Session 4 - Power Devices and Systems - Advances in GaN Power Devices and GaN Monolithic Integration
Monday, December 9, 1:30 p.m.
Continental Ballroom 1-3
Co-Chairs: P. Moens, ON Semiconductor
G. Prechtl, Infineon Technologies

1:35 PM **4.1** 1200 V Multi-Channel Power Devices with 2.8 Ω·mm ON-Resistance
Jun Ma, Catherine Erine, Minghua Zhu, Nela Luca, Peng Xiang, Kai Cheng, Elison Matioli, EPFL, Enkris Semiconductor Inc.

This work demonstrates novel multi-channel GaN devices with slanted tri-gates, presenting high breakdown voltage of 1200 V on a highly-conductivity epi-structure with 80 Ω/sq and low on-resistance of 2.8 Ω*mm. The excellent figure-of-merit of 3.2 GW/cm^2 significantly outperforms conventional single-channel devices, providing a promising pathway for future efficient power devices.

2:00 PM **4.2** Impact Ionization Coefficients in GaN Measured by Above- and Sub-E_g Illuminations for p^-/n^+ Junction
Takuya Maeda, Tetsuo Narita, Shinji Yamada, Tetsu Kachi, Tsunenobu Kimoto, Masahiro Horita, Jun Suda, Nagoya University, Kyoto University, Toyota Central R&D Labs, ULVAC Inc.

We propose a novel method to extract impact ionization coefficients of electrons and holes using above- and sub-bandgap illuminations for a p^-/n s^+ junction diode. By analyzing the avalanche multiplication of electron- and hole-injected (Franz-Keldysh-induced) photocurrents, the impact ionization coefficients of electrons and holes in GaN are extracted separately.

2:25 PM **4.3** Investigation of nBTI degradation on GaN-on-Si E-mode MOSc-HEMT
Abygaël Viey, William Vandendaele, Marie-Anne Jaud, Jacques Cluzel, Jean-Paul Barnes, Simon Martin, Alexis Krakovinsky, Romain Gwoziecki, Marc Plissonier, Fred Gaillard, Roberto Modica, Ferdinando Iucolono, Matteo Meneghini, Enrico Zanoni, Gaudenzio Meneghesso, Gérard Ghibaudo, CEA-Leti, STMicroelectronics, Grenoble Alpes University, University of Padova

We investigate the negative gate stress influence on V_{TH} instabilities in GaN devices. NBTI transients and complementary ToF-SIMS analysis reveal two trap populations positions involved on V_{TH} instabilities. Both of them are related to C_N acceptor traps. NBTI transients exhibit LG influence, which is consistent with the E-field distribution simulation.

3:15 PM **4.4** GaN-on-SOI: Monolithically Integrated All-GaN ICs for Power Conversion
Xiangdong Li, Nooshin Amirifar, Karen Geens, Ming Zhao, Weiming Guo, Hu Liang, Shuzhen You, Niels Posthuma, Brice De Jaeger, Steve Stoffels, Benoit Bakeroot, Dirk Wellekens, Benjamin Vanhove, Thibault Cosnier, Robert Langer, Denis Marcon, Guido Groeseneken, Stefaan Decoutere, imec, KU Leuven

We report the first comprehensive research about GaN power ICs on GaN-on-SOI. HEMT, MIM capacitor, SBD, 2DEG resistor, and resistor-transistor logic (RTL) are co-integrated. A 48V-to-1V buck converter is realized using 200 V GaN half-bridges with integrated drivers. Further, an all-GaN buck converter is successfully designed using the GaN PDK.

3:40 PM *COFFEE BREAK*

4:05 PM **4.5** GaN/AlN Schottky-gate p-channel HFETs with InGaN Contacts and 100mA/mm On-current

Samuel Bader, Reet Chaudhuri, Austin Hickman, Kazuki Nomoto, Shyam Bharadwaj, Han Wui Then, Huili Xing, Debdeep Jena, Cornell University, Intel Corporation

High-performance wide-bandgap p-channel devices are broadly desirable to expand the design topologies available in power/RF electronics. To meet that need, this work advances the GaN-on-AlN platform. Authors fabricate p-channel HFETs with 100mA/mm on-currents at room temperature. Various temperature-dependencies, benchmarking results, and technology perspectives are discussed.

4:30 PM **4.6** First Demonstration of a Self-Aligned GaN p-FET

Nadim Chowdhury, Qingyun Xie, Mengyang Yuan, Nitul Rajput, Peng Xiang, Kai Cheng, Han Wui Then, Tomas Palacios, Massachusetts Institute of Technology, Khalifa University, Enkris Semiconductor Inc., Intel Corporation

A self-aligned p-FET with GaN/$Al_{0.2}$ Ga 0.8 N (20 nm)/GaN heterostructure grown by MOCVD on Si-substrate is demonstrated. Reported Lg=100 nm E-mode p-FET V_{TH} =-1V , exhibits a record R_{ON} =400 Ω·mm and I_{ON} >5 mA/mm with $I_{ON}/I_{OFF} = 6\times10^{5}$ among p-FETs based on GaN/AlGaN heterostructure, making it a promising candidate for GaN-based complementary circuit technology.