N/A
	Edwin Chew
	KLA-Tencor

Room 103	ORAL II APPLICATION  Chairs: Prof. Junichi Itoh, Nagaoka University of Technology, Japan  Prof. Huang-Jen Chiu, National Taiwan University of S&T, Taiwan
	Invited Paper: Wide Bandgap-based Power Conversion Systems for Grid-tied
D2 4	Energy Storage N/A
B2-1	Stanley Atcitty
	Sandia National Laboratories, US
	GaN Based DC-DC Converter for 48 V Automotive Applications 38
B2-2	Suvankar Biswas a and Michael de Rooij b a Efficient Power Conversion Corporation,
	Blacksburg, USA
	□ Efficient Power Conversion Corporation, El Segundo, USA
	Research of PCB Parasitic Inductance in the GaN HEMT Power Loop 44
B2-3	Bainan Sun, Zhe Zhang and Michael A.E. Andersen
	Technical University of Denmark, Denmark
B2-4	Optimization Design of EMI Filter with Chaotic PWM in DC-DC Converters 49
	Hong Li, Yuhang Ding, and Zhichang Yang
	Beijing Jiaotong University, Beijing, China

	ORAL III DEVICE
Room 101	Chairs: Dr. Giorgia Longobardi, <i>University of Cambridge, United Kingdom</i>
	Prof. Kung-Yen Lee, <i>National Taiwan University, Taiwan</i>
	RF Performance of HfO2/SiNx Dual-Layer Passivation of AlGaN/GaN MIS-HEMTs
	Grown on SiC Substrate N/A
40.4	Chia-Jui Yu₁, Bo-Kang Lai₁, Chien-Ju Chen₁, Jyun-Hao Liao₁, Meng-Chyi Wu₁, Yu-Chi
A3-1	Wang₂
	Institute of Electronics Engineering, National Tsing-Hua University, Hsinchu, Taiwan
	2 WIN Semiconductors Corp., Taoyuan, Taiwan
	The Demonstration of Recessed Anodes AlGaN/GaN Schottky Barrier Diodes
	Using Plasma Oxidation/Wet Etching Techniques 14
	Kuang-Po Hsueh a, Hao-Yu Wangb, Hsien-Chin Chiu b, Hsiang-Chun Wang b, Hsuan-Ling
	Kao b, Feng-Tso Chien c, Wen-Yen Lin d
A3-2	a Department of Digital Multimedia Technology, Vanung University, Chungli, Taiwan
	Department of Electronics Engineering, Chang Gung University, Taoyuan, Taiwan
	c Department of Electronics Engineering, Feng-Chia University, Taichung, Taiwan
	Department of Information Management, National Taichung University of Science and
	Technology, Taichung, Taiwan
	Vertical GaN high-electron-mobility transistors on Si substrate using p- GaN/2DEG
	structure N/A
A3-3	Dai-Jie Lin <sub>1</sub> and Jian-Jang Huang <sub>1,2 1</sub> Graduate Institute of Photonics and
	Optoelectronics, National Taiwan University, Taipei, Taiwan
	<sup>2</sup> Department of Electrical Engineering, National Taiwan University, Taipei, Taiwan
	The effect of buffer layer on RF characteristics of AlGaN/GaN-on-Si HEMT N/A
A3-4	Yu-EnJeng 1, Li-Cheng Chang 2, Wei-ChengTzeng 2, Kai-Chieh Hsu 2, Yung-Ting
	Ho 1 and Chao-Hsin Wu 1,2
	Graduate Institute of Photonics and Optoelectronics, National Taiwan University, Taiwan
	<sup>2</sup> Graduate Institute of Electronics Engineering, National Taiwan University, Taiwan

Room 103	ORAL III APPLICATION Chairs: Dr. Stanley Atcitty, Sandia National Laboratories, US
	Prof. Ching-Jen Chen, National Taiwan University, Taiwan
	65 W Synchronous Current-Mode Class D Rectifier Using GaN FETs for 6.78 MHz
B3-1	Resonant Wireless Power Receivers 55
D3-1	Yuanzhe Zhang and Michael de Rooij
	Efficient Power Conversion Corporation, El Segundo, CA, USA
	Study on the Imbalanced Voltage of Series-Connected Active Power
B3-2	Semiconductor Devices in Power Conversion Systems 61
B3-2	Hongjing Zhang, Jun Imaoka, Mostafa Noah, Yuki Ishikura and Masayoshi Yamamoto
	Department of Electrical Engineering, Nagoya University, Nagoya, Aichi, Japan
	Study and Analysis of Robust Control Technology and Wide Bandgap Power
	Device-Based Power Converters 65
B3-3	En-Chih Chang₁, Chenxi Meng₂
B3-3	Department of Electrical Engineering, I-Shou University, Kaohsiung City, Taiwan
	Smart Grid, College of Automation and Electronic Engineering, Qingdao University of
	Science and Technology, Qingdao, Shandong, China
B3-4	Optimizing performance of a pulsed laser diode driver based on a GaN FET 69
	John S. Glaser
	Efficient Power Conversion, El Segundo, CA, USA

## **Technical Sessions (Poster Sessions)**

12:40-13:00

Friday, May 24

Outside Conference Room	Poster Session 1 Chairs: Prof. Kuo-Yuan Lo, National Kaohsiung University of S&T, Taiwan Prof. Ching-Jan Chen, National Taiwan University, Taiwan
P1-1	Study of Passivation Layer on Bevel Edge Termination for SiC RSD 82  Ziyue Wang, Lin Liang, Ludan Zhang  Huazhong University of Science and Technology
P1-2	Simultaneous Formation of Ni/Ti/Al/Ag Ohmic Contacts to both p- and n- type for 4H-SiC RSD 86 Xiaoxue Yan, Lin Liang, Ludan Zhang Huazhong University of Science and Technology
P1-3	Performance Analysis of Coils for Wireless Power Transfer N/A ChiaWei Chu, Yao-Ching Hsieh National Sun-Yat Sen University
P1-4	Current Collapse Suppression in AlGaN/GaN HEMTs Using Silicon Substrate Removal Technique 91 Yueh-Ting Chen, Jian-Jang Huang National Taiwan University
P1-5	Synchronous Rectification Method for High Frequency CLLC Resonant Converter 94  HwaPyeong Park, Hyunjun Choi, JeeHoon Jung  Ulsan National Institute of Science and Technology
P1-6	LV SiC MOSFETs Fabricated using HV DMOS Process N/A Chih-Fang Huang <sub>1</sub> , Cheng-Yi Jiang <sub>1</sub> , Jia-Ching Hung <sub>1</sub> , Tian-Li Wu <sub>2</sub> National Tsing Hua University  National Chiao Tung University
P1-7	Paralleled-GaN based three-phase inverter with overcurrent suppression 98  Zu-Bin Wong, Yaow-Ming Chen  National Taiwan University
P1-8	High-Performance GaN-Based Interleaved Clamp-Switch TCM Buck Converter for a Redundant Power Module N/A Yu-Chen Liu <sub>1</sub> , Bing-Siang Huang <sub>2</sub> , Xin-Han Lin <sub>2</sub> , Huang-Jen Chiu <sub>2</sub>
P1-9	A modified Small-Signal Model with consideration of Leaky Buffer for GaN- on-Si HEMT N/A Yung Ting Ho, Kai Chieh Hsu, Yu Li Ho, Li Cheng Chang, Chao Hsin Wu National Taiwan University
P1-10	Ohmic Contact Annealing Test for GaN N/A Yu-Li Ho, Chao-Hsin Wu National Taiwan University
P1-11	Some novel designs of P implanted regions for junction barrier Schottky diode N/A Jhen-Min Hong, Yun-Kai Lai, Chen-Dong Tzou, Kung-Yen Lee National Taiwan University

Outside	Poster Session 2 Chairs: Prof. Hung-Liang Cheng, <i>I-Shou University, Taiwan</i>
Conference Room	Prof. Chun-An Cheng, <i>I-Shou University, Taiwan</i>
	SiC based Three-Level NPC Converter operated by Predictive Control Method with
P2-1	NP Voltage Balance by Offset Voltage Injection N/A
	Eun-Su Jun, Sangshin Kwak
	Chung-ang University
	Energy Saving in Smart Grid 104
P2-2	Yi-Kuan Ke
	National Taiwan Ocean University
	Design and Implementation of a GaN-Based Diagnostic System for Lithium Battery
	Module N/A
P2-3	Chang-Hua Lin, Guan-Jung Chen, You-Lin Li
	National Taiwan University of Science & Technology
	Two Stage Scheduling of Microgrid Under Spot Market Based on CVaR N/A
P2-4	Gao Rui
	South China University of Technology
	Linearity of AlGaN/GaN HEMTs with Different Gate-to-Source Length 110
P2-5	Yinan Zhong, Yue-Ming Hsin
	National Central University
	Single Phase AC-AC Solid State Transformer based on Single Conversion Stage 113
P2-6	Arief Rahman, Sheng Kai Chen, Huang Jen Chiu
	National Taiwan University of Science and Technology
	Experimental Verification of DC to Single-phase AC converter with Power
	Decoupling Capability using 1.2 kV SiC-MOSFET Module 118
P2-7	Hiroki Watanabe₁, Jun-ichi Itoh₁, Akio Iwabuchi₂
	₁Nagaoka University of Technology
	≥Sanken Electric Co.,Ltd
	Development of a Novel Battery-Powered DC-AC System 122
	Ching-Ming Lai <sub>1</sub> , Jiashen Teh <sub>2</sub> , Yuan-Chih Lin <sub>3</sub> , Claus Hsu <sub>4</sub>
D0 0	₁National Chung Hsing University
P2-8	⊵Universiti Sains Malaysia
	₃National Taiwan University
	₄UPE-Power Technology Co., Ltd
	High Switching Frequency TCM Control for Bidirectional Interleaved Buck
	Converter Without Phase Error for Battery Charging N/A
P2-9	Yu-Chen Liu <sub>1</sub> , Yong-Long Syu <sub>2</sub> , Kai-De Chen <sub>2</sub> , Chen Chen <sub>2</sub> , Katherine A Kim <sub>3</sub> , Huang-
F2-9	Jen Chiu₂ ₁National Ilan University
	National Taiwan University of Science and Technology
	₃National Taiwan University
	Voltage Sharing Control Strategy of Chargers Connected in Series under Constant
P2-10	Current Mode N/A
PZ-10	Elia Huang, Huang-Jen Chiu, Pao-Sheng Huang
	National Taiwan University of Science and Technology
	Improvement of Charging Technology on GEL Battery and Design Analysis of
P2-11	Charger N/A
F Z-11	Chang-Han Xie, Kung-Yen Lee, Bin-Juine Huang
	National Taiwan University