

# Technical Program of ICSCRM 2013

## **Monday, September 30**

***Opening*** **8:45-9:15**

Room: Tenzui

Chair: H. Itoh (JAEA, Japan)

### **Welcome Address**

### **Announcements to the Attendees**

***Mo-PL Plenary*** **9:15-10:45**

Room: Tenzui

Chairs: T. Kimoto (Kyoto University, Japan)

N. Ohtani (Kwansei Gakuin University, Japan)

9:15 **Mo-PL-1 <Invited>**

**Strategic Energy Policy for a Sustainable Society - Expectations for SiC Power Devices**

p. 1

K. Kyuma

Mitsubishi Electric Corporation /Council for Science and Technology Policy, Japan

10:00 **Mo-PL-2 <Invited>**

**Progress in High Voltage SiC and GaN Power Switching Devices**

p. 2

T. P. Chow

Rensselaer Polytechnic Institute, USA

***Invited Poster Announcement 10:45-11:00***

Room: Tenzui

Chairs: T. Kimoto (Kyoto University, Japan)

N. Ohtani (Kwansei Gakuin University, Japan)

10:45 **Mo-IP-1 <Invited Poster>**

**Development of RAF Quality 150mm 4H-SiC Wafer**

p. 3

H. Kondo<sup>1,2)</sup>, H. Takaba<sup>1,2)</sup>, M. Yamada<sup>1,2)</sup>, Y. Urakami<sup>1,2)</sup>, M. Kobayashi<sup>1,3)</sup>, T. Masuda<sup>1,3)</sup>, I. Gunjishima<sup>1,4)</sup>, K. Shigeto<sup>1,4)</sup>, N. Ooya<sup>1,2)</sup>, N. Sugiyama<sup>1,2)</sup>, A. Matsuse<sup>1,3)</sup>, T. Kozawa<sup>1,4)</sup>, T. Sato<sup>1,3)</sup>, F. Hirose<sup>1,2)</sup>, S. Yamauchi<sup>1,2)</sup>, and S. Onda<sup>1,2)</sup>

<sup>1)</sup>R&D Partnership for Future Power Electronics Technology, Japan, <sup>2)</sup>DENSO CORP., Japan, <sup>3)</sup>SHOWA DENKO K.K., Japan, <sup>4)</sup>TOYOTA Central R&D Labs., Japan

10:48 **Tu-IP-1 <Invited Poster>**

**Ge Assisted SiC Epitaxial Growth by CVD on SiC Substrate**

p. 4

K. Alassaad<sup>1)</sup>, V. Soulière<sup>1)</sup>, B. Doisneau<sup>2)</sup>, F. Cauwet<sup>1)</sup>, H. Peyre<sup>3)</sup>, D. Carole<sup>1)</sup>, D. Chaussende<sup>2)</sup>, and G. Ferro<sup>1)</sup>

<sup>1)</sup>Université Claude Bernard Lyon 1, France, <sup>2)</sup>LMGP, Grenoble INP, France, <sup>3)</sup>Université Montpellier, France

10:51 **We-IP-1 <Invited Poster>**

**Study of V and Y Shape Stacking Faults Formation in 4H-SiC Epilayer**

p. 5

H. Wang<sup>1)</sup>, F. Wu<sup>1)</sup>, S. Byrappa<sup>1)</sup>, M. Dudley<sup>1)</sup>, G. Chung<sup>2)</sup>, J. Zhang<sup>2)</sup>, B. Thomas<sup>2)</sup>, E. K. Sanchez<sup>2)</sup>, S. G. Mueller<sup>2)</sup>, D. Hansen<sup>2)</sup>, and M. J. Loboda<sup>2)</sup>

<sup>1)</sup>Stony Brook University, USA, <sup>2)</sup>Dow Corning Compound Semiconductor Solutions, USA

10:54 **Th-IP-1 <Invited Poster>**

**Development of SiC Super-Junction (SJ) Device by a Multi-Epitaxial Growth**

p. 6

R. Kosugi<sup>1,2)</sup>, Y. Sakuma<sup>2)</sup>, K. Kojima<sup>1,2)</sup>, S. Itoh<sup>2)</sup>, A. Nagata<sup>2)</sup>, T. Yatsuo<sup>1,2)</sup>, Y. Tanaka<sup>1,2)</sup>, and H. Okumura<sup>1,2)</sup>

<sup>1)</sup>R&D Partnership for Future Power Electronics Technology, Japan, <sup>2)</sup>National Institute of Advanced Industrial Science and Technology, Japan

**Mo-1A MOSFET 1 11:20-12:50**

Room: Tenzui

Chairs: L. Cheng (Cree, USA)  
M. Kitabatake (Panasonic, Japan)

11:20 **Mo-1A-1 <Invited>** p. 7**The Development of Advanced SiC Devices and Modules**

T. Nakamura, Y. Nakano, M. Aketa, and T. Hanada  
ROHM Co., Ltd, Japan

11:50 **Mo-1A-2** p. 8**4H-SiC Trench MOSFET with Bottom Oxide Protection**

Y. Kagawa, N. Fujiwara, R. Tanaka, Y. Fukui, Y. Yamamoto, N. Miura, M. Imaizumi, S. Nakata, and S. Yamakawa  
Mitsubishi Electric Corporation, Japan

12:10 **Mo-1A-3** p. 9**SiC Trench MOSFET with an Integrated Low Von Unipolar Heterojunction Diode**

W. Ni, T. Marui, K. Emori, Y. Saito, S. Yamagami, T. Hayashi, and M. Hoshi  
Nissan Motor Co., Ltd., Japan

12:30 **Mo-1A-4** p.10**Improvement of Channel Mobility in 4H-SiC C-Face MOSFETs by H<sub>2</sub> Rich Wet Re-Oxidation**

M. Okamoto<sup>1)</sup>, Y. Makifuchi<sup>1)</sup>, T. Araoka<sup>1)</sup>, M. Miyazato<sup>1)</sup>, Y. Sugahara<sup>1)</sup>, T. Tsutsumi<sup>1)</sup>, Y. Onishi<sup>1)</sup>, H. Kimura<sup>1)</sup>, S. Harada<sup>1)</sup>, K. Fukuda<sup>1)</sup>, A. Otsuki<sup>2)</sup>, and H. Okumura<sup>1)</sup>

<sup>1)</sup>National Institute of Advanced Industrial Science and Technology, Japan, <sup>2)</sup>Fuji Electric Co., Ltd., Japan

**Mo-1B Material Properties 11:20-13:00**

Room: Juyo

Chairs: J. Suda (Kyoto University, Japan)  
A. Gali (Budapest University of Technology and Economics, Hungary)

11:20 **Mo-1B-1** p.11**High-Resolution Raman and Luminescence Spectroscopy of Isotope- Pure <sup>28</sup>Si<sup>12</sup>C, Natural and <sup>13</sup>C-Enriched 4H-SiC**

I. G. Ivanov, B. Lundqvist, J. Hassan, P. Stenberg, R. Liljedahl, M. Yazdanfar, O. Kordina, and E. Janzén  
Linköping University, Sweden

11:40 **Mo-1B-2** p.12**Characterization of Ge-doped 4H-SiC Homoepitaxial Layers Grown by Chemical Vapor Deposition**

T. Sledziewski<sup>1)</sup>, S. Beljakowa<sup>1)</sup>, K. Alassaad<sup>2)</sup>, P. Kwasnicki<sup>3)</sup>, R. Arvinte<sup>4)</sup>, S. Juillaguet<sup>3)</sup>, M. Zielinski<sup>4)</sup>, V. Souliere<sup>2)</sup>, G. Ferro<sup>2)</sup>, H. B. Weber<sup>1)</sup>, and M. Krieger<sup>1)</sup>

<sup>1)</sup>FAU Erlangen-Nürnberg, Germany, <sup>2)</sup>LMI, UMR-CNRS, France, <sup>3)</sup>Université Montpellier 2 and CNRS, France, <sup>4)</sup>NOVASiC, France

12:00 **Mo-1B-3** p.13**Injection and Temperature Dependent Diffusivity and Auger Recombination in 4H-SiC**

P. Ščajev<sup>1)</sup>, K. Jarašiūnas<sup>1)</sup>, and P. B. Klein<sup>2)</sup>

<sup>1)</sup>Vilnius University, Lithuania, <sup>2)</sup>Naval Research Laboratory, USA

12:20 **Mo-1B-4** p.14**Persistent Conductivity in n-Type 3C-SiC Observed at Low Temperatures**

S. Beljakowa<sup>1)</sup>, M. Hauck<sup>1)</sup>, M. Bockstedte<sup>1)</sup>, H. Nagasawa<sup>2)</sup>, H.B. Weber<sup>1)</sup>, G. Pensl<sup>1)</sup>, and M. Krieger<sup>1)</sup>

<sup>1)</sup>Universität Erlangen-Nürnberg, Germany, <sup>2)</sup>Tohoku University, Japan

12:40 **Mo-1B-5 <Late News>** p.15**Carrier Lifetime Improvement in Al-Doped p-Type 4H-SiC Epitaxial Layers by Hydrogen Passivation**

T. Okuda, T. Kimoto, and J. Suda  
Kyoto University, Japan

**Mo-2A Solution Growth & Others 14:10-15:40**

Room: Tenzui

Chairs: D. Chaussende (LMGP, CNRS, France)  
K. Kakimoto (Kyushu University, Japan)

14:10 **Mo-2A-1 <Invited>** p.16

**Surface Shape-Controlled Solution Growth of 4H-SiC Bulk Crystal**

H. Daikoku<sup>1)</sup>, M. Kado<sup>1)</sup>, H. Sakamoto<sup>1)</sup>, T. Bessho<sup>1)</sup>, K. Kusunoki<sup>2)</sup>, and K. Kamei<sup>2)</sup>

<sup>1)</sup>Toyota Motor Corporation, Japan, <sup>2)</sup>Nippon Steel Sumitomo & Metal Corporation, Japan

14:40 **Mo-2A-2** p.17

**Increase in the Growth Rate by Rotating the Seed Crystal at a High Speed during the Solution Growth of SiC**

T. Umezaki, D. Koike, S. Harada, and T. Ujihara  
Nagoya University, Japan

15:00 **Mo-2A-3** p.18

**Dependence of Growth Rate and Surface Morphology of 4H-SiC Crystals Grown from Si-Cr-C and Si-Cr-Al-C Solutions under Various C Solubility and Supersaturation Conditions**

T. Mitani<sup>1,2)</sup>, N. Komatsu<sup>1)</sup>, T. Takahashi<sup>1,2)</sup>, T. Kato<sup>1,2)</sup>, K. Fujii<sup>1,3)</sup>, I. Nagai<sup>1,3)</sup>, T. Ujihara<sup>4)</sup>, Y. Matsumoto<sup>5)</sup>, K. Kurashige<sup>1,3)</sup>, and H. Okumura<sup>1,2)</sup>

<sup>1)</sup>R&D Partnership for Future Power Electronics Technology, Japan <sup>2)</sup>National Institute of Advanced Industrial Science and Technology, Japan, <sup>3)</sup>Hitachi Chemical Co., Ltd., Japan, <sup>4)</sup>Nagoya University, Japan <sup>5)</sup>Tohoku University, Japan

15:20 **Mo-2A-4** p.19

**Fast 4H-SiC Crystal Growth by High-Temperature Gas Source Method**

N. Hoshino<sup>1)</sup>, I. Kamata<sup>1)</sup>, Y. Tokuda<sup>2,3)</sup>, E. Makino<sup>2,3)</sup>, J. Kojima<sup>2,3)</sup>, and H. Tsuchida<sup>1)</sup>

<sup>1)</sup>Central Research Institute of Electric Power Industry, Japan, <sup>2)</sup>R&D Partnership for Future Power Electronics Technology, Japan, <sup>3)</sup>DENSO CORPORATION, Japan

**Mo-2B Doping & Contacts 14:10-15:40**

Room: Juyo

Chairs: K. Fukuda (AIST, Japan)  
F. Roccaforte (CNR-IMM, Italy)

14:10 **Mo-2B-1 <Invited>** p.20

**Applications of Vapor-Liquid-Solid Selective Epitaxy of Highly p-Type Doped 4H-SiC : PiN Diodes with Peripheral Protection and Improvement of Specific Contact Resistance of Ohmic Contacts**

N. Thierry-Jebali<sup>1)</sup>, M. Lazar<sup>1)</sup>, A. Vo-Ha<sup>2)</sup>, D. Carole<sup>2)</sup>, V. Soulière<sup>2)</sup>, B. Asllani<sup>1)</sup>, A. Henry<sup>3)</sup>, D. Planson<sup>1)</sup>, G. Ferro<sup>2)</sup>, H. Peyre<sup>4)</sup>, L. Konczewicz<sup>4)</sup>, S. Contreras<sup>4)</sup>, G. Regula<sup>5)</sup>, C. Brylinski<sup>2)</sup>, and P. Brosseard<sup>1)</sup>

<sup>1)</sup>Université de Lyon, INSA de Lyon, France, <sup>2)</sup>Université de Lyon 1, France, <sup>3)</sup>Linköping University, Sweden, <sup>4)</sup>Université de Montpellier, France, <sup>5)</sup>Université Paul Cézanne, France

14:40 **Mo-2B-2** p.21

**N- and P-Type Doping of 4H-SiC by Wet-Chemical Laser Processing**

K. Nishi, A. Ikeda, D. Marui, H. Ikenoue, and T. Asano  
Kyushu University, Japan

15:00 **Mo-2B-3** p.22

**Contact Property of 4H-SiC with Phosphorus-Doped and Crystallized Amorphous-Silicon Insertion Layer**

H. Hanafusa, A. Ohta, R. Ashihara, K. Maruyama, T. Mizuno, S. Hayashi, H. Murakami, and S. Higashi  
Hiroshima University, Japan

15:20 **Mo-2B-4** p.23

**Microwave Annealing of Al<sup>+</sup> Implanted 4H-SiC: Towards Device Fabrication**

A. Nath<sup>1)</sup>, F. Moscatelli<sup>2)</sup>, A. Parisini<sup>3)</sup>, Y -L. Tian<sup>4)</sup>, M.V. Rao<sup>1)</sup>, and R. Nipoti<sup>2)</sup>

<sup>1)</sup>George Mason University, USA, <sup>2)</sup>CNR-IMM of Bologna, Italy, <sup>3)</sup>Università di Parma, Italy, <sup>4)</sup>LT Technologies, USA

- Mo-IP-1 <Invited Poster>** p. 3  
**Development of RAF Quality 150mm 4H-SiC Wafer**  
H. Kondo<sup>1,2)</sup>, H. Takaba<sup>1,2)</sup>, M. Yamada<sup>1,2)</sup>, Y. Urakami<sup>1,2)</sup>, M. Kobayashi<sup>1,3)</sup>, T. Masuda<sup>1,3)</sup>, I. Gunjishima<sup>1,4)</sup>, K. Shigeto<sup>1,4)</sup>, N. Ooya<sup>1,2)</sup>, N. Sugiyama<sup>1,2)</sup>, A. Matsuse<sup>1,3)</sup>, T. Kozawa<sup>1,4)</sup>, T. Sato<sup>1,3)</sup>, F. Hirose<sup>1,2)</sup>, S. Yamauchi<sup>1,2)</sup>, and S. Onda<sup>1,2)</sup>  
<sup>1</sup>R&D Partnership for Future Power Electronics Technology, Japan, <sup>2</sup>DENSO CORP., Japan, <sup>3</sup>SHOWA DENKO K.K., Japan, <sup>4</sup>TOYOTA Central R&D Labs., Japan
- <Bulk Growth>*
- Mo-P-1** p.24  
**4H-SiC Bulk Growth Using High-Temperature Gas Source Method**  
Y. Tokuda<sup>1,2)</sup>, J. Kojima<sup>1,2)</sup>, K. Hara<sup>1,2)</sup>, H. Tsuchida<sup>3)</sup>, and S. Onda<sup>1,2)</sup>  
<sup>1</sup>R&D Partnership for Future Power Electronics Technology, Japan, <sup>2</sup>DENSO CORP., Japan, <sup>3</sup>Central Research Institute of Electric Power Industry, Japan
- Mo-P-2** p.25  
**Solution Growth of n-Type 4H-SiC Bulk Crystals with Low Resistivity**  
T. Shirai<sup>1)</sup>, K. Danno<sup>1)</sup>, A. Seki<sup>1)</sup>, H. Sakamoto<sup>1)</sup>, T. Bessho<sup>1)</sup>, and T. Kimoto<sup>2)</sup>  
<sup>1</sup>Toyota Motor Corporation, Japan, <sup>2</sup>Kyoto University, Japan
- Mo-P-3** p.26  
**N-Type Doping of 4H-SiC by the Top-Seeded Solution Growth Technique**  
K. Kusunoki<sup>1,2)</sup>, K. Kamei<sup>1)</sup>, K. Seki<sup>2)</sup>, S. Harada<sup>2)</sup>, and T. Ujihara<sup>2)</sup>  
<sup>1</sup>Nippon Steel and Sumitomo Metal Corporation, Japan, <sup>2</sup>Nagoya University, Japan
- Mo-P-4** p.27  
**High Temperature Chemical Vapor Deposition Using Tetramethylsilane toward Bulk Crystal Growth of SiC**  
S. -H. Jeong, D. -H. Nam, B. G. Kim, J. -Y. Yoon, K. -H Kim, Y. -J. Yoon, M. -H. Lee, and W. -S. Seo  
Korea Institute of Ceramic Engineering and Technology, Korea

- Mo-P-5** p.28  
**Control of Dislocation Conversion during Solution Growth by Changing Surface Step Structure**  
S. Harada, Y. Yamamoto, S. Xiao, A. Horio, M. Tagawa, and T. Ujihara  
Nagoya University, Japan
- Mo-P-6** p.29  
**Electromagnetic Enhancement of Carbon Transport in SiC Solution Growth Process: a Numerical Modeling Approach**  
K. Ariyawong, J. M. Dedulle, and D. Chaussende  
LMGP, CNRS UMR5628, Grenoble INP, France
- Mo-P-7** p.30  
**The Suppression of the Trenches by the Control of Solution Flow above Growth Surface in the Solution Growth of SiC**  
C. Zhu<sup>1)</sup>, S. Harada<sup>1)</sup>, S. Xiao<sup>1)</sup>, K. Seki<sup>2)</sup>, M. Tagawa<sup>1)</sup>, Y. Matsumoto<sup>3)</sup>, T. Kato<sup>4,5)</sup>, K. Kurashige<sup>5,6)</sup>, H. Okamura<sup>4,5)</sup>, and T. Ujihara<sup>1)</sup>  
<sup>1</sup>Nagoya University, Japan, <sup>2</sup>Nagoya University, Japan, <sup>3</sup>Tohoku University, Japan, <sup>4</sup>National Institute of Advanced Industrial Science and Technology, Japan, <sup>5</sup>R&D Partnership for Future Power Electronics Technology, Japan, <sup>6</sup>Hitachi Chemical Co., Ltd., Japan
- Mo-P-8** p.31  
**Interference Observation of the Interface between SiC and Liquid Alloy and Its Application to Dissolution Process of SiC**  
S. Kawanishi, T. Yoshikawa, and K. Morita  
The University of Tokyo, Japan

<Epitaxy>

**Mo-P-9** p.32  
**Dependence of the Growth Parameters on the in-Plane Distribution of 150 mm $\phi$  Size SiC Epitaxial Wafer**

C. Kudou<sup>1,2)</sup>, K. Tamura<sup>1,3)</sup>, J. Nishio<sup>1,4)</sup>, K. Masumoto<sup>1,5)</sup>, K. Kojima<sup>1,5)</sup>, and T. Ohno<sup>1,6)</sup>

<sup>1)</sup>R&D Partnership for Future Power Electronics Technology, Japan, <sup>2)</sup>Panasonic Corporation, Japan, <sup>3)</sup>ROHM Co., Ltd, Japan, <sup>4)</sup>Toshiba Corporation, Japan,

<sup>5)</sup>National Institute of Advanced Industrial Science and Technology, Japan,

<sup>6)</sup>Hitachi, Ltd., Japan

**Mo-P-10** p.33

**Comparative Study of Defects in 4H-SiC Epilayers Grown on 4<sup>o</sup> Off-Axis (0001) and (000-1) Substrates**

T. Aigo, W. Itoh, T. Fujimoto, and T. Yano

Nippon Steel & Sumitomo Metal Corporation, Japan

**Mo-P-11** p.34

**3C-SiC Seeded Growth on Diamond Substrate by VLS Transport**

A. Vo-Ha<sup>1)</sup>, D. Carole<sup>1)</sup>, M. Lazar<sup>2)</sup>, A. Tallaire<sup>3)</sup>, V. Souliere<sup>1)</sup>, and G. Ferro<sup>1)</sup>

<sup>1)</sup>Universite Lyon 1 CNRS, UMR 5615, France, <sup>2)</sup>Universite de Lyon, INSA de Lyon, France, <sup>3)</sup>Universite Paris XII, France

**Mo-P-12 Moved to Th-P-59**

**Mo-P-13** p.35

**Characterization of the Defects Evolution in Thick Heavily Al-Doped 4H-SiC Epilayers**

S. Y. Ji<sup>1)</sup>, K. Kojima<sup>1)</sup>, Y. Ishida<sup>1)</sup>, H. Yamaguchi<sup>1)</sup>, S. Saito<sup>1)</sup>, T. Kato<sup>1)</sup>, H. Tsuchida<sup>2)</sup>, S. Yoshida<sup>1)</sup>, and H. Okumura<sup>1)</sup>

<sup>1)</sup>National Institute of Advanced Industrial Science and Technology, Japan,

<sup>2)</sup>Central Research Institute of Electric Power Industry, Japan

**Mo-P-14** p.36

**Crystal Growth of Silicon Carbide by Chemical Vapor Deposition with Alternating Gas Supply**

T. Nagano and K. Sato

Japan Fine Ceramics Center, Japan

**Mo-P-15** p.37

**Lateral Enlargement of 3C-SiC on Off-Oriented 4H-SiC Substrates**

V. Jokubavicius, P. Chen, R. Yakimova, and M. Syväjärvi

Linköping University, Sweden

**Mo-P-16** p.38

**Monte Carlo Study of the First Stages Growth of 3C-SiC on Misoriented <11-20> and <1-100> 6H-SiC Substrates by CVD Growth**

M. Camarda, A. La Magna, and F. La Via

IMM-CNR, Italy

<Characterization>

**Mo-P-17** p.39

**Driving Force of Stacking Fault Expansion in 4H-SiC by Electroluminescence Observation *in situ***

K. Konishi, S. Yamamoto, S. Nakata, Y. Toyoda, and S. Yamakawa

Mitsubishi Electric Corporation, Japan

**Mo-P-18** p.40

**Dislocation Revelation for 4H-SiC by Using Vaporized NaOH: a Possible Way to Distinguish Edge, Screw and Mixed Threading Dislocations by Etch Pit Method**

Y. Yao<sup>1)</sup>, Y. Ishikawa<sup>1)</sup>, Y. Sugawara<sup>1)</sup>, K. Sato<sup>1)</sup>, K. Danno<sup>2)</sup>, H. Suzuki<sup>2)</sup>, H. Sakamoto<sup>2)</sup>, T. Bessho<sup>2)</sup>, S. Yamaguchi<sup>3)</sup>, and K. Nishikawa<sup>3)</sup>

<sup>1)</sup>Japan Fine Ceramics Center, Japan, <sup>2)</sup>Toyota Motor Corporation, Japan,

<sup>3)</sup>Toyota Central Research and Development Laboratories Inc., Japan

- Mo-P-19** p.41  
**Identification of Structures of the Deep Levels in 4H-SiC**  
H. Nakane<sup>1)</sup>, M. Kato<sup>1)</sup>, M. Ichimura<sup>1)</sup>, and T. Ohshima<sup>2)</sup>  
<sup>1)</sup>Nagoya Institute of Technology, Japan, <sup>2)</sup>Japan Atomic Energy Agency, Japan
- Mo-P-20** p.42  
**TEM Observation of Defect Structure of Low-Energy Ion Implanted SiC**  
T. Kameda, A. Tomita, T. Matsui, and T. Isshiki  
 Kyoto Institute of Technology, Japan
- Mo-P-21** p.43  
**EPR Observation of the Neutral (C-C)<sub>C</sub> Split Interstitial in Low-Energy Electron Irradiated 3C-SiC**  
 H. J. von Bardeleben<sup>1)</sup>, J. L. Cantin<sup>1)</sup>, F. Bruneval<sup>2)</sup>, E. Rauls<sup>3)</sup>, and U. Gerstmann<sup>3)</sup>  
<sup>1)</sup>Universite Pierre et Marie Curie, France, <sup>2)</sup>CEA, DEN, France, <sup>3)</sup>University of Paderborn, Germany
- Mo-P-22 Canceled** p.44
- Mo-P-23** p.45  
**Oxidation Induced ON<sub>1</sub>, ON<sub>2,a/b</sub> Defects in 4H-SiC Characterized by DLTS**  
I. D. Booker<sup>1)</sup>, H. Abdallah<sup>1)</sup>, L. Lilja<sup>1)</sup>, J. ul-Hassan<sup>1)</sup>, J. P. Bergman<sup>1)</sup>, E. Ö. Sveinbjornsson<sup>1,2)</sup>, and E. Janzén<sup>1)</sup>  
<sup>1)</sup>Linköping University, Sweden, <sup>2)</sup>University of Iceland, Iceland
- Mo-P-24** p.46  
**Identification of the Negative Carbon Vacancy at Quasi-Cubic Site in 4H-SiC by EPR and Theoretical Calculations**  
X. T. Trinh<sup>1)</sup>, K. Szász<sup>2)</sup>, T. Hornos<sup>2)</sup>, K. Kawahara<sup>3)</sup>, J. Suda<sup>3)</sup>, T. Kimoto<sup>3)</sup>, A. Gali<sup>2,4)</sup>, E. Janzen<sup>1)</sup>, and N. T. Son<sup>1)</sup>  
<sup>1)</sup>Linköping University, Sweden, <sup>2)</sup>Hungarian Academy of Sciences, Hungary, <sup>3)</sup>Kyoto University, Japan, <sup>4)</sup>Budapest University of Technology and Economics, Hungary
- Mo-P-25** p.47  
**First Principle Investigation of Divacancy in SiC Polytypes for Solid State Qubit Application**  
 K. Szasz<sup>1)</sup>, V. Ivady<sup>2)</sup>, and A. Gali<sup>1,3)</sup>  
<sup>1)</sup>Hungarian Academy of Sciences, Hungary, <sup>2)</sup>Linköping University, Sweden, <sup>3)</sup>Budapest University of Technology and Economics, Hungary
- Mo-P-26** p.48  
**Room Temperature Magnetic Resonance on SiC Quantum Defects: a Silicon Carbide MASER?**  
H. Kraus<sup>1)</sup>, F. Fuchs<sup>1)</sup>, V. Soltamov<sup>2)</sup>, S. Váth<sup>1)</sup>, D. Riedel<sup>1)</sup>, A. Sperlich<sup>1)</sup>, P. Baranov<sup>2)</sup>, E. Mokhov<sup>2)</sup>, V. Dyakonov<sup>1)</sup>, and G. V. Astakhov<sup>1,3)</sup>  
<sup>1)</sup>Julius Maximilian University of Würzburg, Germany, <sup>2)</sup>Ioffe Physical-Technical Institute, Russia, <sup>3)</sup>ZAE Bayern, Germany
- Mo-P-27** p.49  
**Investigation of Obtuse Triangular Defects on 4H-SiC Epitaxial Layers**  
L. Dong<sup>1,2)</sup>, G. S. Sun<sup>1,2)</sup>, J. Yu<sup>2)</sup>, L. Zheng<sup>1)</sup>, X. F. Liu<sup>1)</sup>, F. Zhang<sup>1)</sup>, G. G. Yan<sup>1)</sup>, W. S. Zhao<sup>1)</sup>, L. Wang<sup>1)</sup>, X. G. Li<sup>2)</sup>, and Z. G. Wang<sup>1)</sup>  
<sup>1)</sup>Chinese Academy of Sciences, China, <sup>2)</sup>Tianyu Semiconductor Technology Co., Ltd, China

<Processing>

**Mo-P-28** p.50  
**Al<sup>+</sup> Implanted 4H-SiC p<sup>+</sup>-i-n Diodes: Evidence for Post-Implantation-Annealing Dependent Defect Activation**

U. Grossner<sup>1</sup>, M. Moscatelli<sup>2</sup>, G. Pizzochero<sup>2</sup>, and R. Nipoti<sup>2</sup>

<sup>1</sup>ABB Corporate Research, Switzerland, <sup>2</sup>CNR-IMM of Bologna, Italy

**Mo-P-29** p.51  
**Temperature Dependence of Electric Conductivities in Femtosecond Laser Modified Areas in Silicon Carbide**

S. Takayoshi<sup>1</sup>, M. Deki<sup>1</sup>, Y. Naoi<sup>1</sup>, T. Makino<sup>2</sup>, T. Ohshima<sup>2</sup>, and T. Tomita<sup>1</sup>

<sup>1</sup>The University of Tokushima, Japan, <sup>2</sup>Japan Atomic Energy Agency, Japan

**Mo-P-30** p.52  
**Electrical Characteristics of Schottky Contacts on Ge-Doped 4H-SiC**

M. Vivona<sup>1</sup>, K. Alassad<sup>2</sup>, V. Soulière<sup>2</sup>, F. Giannazzo<sup>1</sup>, F. Roccaforte<sup>1</sup>, and G. Ferro<sup>2</sup>

<sup>1</sup>CNR-IMM, Italy, <sup>2</sup>University Claude Bernard Lyon 1, France

**Mo-P-31** p.53  
**Temperature-Dependence of the Electrical Characteristics of Ni<sub>2</sub>Si Ohmic Contacts to n- and p-Type Implanted 4H-SiC**

M. Vivona<sup>1</sup>, G. Greco<sup>1</sup>, S. Di Franco<sup>1</sup>, F. Giannazzo<sup>1</sup>, F. Roccaforte<sup>1</sup>, A. Frazzetto<sup>2</sup>, S. Rascunà<sup>2</sup>, E. Zanetti<sup>2</sup>, A. Guarnera<sup>2</sup>, and M. Saggio<sup>2</sup>

<sup>1</sup>CNR-IMM, Italy, <sup>2</sup>ST Microelectronics, Italy

**Mo-P-32** p.54  
**I-V Characteristics in Surface-Activated Bonding (SAB) Based Si/SiC Junctions at Raised Ambient Temperatures**

S. Nishida<sup>1</sup>, J. Liang<sup>1</sup>, M. Morimoto<sup>1</sup>, N. Shigekawa<sup>1</sup>, and M. Arai<sup>2</sup>

<sup>1</sup>Osaka City University, Japan, <sup>2</sup>New Japan Radio Co., Ltd., Japan

**Mo-P-33** p.55  
**Ti/Al/Si Ohmic Contacts for Both n-Type and p-Type 4H-SiC**

H. Tamaso, S. Yamada, H. Kitabayashi, and T. Horii

Sumitomo Electric Industries, Ltd., Japan

**Mo-P-34** p.56  
**Development of a Novel Cap-Free Activation Annealing Technique of 4H-SiC by Si-Vapor Ambient Anneal Using TaC/Ta Composite Materials**

S. Torimi<sup>1</sup>, S. Nogami<sup>1</sup>, and T. Kaneko<sup>2</sup>

<sup>1</sup>Toyo Tanso Co., Japan, <sup>2</sup>Kwansei Gakuin University, Japan

**Mo-P-35** p.57  
**Impact of Interface Traps on Current-Voltage Characteristics of 4H-SiC Schottky-Barrier Diodes**

H. Amini Moghadam, S. Dimitrijević, and J. Han

Griffith University, Australia

**Mo-P-36** p.58  
**Low Cost Ion Implantation Process with High Heat Resistant Photoresist in Silicon Carbide Device Fabrication**

T. Fujiwara<sup>1</sup>, Y. Tanigaki<sup>1</sup>, Y. Furukawa<sup>2</sup>, K. Tonari<sup>2</sup>, A. Ootsuki<sup>3</sup>, T. Imai<sup>4</sup>, N. Oose<sup>4</sup>, M. Utsumi<sup>4</sup>, M. Ryo<sup>4</sup>, M. Gotoh<sup>4</sup>, S. Nakamata<sup>4</sup>, T. Sakai<sup>4</sup>, Y. Sakai<sup>4</sup>, M. Miyajima<sup>4</sup>, H. Kimura<sup>4</sup>, K. Fukuda<sup>4</sup>, and H. Okumura<sup>4</sup>

<sup>1</sup>Toray Industries, Inc., Japan, <sup>2</sup>ULVAC Inc., Japan, <sup>3</sup>Fuji Electric Holdings Co. Ltd., Japan, <sup>4</sup>National Institute of Advanced Industrial Science and Technology, Japan

**Mo-P-37** p.59  
**Characteristics of a Schottky Barrier Diode and the SiC Wafers Sliced by Wire Electrical Discharge Machining**

H. Miyake, N. Tomita, Y. Nakaki, T. Furusho, A. Itokazu, T. Hashimoto, Y.

Toyoda, S. Yamakawa, H. Sumitani, T. Kuroiwa, and T. Sato

Mitsubishi Electric Corporation, Japan

**Mo-P-38** p.60  
**Stable Ohmic Nickel/Titanium/Aluminium Contacts to 4H-SiC Characterized from -40°C to 500°C**

K. Smedfors, L. Lanni, M. Östling, and C. -M. Zetterling

KTH Royal Institute of Technology, Sweden



- Mo-P-39** p.61  
**Electrical Properties of Mg-Implanted 4H-SiC**  
H. Matsuura<sup>1)</sup>, T. Morine<sup>1)</sup>, and S. Nagamachi<sup>2)</sup>  
<sup>1)</sup>Osaka Electro-Communication University, Japan, <sup>2)</sup>Nagamachi Science Laboratory Co., Ltd., Japan
- Mo-P-40** p.62  
**Low Ohmic Contact Formation of Ni Silicide on Partially Si Ion Implanted n<sup>+</sup> 4H-SiC**  
M. de Silva, T. Sato, S. Kuroki, and T. Kikkawa  
Hiroshima University, Japan
- <Devices and Circuits>
- Mo-P-41** p.63  
**Blocking Characteristics of 2.2 kV and 3.3 kV -Class 4H-SiC MOSFETs with Improved Doping Control for Edge Termination**  
K. Wada, K. Uchida, T. Hiyoshi, R. Kimura, M. Sakai, S. Hatsukawa, K. Hiratsuka, N. Hirakata, and Y. Mikamura  
Sumitomo Electric Industries, Ltd., Japan
- Mo-P-42** p.64  
**Simulation, Fabrication and Characterization of 4500V 4H-SiC JBS Diode**  
R. Huang<sup>1)</sup>, G. Chen<sup>1)</sup>, S. Bai<sup>2)</sup>, R. Li<sup>2)</sup>, and Y. Li<sup>2)</sup>  
<sup>1)</sup>Nanjing Electronic Devices Institute, China, <sup>2)</sup>Science and Technology on Monolithic Integrated Circuits and Modules Laboratory Nanjing, China
- Mo-P-43** p.65  
**High Temperature Reliability of the SiC-MOSFET with Copper Metallization**  
H. Okabe, M. Yoshida, T. Tominaga, J. Fujita, K. Endo, Y. Yokoyama, K. Nishikawa, Y. Toyoda, and S. Yamakawa  
Mitsubishi Electric Corporation, Japan
- Mo-P-44** p.66  
**Investigation on Internally Unbalanced Switching Behavior for Realization of 1-cm<sup>2</sup> SiC- MOSFET**  
S. Hino, M. Ito, N. Miura, M. Imaizumi, and S. Yamakawa  
Mitsubishi Electric Corporation, Japan
- Mo-P-45** p.67  
**Effect of Current-Spreading Layer Formed by Ion Implantation on the Electrical Properties of High-Voltage 4H-SiC p-Channel IGBTs**  
T. Deguchi<sup>1,2)</sup>, S. Katakami<sup>1,2)</sup>, H. Fujisawa<sup>1,3)</sup>, K. Takenaka<sup>1,3)</sup>, M. Takei<sup>1,3)</sup>, H. Ishimori<sup>1)</sup>, S. Takasu<sup>1)</sup>, M. Arai<sup>1,2)</sup>, Y. Yonezawa<sup>1)</sup>, and K. Fukuda<sup>1)</sup>  
<sup>1)</sup>National Institute of Advanced Industrial Science and Technology, Japan, <sup>2)</sup>New Japan Radio Co., Ltd., Japan, <sup>3)</sup>Fuji Electric Co., Ltd., Japan
- Mo-P-46** p.68  
**Improved Analytical Expressions for Avalanche Breakdown in 4H-SiC**  
Z. Stum<sup>1,2)</sup>, Y. Tang<sup>1)</sup>, H. Naik<sup>1)</sup>, and T. P. Chow<sup>1)</sup>  
<sup>1)</sup>Rensselaer Polytechnic Institute, USA, <sup>2)</sup>General Electric Global Research, USA
- Mo-P-47** p.69  
**Reliability Performance of 1200 V and 1700 V 4H-SiC DMOSFETs for Next Generation Power Conversion Applications**  
D. A. Gajewski, S. -H. Ryu, M. Das, and B. Hull, J. Young, and J. Palmour  
Cree, Inc., USA
- Mo-P-48** p.70  
**Evaluation of SiC Stack Cascode for 200°C Operations**  
X. Li, P. Alexandrov, J. Hostetler, and A. Bhalla  
United Silicon Carbide, Inc., USA

**Mo-P-49** p.71  
**Beam Acceleration Experiment with SiC Based Power Supply and the Next Generation SiC- JFET Package**  
K. Okamura<sup>1</sup>, Y. Osawa<sup>2</sup>, M. Wake<sup>1</sup>, and K. Takayama<sup>1</sup>  
<sup>1</sup>High Energy Accelerator Research Organization, Japan, <sup>2</sup>Shindengen Electric Manufacturing, Japan

**Mo-P-50** p.72  
**Comparison of 5kV 4H-SiC JBS and PiN Diodes**  
M. Berthou<sup>1</sup>, P. Godignon<sup>1</sup>, J. Calvo<sup>1</sup>, A. Mihaila<sup>2</sup>, E. Bianda<sup>2</sup>, and I. Nistor<sup>2</sup>  
<sup>1</sup>CNM-CSIC, Spain, <sup>2</sup>ABB Switzerland Ltd, Switzerland

**Mo-P-51** p.73  
**Selection of SPICE Parameters and Equations for Effective Simulation of Circuits with 4H-SiC Power MOSFETs**  
P. Tanner, S. Dimitrijević, H. Aminimoghadam, A. Aminbeidokhti, and J. Han  
Griffith University, Australia

**Mo-P-52** p.74  
**Modeling and Characterization of a Novel Advanced 4H-SiC Trench MOS Barrier Schottky Diode (TMBS)**  
L. Zheng, F. Zhang, S. B. Liu, L. Dong, X. F. Liu, B. Liu, G. G. Yan, L. Wang, W. S. Zhao, and G. S. Sun  
Chinese Academy of Sciences, China

**Mo-P-53** p.75  
**FLR with Partially Surface Doped Structure for 5kV 4H-SiC PiN Diode**  
H. W. Kim<sup>1</sup>, W. Bahng<sup>1</sup>, N. K. Kim<sup>1</sup>, and J. Y. Jo<sup>2</sup>  
<sup>1</sup>Korea Electrotechnology Research Institute, Korea, <sup>2</sup>Ajou University, Korea

**Mo-P-54** p.76  
**Comparison of 600V Si, SiC and GaN Power Devices**  
S. Chowdhury<sup>1</sup>, Z. M. Stum<sup>2</sup>, Z. Li<sup>1</sup>, and T. P. Chow<sup>1</sup>  
<sup>1</sup>Rensselaer Polytechnic Institute, USA, <sup>2</sup>General Electric Global Research, USA

**Mo-P-55** p.77  
**The Cryogenic Testing and Characterisation of SiC PiN Diodes**  
P. M. Gammon<sup>1</sup>, C. A. Fisher<sup>1</sup>, V. A. Shah<sup>2</sup>, M. R. Jennings<sup>1</sup>, A. Pérez-Tomás<sup>3</sup>, S. E. Burrows<sup>2</sup>, M. Myronov<sup>2</sup>, D. R. Leadley<sup>2</sup>, and P. A. Mawby<sup>1</sup>  
<sup>1</sup>University of Warwick, UK, <sup>2</sup>University of Warwick, UK, <sup>3</sup>IMB-CNM-CSIC, Spain

<Late News: Characterization>

**Mo-P-56** p.78  
**Defect Structure Characterization of AlN/SiC(11-20) Interface by Two Dimensional Photoelectron Diffraction Spectroscopy**  
N. Maejima<sup>1</sup>, F. Matsui<sup>1</sup>, M. Horita<sup>1</sup>, H. Matsui<sup>1</sup>, T. Ota<sup>1</sup>, R. Ishi<sup>1</sup>, M. Fujita<sup>1</sup>, K. Yasuda<sup>1</sup>, T. Matsushita<sup>2</sup>, and H. Daimon<sup>1</sup>  
<sup>1</sup>Nara Institute of Science and Technology, Japan, <sup>2</sup>JASRI/SPring-8, Japan

**Mo-P-57** p.79  
**Defect Levels in High Purity Semi-Insulating 4H-SiC Studied by Alpha Particle Induced Charge Transient Spectroscopy**  
N. Iwamoto, S. Onoda, N. Fujita, T. Makino, and T. Ohshima  
Japan Atomic Energy Agency, Japan

**Mo-P-58** p.80  
**Direct Observation of the Edge Termination of Surface Steps on 4H/6H-SiC {0001} by Tilted Low-Voltage Scanning Electron Microscopy**  
K. Ashida, T. Kajino, Y. Kutsuma, N. Ohtani, and T. Kaneko  
Kwansei Gakuin University, Japan

<Late News: Processing>

**Mo-P-59** p.81  
**Deep Interface Traps in 4H-SiC MOS Capacitors Investigated by Deep Level Transient Spectroscopy**  
E. Ö. Sveinbjörnsson<sup>1,2</sup> and Ó. Gíslason<sup>1</sup>  
<sup>1</sup>University of Iceland, Iceland, <sup>2</sup>Linköping University, Sweden

**Mo-P-60** p.82  
**4H-SiC MOS Capacitors and MOSFET Fabrication with Gate Oxidation at 1400°C**

H. Naik and T. P. Chow  
Rensselaer Polytechnic Institute, USA

**Mo-P-61** p.83  
**Improving Uniformity of Schottky Barrier Height of 4H-SiC Schottky Barrier Diode by Nitrided Sacrificial Oxidation**

D. Lee<sup>1</sup>, C. Kim<sup>1</sup>, H. Lee<sup>1</sup>, S. Lee<sup>1</sup>, H. Kang<sup>1</sup>, H. Kim<sup>1</sup>, Jeong Hyun Moon<sup>2</sup>, and H. J. Kim<sup>1</sup>

<sup>1</sup>Seoul National University, Korea, <sup>2</sup>Korea Electrotechnology Research Institute, Korea

**Mo-P-62** p.84  
**On the Ti<sub>3</sub>SiC<sub>2</sub> Metallic Phase Formation for Robust P-Type 4H-SiC Ohmic Contacts**

M. R. Jennings<sup>1</sup>, C. A. Fisher<sup>1</sup>, D. Walker<sup>1</sup>, A. Sanchez<sup>1</sup>, A. Pérez-Tomás<sup>2</sup>, D. P. Hamilton<sup>1</sup>, P. J. Gammon<sup>1</sup>, S. E. Burrows<sup>1</sup>, S. M. Thomas<sup>1</sup>, Y. Sharma<sup>1</sup>, F. Li<sup>1</sup>, and P. A. Mawby<sup>1</sup>

<sup>1</sup>University of Warwick, UK, <sup>2</sup>IMB-CNM-CSIC, Spain

***Industrial Session***      ***19:00-21:00***

Room: Tenzui and Juyo

## Tuesday, October 1

### **Tu-1A High Voltage Devices I 8:30-10:20**

Chairs: Y. Yonezawa (AIST, Japan)

R. Singh (GeneSiC Semiconductor, USA)

Room: Tenzui

8:30 **Tu-1A-1 <Invited>** p.85  
**Strategic Overview of High-Voltage SiC Power Device Development Aiming at Global Energy Savings**

L. Cheng<sup>1)</sup>, J. W. Palmour<sup>1)</sup>, A. K. Agarwal<sup>1,2)</sup>, E. V. Brunt<sup>1)</sup>, V. Pala<sup>1)</sup>, S. T. Allen<sup>1)</sup>, M. O'Loughlin<sup>1)</sup>, A. Burk<sup>1)</sup>, D. Grider<sup>1)</sup>, G-Y Wang<sup>3)</sup>, A. Q. Huang<sup>3)</sup>, and C. Scozzie<sup>4)</sup>

<sup>1)</sup>Cree Inc., USA, <sup>2)</sup>U.S. Dept. of Energy, USA, <sup>3)</sup>North Carolina State University, USA, <sup>4)</sup>U.S. Army Research Laboratory, USA

9:00 **Tu-1A-2** p.86  
**Ultrahigh-Voltage (> 20 kV) SiC PiN Diodes with a Space-Modulated JTE and Lifetime Enhancement Process via Thermal Oxidation**

N. Kaji, H. Niwa, J. Suda, and T. Kimoto

Kyoto University, Japan

9:20 **Tu-1A-3** p.87  
**Optical Triggering of High Current (1300 A), High-Voltage (12 kV) 4H-SiC Thyristor**

S. Romyantsev<sup>1,2)</sup>, M. Levinshtein<sup>1)</sup>, M. Shur<sup>2)</sup>, L. Cheng<sup>3)</sup>, A. Agarwal<sup>3)</sup>, and J. Palmour<sup>3)</sup>

<sup>1)</sup>Ioffe Physico-Technical Institute of Russian Academy of Sciences, Russia,

<sup>2)</sup>Rensselaer Polytechnic Institute, USA, <sup>3)</sup>Cree Inc., USA

9:40 **Tu-1A-4** p.88  
**Designing and Fabrication of the VLD Edge Termination for 3.3 kV SiC Devices**

K. Ebihara, Y. Yamamoto, Y. Nakaki, S. Aya, S. Nakata, M. Imaizumi, Y. Toyoda, and S. Yamakawa

Mitsubishi Electric Corporation, Japan

10:00 **Tu-1A-5 <Late News>** p.89  
**Static and Dynamic Performance Evaluation of >13KV SiC-ETO and Its Application as A Solid-State Breaker**

M. A. Rezaei<sup>1)</sup>, G. Wang<sup>1)</sup>, A. Q. Huang<sup>1)</sup>, and L. Cheng<sup>2)</sup>

<sup>1)</sup>North Carolina State University, USA, <sup>2)</sup>CREE Inc., USA

### **Tu-1B Physical Vapor Transport Growth 8:30-10:20**

Chairs: M. Pons (INPG, CNRS, France)

S. Nishizawa (AIST, Japan)

Room: Juyo

8:30 **Tu-1B-1 <Invited>** p.90  
**Open Issues in SiC Bulk Growth**

D. Chaussende, K. Ariyawong, N. Tsavdaris, M. Seiss, Y.J. Shin, J-M. Dedulle, R. Madar, E. Sarigiannidou, J. La Manna, O. Chaix-Pluchery, and T. Ouisse  
LMGP, CNRS UMR5628, Grenoble INP-Minatec, France

9:00 **Tu-1B-2** p.91  
**ZMP and Ultralow BPD SiC Substrates in Manufacturing**

A.R. Powell, R.L. Leonard, Y. Khlebnikov, E. Deyneka, M. McKay, J.J. Sumakeris, V. Tsvetkov, and E. Balkas

Cree, Inc., USA

9:20 **Tu-1B-3** p.92  
**Dislocation Density-Based Modeling of Plastic Behavior of 4H-SiC Single Crystals by the Alexander- Haasen Model during PVT Growth**

B. Gao<sup>1)</sup>, S. Nishizawa<sup>2)</sup>, and K. Kakimoto<sup>1)</sup>

<sup>1)</sup>Kyushu University, Japan, <sup>2)</sup>National Institute of Advanced Industrial Science and Technology, Japan

9:40 **Tu-1B-4** p.93  
**Real-Time Measurement of the Evolution of Growth Facets during SiC PVT Bulk Growth Using 3-D X-Ray Computed Tomography**

G. Neubauer<sup>1)</sup>, M. Salamon<sup>2)</sup>, N. Uhlmann<sup>2)</sup>, and P.J. Wellmann<sup>1)</sup>

<sup>1)</sup>University of Erlangen-Nürnberg, Germany, <sup>2)</sup>EZRT, Germany

10:00 **Tu-1B-5** p.94  
**Effect of Facet Occurrence on Polytype Destabilization during Bulk Crystal Growth of SiC by Seeded Sublimation**

N. Tsavdaris, K. Ariyawong, O. Chaix-Pluchery, E. Sarigiannidou, J.M. Dedulle, and D. Chaussende

LMGP, CNRS UMR5628, Grenoble INP-Minatec, France

**Tu-2A Epitaxy I: Defect Reduction 10:40-12:30**

Room: Tenzui

Chairs: A. Burk (Cree, USA)

G. Ferro (University Claude Bernard Lyon I, France)

10:40 **Tu-2A-1 <Invited>** p.95**Evolution of Fast 4H-SiC CVD Growth and Defect Reduction Techniques**H. Tsuchida<sup>1)</sup>, I. Kamata<sup>1)</sup>, M. Ito<sup>1)</sup>, T. Miyazawa<sup>1)</sup>, N. Hoshino<sup>1)</sup>, H. Fujibayashi<sup>1)</sup>, H. Ito<sup>1)</sup>, E. Makino<sup>2,3)</sup>, Y. Tokuda<sup>2,3)</sup>, and J. Kojima<sup>2,3)</sup><sup>1)</sup>Central Research Institute of Electric Power Industry, Japan, <sup>2)</sup>R&D Partnership for Future Power Electronics Technology, Japan, <sup>3)</sup>DENSO CORPORATION, Japan11:10 **Tu-2A-2** p.96**Evidence of Two-Dimensional Nucleation during 4H-SiC Homoepitaxy on 4° Off-Cut Substrates**M. Abadier<sup>1)</sup>, R.L. Myers-Ward<sup>2)</sup>, N.A. Mahadik<sup>2)</sup>, R.E. Stahlbush<sup>2)</sup>, V.D. Wheeler<sup>2)</sup>, L.O. Nyakiti<sup>2)</sup>, C.R. Eddy, Jr.<sup>2)</sup>, D.K. Gaskill<sup>2)</sup>, H. Song<sup>3)</sup>, T.S. Sudarshan<sup>3)</sup>, Y.N. Picard<sup>1)</sup>, and M. Skowronski<sup>1)</sup><sup>1)</sup>Carnegie Mellon University, USA, <sup>2)</sup>Naval Research Laboratory, USA, <sup>3)</sup>University of South Carolina, USA11:30 **Tu-2A-3** p.97**Demonstration of High Quality 4H-SiC Epitaxial Growth with Extremely Low Basal Plane Dislocation Density**T. Tanaka, N. Kawabata, Y. Mitani, N. Tomita, M. Tarutani, T. Kuroiwa, Y. Toyoda, M. Imaizumi, H. Sumitani, and S. Yamakawa  
Mitsubishi Electric Corporation, Japan11:50 **Tu-2A-4** p.98**Analysis of the Effects of Growth Rate on the Quality of 4H Silicon Carbide Films for MOSFET Applications**M. Camarda<sup>1)</sup>, S. Privitera<sup>1)</sup>, R. Anzalone<sup>1)</sup>, N. Piluso<sup>1)</sup>, P. Fiorenza<sup>1)</sup>, A. Alberti<sup>1)</sup>, A. La Magna<sup>1)</sup>, F. La Via<sup>1)</sup>, C. Vecchio<sup>2)</sup>, M. Mauceri<sup>2)</sup>, G. Litrico<sup>2)</sup>, A. Pecora<sup>2)</sup>, and D. Crippa<sup>3)</sup><sup>1)</sup>IMM-CNR, Italy, <sup>2)</sup>Epitaxial Technology Center, Italy, <sup>3)</sup>LPE spa, Italy12:10 **Tu-2A-5** p.99**Conversion of Basal Plane Dislocations to Threading Edge Dislocations in Growth of Epitaxial Layers on 4H-SiC Substrates with Vicinal Off-Angle**K. Masumoto<sup>1,2)</sup>, S. Ito<sup>1,2)</sup>, H. Goto<sup>2)</sup>, K. Tamura<sup>1,3)</sup>, C. Kudou<sup>1,4)</sup>, J. Nishio<sup>1,5)</sup>, K. Kojima<sup>1,2)</sup>, T. Ohno<sup>1,6)</sup>, and H. Okumura<sup>1,2)</sup><sup>1)</sup>R&D Partnership for Future Power Electronics Technology, Japan <sup>2)</sup>National Institute of Advanced Industrial Science and Technology, Japan <sup>3)</sup>ROHM Co., Ltd, Japan, <sup>4)</sup>Panasonic Corporation, Japan <sup>5)</sup>Toshiba Corporation, Japan <sup>6)</sup>Hitachi, Ltd, Japan**Tu-2B GaN & Related Materials 10:40-12:40**

Room: Juyo

Chairs: T. P. Chow (Rensselaer Polytechnic Institute, USA)

K. Ueno (Fuji Electric, Japan)

10:40 **Tu-2B-1 <Invited>** p.100**Commercialization of High 600 V GaN-on-Silicon Power HEMTs**P. Parikh, Y. Wu, and L. Shen

Transphorm Inc., USA

11:10 **Tu-2B-2 <Invited>** p.101**Diamond Based Power Device**S. Shikata<sup>1)</sup>, H. Umezawa<sup>1)</sup>, Y. Kato<sup>1)</sup>, H. Yamada<sup>1)</sup>, N. Tsubouchi<sup>1)</sup>, Y. Mokuno<sup>1)</sup>, A. Chayahara<sup>1)</sup> and T. Funaki<sup>2)</sup><sup>1)</sup>National Institute of Advanced Industrial Science and Technology, Japan, <sup>2)</sup>Osaka University, Japan11:40 **Tu-2B-3** p.102**Magnetoresistance of AlGaN/GaN High Electron Mobility Transistors on Silicon**S. Roensch<sup>1)</sup>, V. Sizov<sup>2)</sup>, T. Yagi<sup>2)</sup>, S. Murad<sup>2)</sup>, L. Groh<sup>2)</sup>, S. Lutgen<sup>2)</sup>, M. Sickmoeller<sup>2)</sup>, M. Krieger<sup>1)</sup>, and H. B. Weber<sup>1)</sup><sup>1)</sup>FAU Erlangen-Nuremberg, Germany, <sup>2)</sup>AZZURRO Semiconductors, Germany12:00 **Tu-2B-4** p.103**Evidence of Low Temperature Decomposition of GaN Hetero-Epitaxial Layers on c-Plane Sapphire Surface Characterized by Differential Scanning Calorimetry**N. Thierry-Jebali<sup>1,2)</sup>, R. Chiriac<sup>1)</sup>, and C. Brylinski<sup>1)</sup><sup>1)</sup>Université Lyon 1, CNRS, UMR, France, <sup>2)</sup>Université de Lyon, INSA de Lyon, France12:20 **Tu-2B-5** p.104**A Proposal to Apply Effective Acceptor Level for Representing Increased Ionization Ratio of Mg Acceptors in Extrinsic Photon-Recycled GaN**K. Mochizuki<sup>1)</sup>, T. Mishima<sup>2)</sup>, Y. Ishida<sup>3)</sup>, Y. Hatakeyama<sup>3)</sup>, K. Nomoto<sup>3)</sup>, N. Kaneda<sup>2)</sup>, T. Tsuchiya<sup>2)</sup>, A. Terano<sup>1)</sup>, T. Tsuchiya<sup>1)</sup>, H. Uchiyama<sup>1)</sup>, S. Tanaka<sup>1)</sup>, and T. Nakamura<sup>3)</sup><sup>1)</sup>Hitachi, Ltd., Japan, <sup>2)</sup>Hitachi Cable, Ltd., Japan, <sup>3)</sup>Hosei University, Japan

**Tu-3A Epitaxy 2 : High Throughput 13:45-15:35**

Room: Tenzui

Chairs: A. Henry (Linköping University, Sweden)

H. Tsuchida (CRIEPI, Japan)

**13:45 Tu-3A-1 <Invited> p.105  
Progress in Large-Area 4H-SiC Epitaxial Layer Growth in a Warm-Wall Planetary Reactor**

B. Thomas, D. M. Hansen, J. Zhang, M. J. Loboda, J. Uchiyama, T. J. Toth, G. Chung, I. C. Manning, J. P. Quast, and S.G. Mueller  
Dow Corning Corporation, USA

**14:15 Tu-3A-2 p.106  
C-Face Epitaxial Growth of 4H-SiC on Quasi-150-mm Diameter Wafers with High Throughput**

J. Nishio<sup>1,2)</sup>, C. Kudou<sup>1,3)</sup>, K. Tamura<sup>1,4)</sup>, K. Masumoto<sup>1,5)</sup>, K. Kojima<sup>1,5)</sup> and T. Ohno<sup>1,6)</sup>  
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**14:35 Tu-3A-3 p.107  
Latest SiC Epitaxial Layer Growth Results in a High-Throughput 6x150 mm Warm-Wall Planetary Reactor**

A. A. Burk, D. Tsvetkov, M. J. O'Loughlin, S. Ustin, and L. Garrett  
Cree, Inc., USA

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Fast 150 mm 4H-SiC Epitaxial Growth with High-Speed Wafer Rotation**

H. Fujibayashi<sup>1,2)</sup>, M. Ito<sup>1)</sup>, H. Ito<sup>1,3)</sup>, I. Kamata<sup>1)</sup>, M. Naito<sup>2)</sup>, K. Hara<sup>2)</sup>, S. Yamauchi<sup>2)</sup>, K. Suzuki<sup>3)</sup>, M. Yajima<sup>3)</sup>, S. Mitani<sup>3)</sup>, K. Suzuki<sup>4)</sup>, H. Aoki<sup>4)</sup>, K. Nishikawa<sup>5)</sup>, T. Kozawa<sup>5)</sup>, and H. Tsuchida<sup>1)</sup>  
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**15:15 Tu-3A-5 p.109  
SiC-4H Epitaxial Layer Grown on 150 mm Automatic Horizontal Hot Wall Reactor PE106**

D. Crippa<sup>1)</sup>, M. Mauceri<sup>2)</sup>, A. Pecora<sup>2)</sup>, G. Litrico<sup>2)</sup>, C. Vecchio<sup>2)</sup>, M. Puglisi<sup>2)</sup>, N. Piluso<sup>3)</sup>, M. Camarda<sup>3)</sup>, and F. La Via<sup>3)</sup>  
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**Tu-3B Quantum Systems & MOS Characterization 13:45-15:35**

Chairs: N.T. Son (Linköping University, Sweden)

Room: Juyo

R. Stahlbush (Naval Research Laboratory, USA)

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Engineering Defect Spin States in SiC for Sensing and Computation**

A. L. Falk<sup>1)</sup>, W. F. Koehl<sup>1)</sup>, B. B. Buckley<sup>2)</sup>, G. Calusine<sup>2)</sup>, F. J. Heremans<sup>1)</sup>, V. V. Dobrovitski<sup>3)</sup>, A. Politi<sup>2)</sup>, and D. D. Awschalom<sup>1,2)</sup>  
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Theoretical Investigation of the Single Photon Emitter Carbon Antisite-Vacancy Pair in 4H-SiC**

V. Ivády<sup>1,2)</sup> and A. Gal<sup>2,3)</sup>  
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**14:35 Tu-3B-3 p.112  
Silicon Carbide Light-Emitting Diode as a Prospective Room Temperature Source for Single Photons**

F. Fuchs<sup>1)</sup>, V. Soltamov<sup>2)</sup>, S. Váth<sup>1)</sup>, H. Kraus<sup>1)</sup>, P. Baranov<sup>2)</sup>, E. Mokhov<sup>2)</sup>, G. Astakhov<sup>1)</sup>, and V. Dyakonov<sup>1,3)</sup>  
<sup>1</sup>Julius Maximilian University of Würzburg, Germany, <sup>2</sup>Ioffe Physical-Technical Institute, Russia, <sup>3</sup>ZAE Bayern, Germany

**14:55 Tu-3B-4 p.113  
Retarded Oxide Growth on 4H-SiC(0001) Substrates Due to Sacrificial Oxidation**

T. Hosoi<sup>1)</sup>, Y. Uenishi<sup>1)</sup>, Y. Nakano<sup>2)</sup>, T. Nakamura<sup>2)</sup>, T. Shimura<sup>1)</sup>, and H. Watanabe<sup>1)</sup>  
<sup>1</sup>Osaka University, Japan, <sup>2</sup>ROHM Co., Ltd., Japan

**15:15 Tu-3B-5 p.114  
Structural Difference between Near Interface Oxides Grown on Si and C Faces of 4H-SiC Characterized by FTIR-ATR Method**

H. Hirai<sup>1)</sup> and K. Kita<sup>1,2)</sup>  
<sup>1</sup>The University of Tokyo, <sup>2</sup>JST-PRESTO, Japan

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**Ge Assisted SiC Epitaxial Growth by CVD on SiC Substrate**

K. Alassaad<sup>1)</sup>, V. Soulière<sup>1)</sup>, B. Doisneau<sup>2)</sup>, F. Cauwet<sup>1)</sup>, H. Peyre<sup>3)</sup>, D. Carole<sup>1)</sup>, D. Chaussende<sup>2)</sup>, and G. Ferro<sup>1)</sup>

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<sup>3)</sup>Université Montpellier, France

<Bulk Growth>

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D. -G. Shin<sup>1)</sup>, H. -R. Son<sup>2)</sup>, S. Heo<sup>2)</sup>, B. -S. Kim<sup>2)</sup>, J. -E. Han<sup>2)</sup>, K. -S Min<sup>2)</sup>, and D. -H. Lee<sup>2)</sup>

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**Effect of TaC-Coated Crucible on SiC Single Crystal Growth**

D. -H. Lee<sup>1)</sup>, H. -T. Lee<sup>1)</sup>, B. -J. Bae<sup>1)</sup>, H. -J. Lee<sup>1)</sup>, S. -I. Lee<sup>1)</sup>, M. -S. Park<sup>1)</sup>, W. -J. Lee<sup>1)</sup>, I. -G. Yeo<sup>2)</sup>, T. -H. Eun<sup>2)</sup>, and M. -C. Chun<sup>3)</sup>

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**Low-Defect 4" 4H-SiC Single Crystal Growth by Using High Temperature Reaction Seed Adhesion Method**

J. W. Choi, J. H. Park, J. G. Kim, K. R. Ku, M. O. Kyun, J. D. Seo, B. G. Chang, and J. R. Oh

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K. Ariyawong, N. Tsavdaris, J. M. Dedulle, E. Sarigiannidou, T. Ouisse, and D. Chaussende

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**Comparison of Thermodynamic Databases for the Modeling of SiC Growth by PVT**

K. Ariyawong<sup>1)</sup>, E. Blanquet<sup>2)</sup>, J. M. Dedulle<sup>1)</sup>, T. Ouisse<sup>1)</sup>, and D. Chaussende<sup>1)</sup>

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**Spiral Step Dissociation on PVT Grown SiC Crystals**

M. Seiss, T. Ouisse, and D. Chaussende

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C. Ohshige<sup>1)</sup>, T. Takahashi<sup>1)</sup>, N. Ohtani<sup>1,2,3)</sup>, M. Katsuno<sup>4)</sup>, T. Fujimoto<sup>4)</sup>, S. Sato<sup>4)</sup>, H. Tsuge<sup>4)</sup>, T. Yano<sup>4)</sup>, H. Matsuhata<sup>2)</sup>, and M. Kitabatake<sup>2)</sup>

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**4" 4H-SiC Crystals Grown Using W Coating Crucible by PVT**

J. H. Park, J. W. Choi, J. G. Kim, K. R. Ku, M. O. Kyun, J. D. Seo, B. G. Chang, and J. R. Oh

SKC, Korea

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Y. Makarov<sup>1</sup>, D. Litvin<sup>2</sup>, A. Vasiliev<sup>2</sup>, and S. Nagalyuk<sup>2</sup>  
<sup>1</sup>Nitride Crystals Inc., USA, <sup>2</sup>Nitride Crystals Ltd., Russia
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 SHOWA DENKO K.K., Japan
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 Chinese Academy of Sciences, China
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K. Sawada, J. -I. Iwata, and A. Oshiyama  
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<sup>1</sup>Hitachi High-Technologies Corp., Japan, <sup>2</sup>Kyoto Institute of Technology, Japan
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Y. Ishikawa<sup>1</sup>, Y. Yao<sup>1</sup>, K. Sato<sup>1</sup>, Y. Sugawara<sup>1</sup>, Y. Okamoto<sup>2</sup>, and N. Hayashi<sup>2</sup>  
<sup>1</sup>Japan Fine Ceramics Center, Japan, <sup>2</sup>ACT Corporation, Japan



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Y. Sugawara<sup>1)</sup>, M. Nakamori<sup>1)</sup>, Y. Yao<sup>1)</sup>, Y. Ishikawa<sup>1)</sup>, K. Danno<sup>2)</sup>, H. Suzuki<sup>2)</sup>, T. Bessho<sup>2)</sup>, S. Yamaguchi<sup>3)</sup>, K. Nishikawa<sup>3)</sup>, and Y. Ikuhara<sup>1,4)</sup>  
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H. Sako<sup>1)</sup>, T. Yamashita<sup>1)</sup>, K. Tamura<sup>1)</sup>, M. Sasaki<sup>1)</sup>, M. Nagaya<sup>1)</sup>, T. Kido<sup>1)</sup>, K. Kawata<sup>1)</sup>, T. Kato<sup>1,2)</sup>, H. Matsuhata<sup>1,2)</sup>, and M. Kitabatake<sup>1)</sup>  
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T. Yamashita<sup>1,2)</sup>, H. Matsuhata<sup>1,3)</sup>, Y. Miyasaka<sup>1,2)</sup>, K. Momose<sup>1,2)</sup>, T. Sato<sup>1,2)</sup>, and M. Kitabatake<sup>1)</sup>  
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N. Piluso, M. Camarda, R. Anzalone, and F. La Via  
IMM - CNR, Italy

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M. Odawara, K. Kamei, Y. Miyasaka, T. Yamashita, S. Takahashi, Y. Kageshima, K. Momose, H. Osawa, and T. Sato  
SHOWA DENKO K.K., Japan

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N. Sugiyama<sup>1,2)</sup>, M. Yamada<sup>1,2)</sup>, Y. Urakami<sup>1,2)</sup>, M. Kobayashi<sup>1,3)</sup>, T. Masuda<sup>1,3)</sup>, K. Shigetoh<sup>1,4)</sup>, I. Gunjishima<sup>1,4)</sup>, F. Hirose<sup>1,2)</sup>, and S. Onda<sup>1,2)</sup>  
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S. Ushio, T. Fujimoto, H. Tsuge, M. Katsuno, S. Sato, K. Tani, H. Hirano, and T. Yano  
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Y. J. Shin<sup>1,2)</sup>, S. I. Kim<sup>3)</sup>, K. Y. Lee<sup>3)</sup>, H. J. Jung<sup>1)</sup>, C. W. Lee<sup>3)</sup>, and W. Bahng<sup>1)</sup>  
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O. Drozdova<sup>1)</sup>, I. Miura<sup>1)</sup>, and N. Ohtani<sup>2)</sup>  
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M. Sasaki<sup>1)</sup>, K. Tamura<sup>1)</sup>, H. Sako<sup>1)</sup>, M. Kitabatake<sup>1)</sup>, K. Kojima<sup>1,2)</sup>, and H. Matsuhata<sup>1,2)</sup>

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**Development of Silicon Carbide Dry Etcher Using Chlorine Trifluoride Gas**  
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**Reliability Improvement and Optimization of Trench Orientation of 4H-SiC Trench Gate Oxide**

T. Kojima<sup>1,2)</sup>, S. Harada<sup>1,3)</sup>, K. Ariyoshi<sup>1,4)</sup>, J. Senzaki<sup>1,3)</sup>, M. Takei<sup>1,2)</sup>, Y. Yonezawa<sup>1,3)</sup>, Y. Tanaka<sup>1,3)</sup>, and H. Okumura<sup>1,3)</sup>

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**Impact of a High Temperature Anneal on 4H-SiC Trench Profiles**

C. T. Banzhaf<sup>1)</sup>, M. Rambach<sup>1)</sup>, A. Trautmann<sup>1)</sup>, A. J. Bauer<sup>2)</sup>, and L. Frey<sup>2,3)</sup>

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**Conduction Mechanism of Leakage Current in Thermal Oxide on 4H-SiC**

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**Systematic Analysis of the High- and Low-Field Channel Mobility in Lateral 4H-SiC MOSFETs**

C. Strenger<sup>1,4)</sup>, V. Uhnevionak<sup>1,4)</sup>, V. Mortet<sup>2,4)</sup>, G. Ortiz<sup>2,4)</sup>, A. Burenkov<sup>1,4)</sup>, A. J. Bauer<sup>1,4)</sup>, T. Erlbacher<sup>1,4)</sup>, F. Cristiano<sup>2,4)</sup>, E. Bedel-Pereira<sup>2,4)</sup>, P. Pichler<sup>1,4)</sup>, and H. Ryssel<sup>1,3)</sup>

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**Experimental Studies on Water Vapor Plasma Oxidation and Thermal Oxidation of 4H-SiC (0001) for Clarification of the Atomic-Scale Flattening Mechanism in Plasma Assisted Polishing**

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A. Chanthaphan<sup>1)</sup>, T. Hosoi<sup>1)</sup>, Y. Nakano<sup>2)</sup>, T. Nakamura<sup>2)</sup>, T. Shimura<sup>1)</sup>, and H. Watanabe<sup>1)</sup>

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K. Yamada<sup>1)</sup>, O. Ishiyama<sup>1)</sup>, K. Tamura<sup>1)</sup>, T. Yamashita<sup>1)</sup>, A. Shimozato<sup>2)</sup>, T. Kato<sup>1,2)</sup>, J. Senzaki<sup>1,2)</sup>, H. Matsuhata<sup>1,2)</sup>, and M. Kitabatake<sup>1)</sup>

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R. Hasunuma, M. Nagoshi, and K. Yamabe  
University of Tsukuba, Japan

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X. Deng, C. Rao, J. Wei, H. Jiang, M. Chen, X. Wang, and B. Zhang  
University of Electronic Science and Technology of China, China

**Tu-P-43** p.156  
**Improved 4H-SiC Layer Exfoliation for Monolithic Integration of SiC Devices with Si Circuits and for Reduced Cost Device-Quality SiC Substrates**

V. P. Amarasinghe<sup>1)</sup>, G. Liu<sup>1)</sup>, L. Wielunski<sup>1)</sup>, A. Barcz<sup>2)</sup>, L. C. Feldman<sup>1)</sup>, and G. K. Celler<sup>1)</sup>

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Y. Tanaka<sup>1)</sup>, A. Takatsuka<sup>1)</sup>, H. Bao Cong<sup>2)</sup>, Y. Satoh<sup>2)</sup>, A. Fukui<sup>3)</sup>, A. Matsumoto<sup>3)</sup>, M. Yamasaki<sup>4)</sup>, and H. Ohashi<sup>1)</sup>

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Y. Saitoh<sup>1)</sup>, M. Furumai<sup>1)</sup>, T. Hiyoshi<sup>1)</sup>, K. Wada<sup>1)</sup>, T. Masuda<sup>1)</sup>, K. Hiratsuka<sup>1)</sup>, Y. Mikamura<sup>1)</sup>, and T. Hatayama<sup>2)</sup>

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Y. Nakanishi, T. Tominaga, H. Okabe, Y. Suehiro, K. Sugahara, Y. Toyoda, S. Yamakawa, H. Murasaki, K. Kobayashi, and H. Sumitani  
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S. Akiyama, K. Katoh, H. Shimizu, A. Hatanaka, T. Ogawa, N. Yokoyama, and K. Ishikawa  
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**High Temperature Hydrogen Sensor Based on Silicon Carbide (SiC) MOS Capacitor Structure**

B. Ofrim, G. Brezeanu, F. Draghici, and I. Rusu  
University POLITEHNICA of Bucharest, Romania

- Tu-P-49** p.162  
**Development of 3.3 kV SiC-MOSFET: Suppression of Forward Voltage Degradation of the Body Diode**  
S. Yamamoto, Y. Nakao, N. Tomita, S. Nakata, and S. Yamakawa  
Mitsubishi Electric Corporation, Japan
- Tu-P-50** p.163  
**Modeling of High Performance 4H-SiC Emitter-Coupled Logic Circuits**  
S. Singh, N. El Sayed, T. ElBoshra, M. Wahbah, and M. Al Zaabi  
Khalifa University of Science, Technology, and Research, United Arab Emirates
- Tu-P-51** p.164  
**Characterization of 4H-SiC BJT at High Temperatures**  
N. Zhang, Y. Rao, N. Xu, and A. P. Pisano  
University of California, Berkeley, USA
- Tu-P-52** p.165  
**4H-SiC Schottky Diode Avalanche Breakdown Voltage Estimation by Simulation and Experimental Analysis**  
H. Rong<sup>1)</sup>, F. Li<sup>1)</sup>, Y. Sharma<sup>1)</sup>, M. R. Jennings<sup>1,2)</sup>, and P. A. Mawby<sup>1,2)</sup>  
<sup>1)</sup>The University of Warwick, UK, <sup>2)</sup>Anvil Semiconductors Ltd, UK
- Tu-P-53** p.166  
**Variant of Excess Current in 4H-SiC pn Structures**  
A. M. Strel'chuk<sup>1)</sup>, E. V. Kalinina<sup>1)</sup>, A. A. Lebedev<sup>1)</sup>, I. K. Boricheva<sup>2)</sup>, and V. V. Pavshukov<sup>2)</sup>  
<sup>1)</sup>Ioffe Physical-technical Institute of the Russian Academy of Sciences, Russia,  
<sup>2)</sup>Polytechnical University, Russia
- Tu-P-54** p.167  
**High-Temperature and High-Power Operation of 4H-SiC Nanoribbon Field Effect Transistors**  
M. -S. Kang<sup>1)</sup>, A. Hallén<sup>2)</sup>, C. -M. Zetterling<sup>2)</sup>, and S. -M. Koo<sup>1)</sup>  
<sup>1)</sup>Kwangwoon University, Korea, <sup>2)</sup>KTH, Royal Institute of Technology, Sweden
- Tu-P-55** p.168  
**14.7 mΩcm<sup>2</sup> 3.3kV DIMOSFET on 4H-SiC (000-1)**  
H. Kono<sup>1,2)</sup>, M. Furukawa<sup>1,2)</sup>, K. Ariyoshi<sup>1,2)</sup>, T. Suzuki<sup>1,2)</sup>, Y. Tanaka<sup>1,3)</sup>, and T. Shinohe<sup>1,2)</sup>  
<sup>1)</sup>R&D Partnership for Future Power Electronics Technology, Japan, <sup>2)</sup>Toshiba Corp., Japan, <sup>3)</sup>National Institute of Advanced Industrial Science and Technology, Japan
- Tu-P-56** p.169  
**Discriminating High κ Dielectric Gas Sensors**  
S. K. Roy, K. V. Vassilevski, C. J. O'Malley, N. G. Wright, and A. B. Horsfall  
Newcastle University, UK
- Tu-P-57** **Withdrawn**  
*<Late News: Devices and Circuits>*
- Tu-P-58** p.170  
**Stability of Current Gain in SiC BJTs**  
B. Buono, F. Allerstam, M. Domeij, A. Konstantinov, K. Gumaelius, H. Das, and T. Neyer  
Fairchild Semiconductor, Sweden
- Tu-P-59** p.171  
**Fabrication of 700V 4H-SiC SBDs with Ultra-Low Resistance of 0.22mΩ-cm<sup>2</sup> nearby the SiC Material Limit**  
T. Sakaguchi, M. Aketa, Y. Miura, H. Asahara, and T. Nakamura  
ROHM Co., Ltd., Japan
- <Late News: Bulk Growth>*
- Tu-P-60** p.172  
**Solution Growth of P-Type 4H-SiC Bulk Crystals with Low Resistivity**  
T. Shirai, K. Danno, A. Seki, H. Sakamoto, and T. Bessho  
Toyota Motor Corporation, Japan

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**Top-Seeded Solution Growth of 4H-SiC Bulk Crystal Using Metal Solvents**

K.Kusunoki<sup>1)</sup>, K. Kamei<sup>1)</sup>, K. Moriguchi<sup>1)</sup>, N. Okada<sup>1)</sup>, H. Kaido<sup>1)</sup>, H. Daikoku<sup>2)</sup>, M. Kado<sup>2)</sup>, K. Danno<sup>2)</sup>, H. Sakamoto<sup>2)</sup>, and T. Bessho<sup>2)</sup>

<sup>1)</sup>Nippon Steel & Sumitomo Metal Corporation, Japan, <sup>2)</sup>Toyota Motor Corporation, Japan

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**Growth of Low Resistivity N-Type 4H-SiC Bulk Crystals by Sublimation Method Using Co-Doping Technique**

T. Kato<sup>1,2)</sup>, S. Takagi<sup>2)</sup>, T. Miura<sup>1,2)</sup>, K. Eto<sup>1,2)</sup>, Y. Urakami<sup>2,3)</sup>, H. Kondo<sup>2,3)</sup>, F. Hirose<sup>2,3)</sup>, and H. Okumura<sup>1,2)</sup>

<sup>1)</sup>National Institute of Advanced Industrial Science and Technology, Japan, <sup>2)</sup>R&D Partnership for Future Power Electronics Technology, Japan, <sup>3)</sup>DENSO CORPORATION, Japan

**Tu-P-63**

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**Evidence of High-Quality and Very Fast 4H-SiC Crystal Growth by the High-Temperature Gas Source Method**

I. Kamata<sup>1)</sup>, N. Hoshino<sup>1)</sup>, Y. Tokuda<sup>2,3)</sup>, E. Makino<sup>2,3)</sup>, J. Kojima<sup>2,3)</sup>, and H. Tsuchida<sup>1)</sup>

<sup>1)</sup>Central Research Institute of Electric Power Industry, Japan, <sup>2)</sup>R&D Partnership for Future Power Electronics Technology, Japan, <sup>3)</sup>DENSO CORPORATION Research Laboratories, Japan

## Wednesday, October 2

**We-1A MOSFET 2 8:30-10:20**

Room: Tenzui

Chairs: T. Nakamura (ROHM, Japan)  
J. Palmour (Cree, USA)

8:30 **We-1A-1 <Invited>** p.176  
**Electrical Characteristics/Reliability Affected by Defects Analyzed by the Integrated Evaluation Platform for SiC Epitaxial Films**

M. Kitabatake

R&D Partnership for Future Power Electronics Technology, Japan,

9:00 **We-1A-2** p.177  
**Novel Gate Oxide Process for Realization of High Threshold Voltage in 4H-SiC MOSFET**

M. Furuhashi, T. Tanioka, M. Imaizumi, N. Miura, and S. Yamakawa  
Mitsubishi Electric Corporation, Japan

9:20 **We-1A-3** p.178  
**Impact of Hot Carrier Degradation and Positive Bias Stress on Lateral 4H-SiC nMOSFETs**

G. Pobegen<sup>1,3)</sup>, T. Aichinger<sup>2)</sup>, A. Salinaro<sup>2)</sup>, and T. Grasser<sup>3)</sup>

<sup>1)</sup>KAI GmbH, Austria, <sup>2)</sup>Infineon Technologies AG, Austria, <sup>3)</sup>Vienna University of Technology, Austria

9:40 **We-1A-4** p.179  
**1700 V, 5.5 mΩ-cm<sup>2</sup> 4H-SiC DMOSFETs with Stable 225°C Operation**

K. Matocha, K. Chatty, S. Banerjee, and L. Rowland  
Monolith Semiconductor Inc., USA

10:00 **We-1A-5 <Late News>** p.180  
**A Novel Truncated V-groove 4H-SiC MOSFET with High Avalanche Breakdown Voltage and Low On-resistance**

T. Masuda<sup>1)</sup>, K. Wada<sup>1)</sup>, T. Hiyoshi<sup>1)</sup>, Y. Saitou<sup>1)</sup>, H. Tamaso<sup>1)</sup>, M. Sakai<sup>1)</sup>, K. Hiratsuka<sup>1)</sup>, Y. Mikamura<sup>1)</sup>, M. Nishiguchi<sup>1)</sup>, T. Hatayama<sup>2)</sup>, and H. Yano<sup>2)</sup>

<sup>1)</sup>Sumitomo Electric Industries, Ltd, Japan, <sup>2)</sup>Nara Institute of Science and Technology, Japan

**We-1B Epitaxy 3: Novel Approaches 8:30-10:20**

Room: Juyo

Chairs: B. Thomas (Dow Corning, USA)  
J. Nishio (Toshiba, Japan)

8:30 **We-1B-1 <Invited>** p.181  
**Development of Homoepitaxial Growth Technique on 4H-SiC Vicinal off Angled Substrate**

K. Kojima<sup>1,2)</sup>, K. Masumoto<sup>1,2)</sup>, S. Ito<sup>2)</sup>, A. Nagata<sup>2)</sup> and H. Okumura<sup>1,2)</sup>

<sup>1)</sup>R&D Partnership for Future Power Electronics Technology, Japan, <sup>2)</sup>National Institute of Advanced Industrial Science and Technology, Japan

9:00 **We-1B-2** p.182  
**Homo-Epitaxial Growth on Low-Angle Off Cut 4H-SiC Substrate**

X. Li, E. Janzén, and A. Henry  
Linköping University, Sweden

9:20 **We-1B-3** p.183  
**Epitaxial Growth of Thick Multi-Layer 4H-SiC for the Fabrication of Very High-Voltage C-Face n-Channel IGBT**

T. Miyazawa<sup>1)</sup>, S. Ji<sup>2)</sup>, K. Kojima<sup>2)</sup>, Y. Ishida<sup>2)</sup>, K. Nakayama<sup>3)</sup>, A. Tanaka<sup>3)</sup>, K. Asano<sup>3)</sup>, and H. Tsuchida<sup>1)</sup>

<sup>1)</sup>Central Research Institute of Electric Power Industry, Japan, <sup>2)</sup>National Institute of Advanced Industrial Science and Technology, Japan, <sup>3)</sup>Kansai Electric Power Co., Inc., Japan

9:40 **We-1B-4** p.184  
**Chloride-Based CVD of 4H-SiC Using Methane as Carbon Precursor**

M. Yazdanfar, H. Pedersen, O. Kordina, and E. Janzén  
Linköping University, Sweden

10:00 **We-1B-5** p.185  
**Heteroepitaxial CVD Growth of 3C-SiC on Diamond Substrate**

V. Soulière, A. Vo-Ha, D. Carole, and G. Ferro  
Université Claude Bernard Lyon 1, CNRS, France

**We-2A JFET & BJT 10:40-12:30**

Room: Tenzui

Chairs: M. Domeij (Fairchild Semiconductor, Sweden)  
R. Rupp (Infineon Technologies, Germany)

10:40 **We-2A-1 <Invited>** p.186  
**High-Efficiency Power Conversion Using Silicon Carbide Power Electronics**  
H. -P. Nee<sup>1)</sup>, J. Rabkowski<sup>1)</sup>, D. Peftitsis<sup>1)</sup>, G. Tolstoy<sup>1)</sup>, J. Colmenares<sup>1)</sup>, D. Sadik<sup>1)</sup>, M. Bakowski<sup>2)</sup>, J. -K. Lim<sup>2)</sup>, A. Antonopoulos<sup>1)</sup>, L. Ängquist<sup>1)</sup>, and M. Zdanowski<sup>3)</sup>

<sup>1)</sup>KTH Royal Institute of Technology, Sweden, <sup>2)</sup>Acreo, Sweden, <sup>3)</sup>Technical University of Warsaw, Poland

11:10 **We-2A-2** p.187  
**3 kV Normally-Off 4H-SiC Buried Gate Static Induction Transistors (SiC-BGSITs)**

A. Takatsuka<sup>1)</sup>, Y. Tanaka<sup>1)</sup>, K. Yano<sup>2)</sup>, N. Matsumoto<sup>1)</sup>, T. Yatsuo<sup>1)</sup>, and K. Arai<sup>1)</sup>

<sup>1)</sup>National Institute of Advanced Industrial Science and Technology, Japan,  
<sup>2)</sup>University of Yamanashi, Japan

11:30 **We-2A-3** p.188  
**Rapidly Maturing SiC Junction Transistors Featuring Current Gain ( $\beta$ ) > 130 and Blocking Voltages up to 2700 V**

S. Sundaresan, S. Jeliakov, B. Grummel, and R. Singh  
GeneSiC Semiconductor Inc., USA

11:50 **We-2A-4** p.189  
**650 V SiC JFET for High Efficiency Applications**  
W. Bergner<sup>1)</sup>, R. Rupp<sup>2)</sup>, U. Kirchner<sup>1)</sup>, and D. Kück<sup>1)</sup>  
<sup>1)</sup>Infineon Technologies Austria AG, Austria, <sup>2)</sup>Infineon Technologies AG, Germany

12:10 **We-2A-5 <Late News>** p.190  
**40m $\Omega$ /1700V DioMOS (Diode in SiC MOSFET) for High Power Switching Applications**  
A. Ohoka, N. Horikawa, T. Kiyosawa, H. Sorada, M. Uchida, Y. Kanzawa, K. Sawada, T. Ueda, and E. Fujii  
Panasonic Corporation, Japan

**We-2B Graphene I 10:40-12:30**

Room: Juyo

Chairs: S. Tanaka (Kyushu University, Japan)  
M. Hundhausen (University of Erlangen-Nürnberg, Germany)

10:40 **We-2B-1 <Invited>** p.191  
**Exceptional Ballistic Transport in Epitaxial Graphene Nanoribbons**  
W. A. de Heer<sup>1)</sup>, J. Baringhaus<sup>2)</sup>, M. Ruan<sup>1)</sup>, F. Edler<sup>2)</sup>, A. Tejada<sup>3,4)</sup>, M. Sicot<sup>3)</sup>, A. Taleb-Ibrahimi<sup>4)</sup>, Z. Jiang<sup>1)</sup>, E. Conrad<sup>1)</sup>, C. Berger<sup>1,5)</sup>, and C. Tegenkamp<sup>2)</sup>

<sup>1)</sup>Georgia Institute of Technology, USA, <sup>2)</sup>Leibniz Universität, Germany, <sup>3)</sup>CNRS. Univ. de Nancy UPV-Metz, France, <sup>4)</sup>CNRS/Synchrotron SOLEIL, France, <sup>5)</sup>CNRS-Institut Neel, France

11:10 **We-2B-2** p.192  
**Stability and Reactivity of [11-20] Step in Initial Stage of Epitaxial Graphene Growth on SiC(0001)**

H. Kageshima<sup>1)</sup>, H. Hibino<sup>1)</sup>, H. Yamaguchi<sup>1)</sup>, and M. Nagase<sup>2)</sup>

<sup>1)</sup>NTT Corporation, Japan, <sup>2)</sup>University of Tokushima, Japan

11:30 **We-2B-3** p.193  
**A Novel Ordered Phase Observed on an Epitaxial Graphene Superlattice on SiC(0001) Induced by the Intercalation of Cu Atoms**

S. Forti<sup>1)</sup>, A. Stöhr<sup>1)</sup>, Y. R. Niu<sup>2)</sup>, A. A. Zakharov<sup>2)</sup>, and U. Starke<sup>1)</sup>

<sup>1)</sup>Max Planck Institute for Solid State Research, Germany, <sup>2)</sup>MAX Lab Synchrotron Radiation Facility, Sweden

11:50 **We-2B-4** p.194  
**Thickness Uniformity and Wrinkling in Epitaxial Graphene Grown on SiC Polytypes**

G.R. Yazdi<sup>1)</sup>, T. Iakimov<sup>1)</sup>, M. Neek-Amal<sup>2)</sup>, F.M. Peeters<sup>2)</sup>, A. Zakharov<sup>3)</sup>, and R. Yakimova<sup>1)</sup>

<sup>1)</sup>Linköping University, Sweden, <sup>2)</sup>Universiteit Antwerpen, Belgium, <sup>3)</sup>Max Lab, Sweden

12:10 **We-2B-5** p.195  
**Disentangling the Effects of Strain and Charge on the Raman Lines of Epitaxial Graphene**

F. Fromm<sup>1)</sup>, P. Wehrfritz<sup>1)</sup>, M. Hundhausen<sup>2)</sup>, and T. Seyller<sup>1)</sup>

<sup>1)</sup>TU Chemnitz, Germany, <sup>2)</sup>Universität Erlangen-Nürnberg, Germany

**We-3A MOS Interface 13:45-15:35**

Room: Tenzui

Chairs: H. Watanabe (Osaka University, Japan)  
S. Dimitrijevic (Griffith University, Australia)

- 13:45 **We-3A-1 <Invited>** p.196  
**Accurate Characterization of Interface State Density of SiC MOS Structures and the Impacts on Channel Mobility**  
H. Yoshioka<sup>1,2)</sup>, T. Nakamura<sup>3)</sup>, J. Senzaki<sup>2)</sup>, A. Shimosato<sup>2)</sup>, Y. Tanaka<sup>2)</sup>, H. Okumura<sup>2)</sup>, and T. Kimoto<sup>1)</sup>  
<sup>1)</sup>Kyoto University, Japan, <sup>2)</sup>National Institute of Advanced Industrial Science and Technology, Japan, <sup>3)</sup>Rohm Co., Ltd., Japan
- 14:15 **We-3A-2** p.197  
**Deep-Level Transient Spectroscopy Characterization of Mobility-Limiting Interface States in SiO<sub>2</sub>/4H-SiC Structures**  
T. Hatakeyama<sup>1,2)</sup>, M. Sometani<sup>1)</sup>, K. Fukuda<sup>1)</sup>, H. Okumura<sup>1)</sup>, and T. Kimoto<sup>3)</sup>  
<sup>1)</sup>National Institute of Advanced Industrial Science and Technology, Japan, <sup>2)</sup>Toshiba Corporation, Japan, <sup>3)</sup>Kyoto University, Japan
- 14:35 **We-3A-3** p.198  
**Comparative Study of Threshold Voltage Instability in 4H-SiC MOSFETs with POCl<sub>3</sub>- and NO- Annealed Gate Oxides**  
H. Yano, A. Osawa, T. Hatayama, and T. Fuyuki  
Nara Institute of Science and Technology, Japan
- 14:55 **We-3A-4** p.199  
**Reduction of Density of 4H-SiC/SiO<sub>2</sub> Interface Traps by Pre-Oxidation Phosphorus Implantation**  
T. Sledziewski<sup>1)</sup>, A. Mikhaylov<sup>2)</sup>, S. Reshanov<sup>3)</sup>, A. Schöner<sup>2,3)</sup>, H. B. Weber<sup>1)</sup>, and M. Krieger<sup>1)</sup>  
<sup>1)</sup>FAU Erlangen-Nürnberg, Germany, <sup>2)</sup>Acreo Swedish ICT AB, Sweden, <sup>3)</sup>Ascatron AB, Sweden
- 15:15 **We-3A-5** p.200  
**Nitridation Effects of Gate Oxide on Channel Properties of SiC Trench MOSFETs**  
K. Ariyoshi<sup>1,2)</sup>, S. Harada<sup>1,3)</sup>, J. Senzaki<sup>1,3)</sup>, T. Kojima<sup>1,4)</sup>, K. Kojima<sup>1,3)</sup>, Y. Tanaka<sup>1,3)</sup>, and T. Shinoh<sup>1,2)</sup>  
<sup>1)</sup>R&D Partnership for Future Power Electronics Technology, Japan, <sup>2)</sup>Toshiba Corporation, Japan, <sup>3)</sup>National Institute of Advanced Industrial Science and Technology, Japan

**We-3B Extended Defects 13:45-15:35**

Room: Juyo

Chairs: M. Dudley (Stony Brook University, USA)  
B. Kallinger (Fraunhofer Institute, Germany)

- 13:45 **We-3B-1 <Invited>** p.201  
**Photoluminescence Imaging and Discrimination of Threading Dislocations in 4H-SiC Epilayers**  
M. Nagano, I. Kamata, and H. Tsuchida  
Central Research Institute of Electric Power Industry, Japan
- 14:15 **We-3B-2** p.202  
**Polarized Photoluminescence from Partial Dislocations in 4H-SiC**  
R. Hirano<sup>1,2)</sup>, H. Tsuchida<sup>3)</sup>, M. Tajima<sup>1)</sup>, K. M. Itoh<sup>2)</sup>, K. Maeda<sup>4)</sup>  
<sup>1)</sup>JAXA, Japan, <sup>2)</sup>Keio University, Japan, <sup>3)</sup>Central Research Institute of Electric Power Industry, Japan, <sup>4)</sup>The University of Tokyo, Japan
- 14:35 **We-3B-3** p.203  
**Post-Growth Reduction of Basal Plane Dislocations by High Temperature Annealing in 4H-SiC Epilayers**  
N. A. Mahadik<sup>1)</sup>, A. Nath<sup>2)</sup>, R. E. Stahlbush<sup>1)</sup>, E. A. Imhoff<sup>1)</sup>, M. J. Tadjer<sup>1)</sup>, B. N. Feygelson<sup>1)</sup> and R. Nipoti<sup>3)</sup>  
<sup>1)</sup>Naval Research Laboratory, USA, <sup>2)</sup>George Mason University, USA, <sup>3)</sup>CNR-IMM, Italy
- 14:55 **We-3B-4** p.204  
**Measurement of Critical Thickness for the Formation of Misfit Dislocation in 4H-SiC Epilayer via X-Ray Topography**  
H. Wang<sup>1)</sup>, F. Wu<sup>1)</sup>, S. Byrappa<sup>1)</sup>, M. Dudley<sup>1)</sup>, G. Chung<sup>2)</sup>, J. Zhang<sup>2)</sup>, B. Thomas<sup>2)</sup>, E. K. Sanchez<sup>2)</sup>, S. G. Mueller<sup>2)</sup>, D. Hansen<sup>2)</sup>, and M. J. Loboda<sup>2)</sup>  
<sup>1)</sup>Stony Brook University, USA, <sup>2)</sup>Dow Corning Compound Semiconductor Solutions, USA
- 15:15 **We-3B-5** p.205  
**Basal Plane Dislocations from Inclusions in 4H-SiC Epitaxy**  
R. E. Stahlbush<sup>1)</sup>, N. A. Mahadik<sup>1)</sup>, and M. J. O'Loughlin<sup>2)</sup>  
<sup>1)</sup>Naval Research Laboratory, USA, <sup>2)</sup>Cree, Inc., USA



**We-IP-1 <Invited Poster>** p.5  
**Study of V and Y Shape Stacking Faults Formation in 4H-SiC Epilayer**  
H. Wang<sup>1</sup>, F. Wu<sup>1</sup>, S. Byrappa<sup>1</sup>, M. Dudley<sup>1</sup>, G. Chung<sup>2</sup>, J. Zhang<sup>2</sup>, B. Thomas<sup>2</sup>, E. K. Sanchez<sup>2</sup>, S. G. Mueller<sup>2</sup>, D. Hansen<sup>2</sup>, and M. J. Loboda<sup>2</sup>  
<sup>1</sup>Stony Brook University, USA, <sup>2</sup>Dow Corning Compound Semiconductor Solutions, USA

<Epitaxy>

**We-P-1** p.206  
**The Influence of the Carbonization Mechanisms on the Crystalline Quality of the Carbonization Layer for Heteroepitaxial Growth of 3C-SiC**  
Y. Watanabe<sup>1,2,3</sup>, T. Horikawa<sup>2</sup>, and K. Kamimura<sup>3</sup>  
<sup>1</sup>Seiko Epson Co., Japan, <sup>2</sup>Advanced Industrial Science and Technology, Japan, <sup>3</sup>Shinshu University, Japan

**We-P-2 Withdrawn** p.207

**We-P-3** p.208  
**HCl Assisted Growth of Thick Epilayers for Bipolar Power Devices**  
B. Kallinger, C. Ehlers, P. Berwian, J. Friedrich, and M. Rommel  
Fraunhofer IISB, Germany

**We-P-4** p.209  
**Homo-Epitaxial Growth on 2° Off-Cut 4H-SiC(0001) Si-Face Substrates Using H<sub>2</sub>-SiH<sub>4</sub>-C<sub>3</sub>H<sub>8</sub> CVD System**  
K. Tamura<sup>1,3</sup>, C. Kudou<sup>1,4</sup>, K. Masumoto<sup>1,2</sup>, J. Nishio<sup>1,5</sup>, and K. Kojima<sup>1,2</sup>  
<sup>1</sup>R&D Partnership for Future Power Electronics Technology, Japan, <sup>2</sup>National Institute of Advanced Industrial Science and Technology, Japan, <sup>3</sup>Rohm Co., Ltd., Japan, <sup>4</sup>Panasonic Corporation, Japan, <sup>5</sup>Toshiba R&D Center, Japan

**We-P-5** p.210  
**Investigation of Aluminum Incorporation in 3C-SiC Epitaxial Layers Grown by CVD**  
R. Arvinte<sup>1</sup>, M. Zielinski<sup>1</sup>, T. Chassagne<sup>1</sup>, M. Portail<sup>2</sup>, A. Michon<sup>2</sup>, P. Kwasnicki<sup>3</sup>, S. Juillaguet<sup>3</sup>, and H. Peyre<sup>3</sup>  
<sup>1</sup>NOVASiC, France, <sup>2</sup>CRHEA-CNRS UPR 10, France, <sup>3</sup>CNRS, Laboratoire Charles Coulomb UMR 5221, France

**We-P-6** p.211  
**Simulations of SiC CVD - Perspectives on the Need for Surface Reaction Improvements**  
Ö. Danielsson, O. Kordina, and E. Janzén  
Linköping University, Sweden

**We-P-7** p.212  
**Simulation Studies on Giant Step Bunching in 4H-SiC Epitaxial Growth: Cluster Effect**  
Y. Ishida and S. Yoshida  
National Institute of Advanced Industrial Science and Technology, Japan

<Characterization>

**We-P-8** p.213  
**Drain-Current Deep Level Transient Spectroscopy Investigation on Epitaxial Graphene / 6H-SiC Field Effect Transistors**  
S. Roensch<sup>1</sup>, S. Hertel<sup>1</sup>, S. Reshanov<sup>2</sup>, A. Schoener<sup>2</sup>, M. Krieger<sup>1</sup>, and H. B. Weber<sup>1</sup>  
<sup>1</sup>FAU Erlangen-Nuremberg, Germany, <sup>2</sup>ACREO AB, Sweden

**We-P-9** p.214  
**Non Destructive Inspection of Dislocations in SiC Wafer by Mirror Projection Electron Microscopy**  
T. Isshiki<sup>1</sup> and M. Hasegawa<sup>2</sup>  
<sup>1</sup>Kyoto Institute of Technology, Japan, <sup>2</sup>Hitachi, Ltd., Japan

- We-P-10** p.215  
**High-Sensitivity High-Resolution Full-Wafer Imaging of Properties of Large n-Type SiC Using Relative Reflectance of Two Terahertz Waves**  
A. Hamano<sup>1)</sup>, S. Ohno<sup>2,3)</sup>, H. Minamide<sup>2)</sup>, H. Ito<sup>2)</sup>, and Y. Usuki<sup>1)</sup>  
<sup>1)</sup>Furukawa Co., Ltd., Japan, <sup>2)</sup>RIKEN ASI, Japan, <sup>3)</sup>Tohoku University, Japan
- We-P-11** p.216  
**Mechanical Properties and Residual Stress of Thin 3C-SiC(111) Films Determined Using MEMS Structures**  
 B. Häehnlein<sup>1)</sup>, M. Stubenrauch<sup>1)</sup>, S. Michael<sup>2)</sup>, and J. Pezoldt<sup>1)</sup>  
<sup>1)</sup>FG Nanotechnologie, TU Ilmenau, Germany, <sup>2)</sup>IMMS gGmbH, Germany
- We-P-12** p.217  
**Estimation of Surface Recombination Velocities for n-Type 4H-SiC Surfaces Treated by Various Processes**  
Y. Mori, M. Kato, and M. Ichimura  
 Nagoya Institute of Technology, Japan
- We-P-13** p.218  
**The Silicon Monovacancy in SiC: Beyond the 1- Charge State**  
 H. J. von Bardeleben<sup>1)</sup>, J. L. Cantin<sup>1)</sup>, F. Bruneval<sup>2)</sup>, and U. Gerstmann<sup>3)</sup>  
<sup>1)</sup>Universite Pierre et Marie Curie, France, <sup>2)</sup>CEA, DEN, Service de Metallurgie Physique, France, <sup>3)</sup>University of Paderborn, Germany
- We-P-14** p.219  
**Influence of P<sup>+</sup>-Implantation and Post-Annealing on Warpage Structure of 4H-SiC Wafers**  
K. Ishiji<sup>1)</sup>, S. Kawado<sup>1)</sup>, Y. Hirai<sup>1)</sup>, and S. Nagamachi<sup>2)</sup>  
<sup>1)</sup>Kyushu Synchrotron Light Research Center, Japan, <sup>2)</sup>Nagamachi Science Laboratory Co., Ltd., Japan
- We-P-15** p.220  
**Residual Stress Measurements of 4H-SiC Crystals Using X-Ray Diffraction**  
M. Nakabayashi<sup>1)</sup>, T. Fujimoto<sup>1)</sup>, H. Tsuge<sup>1)</sup>, K. Kojima<sup>2)</sup>, K. Abe<sup>2)</sup>, and K. Shimomura<sup>2)</sup>  
<sup>1)</sup>Nippon Steel and Sumitomo Metal Corporation, Japan, <sup>2)</sup>Nippon Steel and Sumikin Metal Corporation, Japan
- We-P-16** p.221  
**On Photoelectric Properties of 6H-SiC Bulk Crystals PVT-Grown on Different Substrates**  
G. Liaugaudas<sup>1)</sup>, K. Jarašiūnas<sup>1)</sup>, N. Tsavdaris<sup>2)</sup>, E. Sarigiannidou<sup>2)</sup>, and D. Chaussende<sup>2)</sup>  
<sup>1)</sup>Vilnius University, Lithuania, <sup>2)</sup>Grenoble INP-Minatec, France
- We-P-17** p.222  
**First-Principles Study of the 3C-SiC(1-10) and 4H-SiC(11-20) Surface Electronic States**  
H. Koyama<sup>1,3)</sup>, J. Nara<sup>1,3)</sup>, and T. Ohno<sup>1,2,3)</sup>  
<sup>1)</sup>National Institute for Materials Science, Japan, <sup>2)</sup>The University of Tokyo, Japan, <sup>3)</sup>MARCEED (Materials Research Consortium for Energy Efficient Electronic Devices), Japan
- We-P-18** p.223  
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K. Muraoka<sup>1)</sup>, Y. Kumai<sup>1)</sup>, Y. Suehiro<sup>1)</sup>, A. Morioka<sup>2)</sup>, M. Naitoh<sup>2)</sup>, and T. Ikari<sup>1)</sup>  
<sup>1)</sup>Ube National College of Technology, Japan, <sup>2)</sup>Kyushu Institute of Technology, Japan
- We-P-19** p.224  
**Low Frequency Noise Analysis of Monolithically Fabricated 4H-SiC CMOS Field Effect Transistors**  
L. C. Martin<sup>1)</sup>, H. K. Chan<sup>1)</sup>, D. Clark<sup>2)</sup>, E. P. Ramsay<sup>2)</sup>, A. E. Murphy<sup>2)</sup>, D. A. Smith<sup>2)</sup>, R. F. Thompson<sup>2)</sup>, R. A. R. Young<sup>2)</sup>, J. P. Goss<sup>1)</sup>, N. G. Wright<sup>1)</sup>, and A. B. Horsfall<sup>1)</sup>  
<sup>1)</sup>Newcastle University, UK, <sup>2)</sup>Raytheon UK, UK

**We-P-20 Withdrawn**

<Processing>

**We-P-21** p.225

**Rapid Thermal Oxidation of Si-Face n and p-Type On-Axis 4H-SiC**

M. Florentin<sup>1)</sup>, J. Montserrat<sup>1)</sup>, P. Brosselard<sup>2)</sup>, A. Henry<sup>3)</sup>, and P. Godignon<sup>1)</sup>

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<sup>3)</sup>Linköping University, Sweden

**We-P-22** p.226

**Influence of Diverse Post-Trench Processes on the Electrical Performance of Thick Bottom Oxide 4H-SiC Trench-MOS Structures**

C. T. Banzhaf<sup>1)</sup>, M. Grieb<sup>1)</sup>, A. Trautmann<sup>1)</sup>, A. J. Bauer<sup>2)</sup>, and L. Frey<sup>2,3)</sup>

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**We-P-23** p.227

**Characterization of SiO<sub>2</sub>/SiC Interfaces Annealed in N<sub>2</sub>O or POCl<sub>3</sub>**

P. Fiorenza<sup>1)</sup>, L. K. Swanson<sup>1)</sup>, M. Vivona<sup>1)</sup>, F. Giannazzo<sup>1)</sup>, C. Bongiorno<sup>1)</sup>, S. Lorenti<sup>2)</sup>, A. Frazzetto<sup>2)</sup>, and F. Roccaforte<sup>1)</sup>

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**We-P-24** p.228

**Growth of Gate Oxides on 4H-SiC by O<sub>2</sub>/NO Mixture at Low-Partial-Pressures**

D. E. Haasmann, S. Dimitrijević, J. Han, and A. Iacopi  
Griffith University, Australia

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**Fabrication of 4H-SiC MOSFETs Using Stacked Al<sub>2</sub>O<sub>3</sub> Gate Insulator with Pre-Annealed Al<sub>2</sub>O<sub>3</sub> Buffer Layer**

H. Yamada<sup>1)</sup>, S. Hino<sup>2)</sup>, N. Miura<sup>2)</sup>, M. Imaizumi<sup>2)</sup>, S. Yamakawa<sup>2)</sup>, and E. Tokumitsu<sup>1,3)</sup>

<sup>1)</sup>Tokyo Institute of Technology, Japan, <sup>2)</sup>Mitsubishi Electric Corporation, Japan,

<sup>3)</sup>Japan Advanced Institute of Science and Technology, Japan

**We-P-26** p.230

**Effect of Shallow n-Doping on Field Effect Mobility in p-Doped Channels of 4H-SiC MOSFET Transistors**

S. Noll<sup>1)</sup>, M. Rambach<sup>1)</sup>, M. Grieb<sup>1)</sup>, D. Scholten<sup>1)</sup>, A. Bauer<sup>2)</sup>, and L. Frey<sup>2,3)</sup>

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**We-P-27** p.231

**Preparation and Characterization of Nitridation Layer on 4H SiC (0001) Surface by Direct Plasma Nitridation**

Y. Akahane, T. Kano, K. Kimura, H. Komatsu, Y. Watanabe, T. Yamakami, and K. Kamimura

Shinshu University, Japan

**We-P-28** p.232

**Impact of Oxidation Temperature on the Interface Trap Density in 4H-SiC MOS Capacitors**

S. M. Thomas, Y. K. Sharma, M. R. Jennings, C. A. Fisher, and P. A. Mawby  
University of Warwick, UK

**We-P-29 Moved to Th-P-60**

**We-P-30** p.233

**Step-Bunching Dependence of Lifetime of MOS Capacitor for 4° Off Si-Face 4H-SiC Epitaxial Wafers**

A. Bandoh, K. Suzuki, H. Osawa, and T. Sato

SHOWA DENKO K.K., Japan

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**Re-Investigation of the Post-Oxidation Effects on 4H-SiC MOS Interface with High- Temperature Thermal Oxide**

R. H. Kikuchi<sup>1)</sup> and K. Kita<sup>1,2)</sup>

<sup>1)</sup>The University of Tokyo, Japan, <sup>2)</sup>JST-PRESTO, Japan

<Devices and Circuits>

**We-P-32** p.235  
**Investigation of Stacking Faults Affecting on Reverse Leakage Current of 4H-SiC Junction Barrier Schottky Diodes Using Device Simulation**

J. Hasegawa<sup>1</sup>, K. Konishi<sup>2</sup>, Y. Nakamura<sup>2</sup>, K. Ohtsuka<sup>2</sup>, S. Nakata<sup>2</sup>, Y. Nakamine<sup>1</sup>, T. Nishimura<sup>1</sup>, and M. Hatano<sup>1</sup>

<sup>1</sup>Tokyo Institute of Technology, Japan, <sup>2</sup>Mitsubishi Electric Corporation, Japan

**We-P-33** p.236  
**Comparative Study of 4H-SiC DMOSFETs with N<sub>2</sub>O Thermal Oxide and Deposit Oxide with Post Oxidation Anneal**

C. Yen<sup>1,4</sup>, C. Hung<sup>1,4</sup>, A. Mikhailov<sup>2</sup>, C. Lee<sup>1,4</sup>, L. Lee<sup>1,4</sup>, J. Wei<sup>4</sup>, T. Chiu<sup>4</sup>, C. Huang<sup>4,5</sup>, S. Reshanov<sup>3</sup>, and A. Schoner<sup>3</sup>

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<sup>4</sup>Industrial Technology Research Institute, Taiwan, <sup>5</sup>National Tsing Hua University, Taiwan

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**1200 V 4H-SiC DMOSFET with an Integrated Gate Buffer**

S. Ryu, C. Jonas, C. Capell, Y. Lemma, A. Agarwal, D. Grider, S. Allen, and J. Palmour

Cree, Inc., USA

**We-P-35** p.238  
**Two Packaging Solutions for High Temperature SiC Diode Sensors**

G. Brezeanu<sup>1</sup>, F. D. Draghici<sup>1</sup>, M. Badila<sup>1</sup>, F. Craciunoiu<sup>2</sup>, G. Pristavu<sup>1</sup>, R. Pascu<sup>2</sup>, and F. Bernea<sup>3</sup>

<sup>1</sup>University "POLITEHNICA", Romania, <sup>2</sup>National Institute for R&D in Microtechnology, Romania, <sup>3</sup>Carpatcement Holding, Romania

**We-P-36** p.239  
**Pressure Dependence of Thermal Contact Resistance between Copper Heat Sink and Copper DBC Surfaces in SiC Power Device Packages**

Z. Toth-Pal<sup>1</sup>, T. Hammam<sup>1</sup>, and H. Nee<sup>2</sup>

<sup>1</sup>Swerea KIMAB, Sweden, <sup>2</sup>Royal Institute of Technology, Sweden

**We-P-37** p.240  
**Transient Simulation of Mobile Ion Effects in Silicon Carbide MOS Gate Oxides**

D. B. Habersat<sup>1</sup>, A. J. Lelis<sup>1</sup>, and N. Goldsman<sup>2</sup>

<sup>1</sup>U. S. Army Research Laboratory, USA, <sup>2</sup>University of Maryland, USA

**We-P-38** p.241  
**SiC Power Devices Operation from Cryogenic to High Temperature: Investigation of Various 1.2kV SiC Power Devices**

T. Chailloux, C. Calvez, N. Thierry-Jebali, D. Tournier, and D. Planson  
University of Lyon, France

**We-P-39** p.242  
**Low Power Silicon Carbide Devices and Integrated Circuits for Harsh Environment Applications**

A. Maralani and A. P. Pisano

University of California, Berkeley, USA

**We-P-40** p.243  
**Silicon Carbide Field Effect Transistors for Detection of Ultra-Low Concentrations of Hazardous Volatile Organic Compounds**

D. Puglisi<sup>1</sup>, J. Eriksson<sup>1</sup>, C. Bur<sup>1,2</sup>, A. Schuetze<sup>2</sup>, A. Lloyd Spetz<sup>1,3</sup>, and M. Andersson<sup>1</sup>

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**We-P-41** p.244  
**Effect of Threading Dislocations on the Characteristics of 4H-SiC Schottky Barrier Diodes**

I. Kang<sup>1</sup>, S. B. Yun<sup>1,2</sup>, M. K. Na<sup>1</sup>, J. H. Moon<sup>1</sup>, and W. Bahng<sup>1</sup>

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**We-P-42** p.245  
**Designing of Quasi-Modulated Region in 4H-SiC Lateral RESURF MOSFETs**

Y. Nanen, J. Suda, and T. Kimoto  
Kyoto University, Japan

**We-P-43** p.246  
**Single Event Gate Rupture in SiC MOS Capacitors with Different Gate Oxide Thicknesses**

M. Deki<sup>1)</sup>, T. Makino<sup>2)</sup>, K. Kojima<sup>3)</sup>, T. Tomita<sup>1)</sup>, and T. Ohshima<sup>2)</sup>  
<sup>1)</sup>The University of Tokushima, Japan, <sup>2)</sup>Japan Atomic Energy Agency, Japan, <sup>3)</sup>National Institute of Advanced Industrial Science and Technology, Japan

**We-P-44** p.247  
**Nuclear Radiation Detectors Based on 4H-SiC p<sup>+</sup>-n Junction**

F. Issa<sup>1)</sup>, L. Ottaviani<sup>1)</sup>, V. Vervisch<sup>1)</sup>, M. Lazar<sup>2)</sup>, A. Kuznetsov<sup>3)</sup>, A. Klix<sup>4)</sup>, D. Szalkai<sup>4)</sup>, O. Palais<sup>1)</sup>, L. Vermeeren<sup>5)</sup>, and A. Lyoussi<sup>6)</sup>  
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**We-P-45** p.248  
**High Temperature Electrical Characterization of 4H-SiC MESFET Basic Logic Gates**

M. Alexandru<sup>1)</sup>, V. Banu<sup>1)</sup>, P. Godignon<sup>1)</sup>, X. Jordà<sup>1)</sup>, M. Vellvehi<sup>1)</sup>, and D. Tournier<sup>2)</sup>  
<sup>1)</sup>CNM-IMB, CSIC, Spain, <sup>2)</sup>AMPERE, INSA Lyon, France

**We-P-46** p.249  
**The Fabrication of 4H-SiC Floating Junction SBDs (FJ\_SBDs)**

H. Yuan, X. Tang, Y. Zhang, Y. Zhang, H. Lv, Y. Wang, Y. Zhou, and Q. Song  
Xidian University, China

**We-P-47 Canceled** p.250

<Graphene, GaN, and Related Materials>

**We-P-48** p.251  
**Evaluation of Degradation due to Electron Irradiation of Si<sub>1-x</sub>C<sub>x</sub> S/D n-Type Si MOSFET**

M. Hori<sup>1)</sup>, Y. Asai<sup>2)</sup>, M. Yoneoka<sup>1)</sup>, I. Tsunoda<sup>1)</sup>, K. Takakura<sup>1)</sup>, T. Nakashima<sup>3,4)</sup>, B. M. Gonzalez<sup>5)</sup>, E. Simoen<sup>6)</sup>, and C. Claeys<sup>6,7)</sup>  
<sup>1)</sup>Kumamoto National College of Technology, Japan, <sup>2)</sup>Kyushu University, Japan, <sup>3)</sup>University of Miyazaki, Japan, <sup>4)</sup>Chuo Denshi Kogyo Co. LTD, Japan, <sup>5)</sup>Institut de Microelectronica de Barcelona, Spain, <sup>6)</sup>imec, Belgium, <sup>7)</sup>KU Leuven, Belgium

**We-P-49** p.252  
**Elastic and Dielectric Characteristics of the Graphene-Like A<sub>N</sub>B<sub>8-N</sub> Compounds**

S. Y. Davydov<sup>1)</sup>, A. A. Lebedev<sup>1)</sup>, and O. V. Posrednik<sup>2)</sup>  
<sup>1)</sup>Ioffe Physical Technical Institute, Russia, <sup>2)</sup>St. Petersburg Electrotechnical University, Russia

**We-P-50** p.253  
**Size Confinement Effect in Bilayer Graphene Grown on 6H-SiC (0001) Substrate**

A. A. Lebedev<sup>1)</sup>, V. M. Mikoushkin<sup>1)</sup>, V. V. Shnitov<sup>1)</sup>, S. P. Lebedev<sup>1)</sup>, E. V. Likhachev<sup>1)</sup>, R. Yakimova<sup>2)</sup>, and O. Y. Vilkov<sup>3,4)</sup>  
<sup>1)</sup>Ioffe Institute, Russia, <sup>2)</sup>Linköping University, Sweden, <sup>3)</sup>Technische Universität Dresden, Germany, <sup>4)</sup>St. Petersburg State University, Russia

**We-P-51** p.254  
**ENDOR Studies of the Nitrogen Split Interstitial (N-N)<sub>N</sub><sup>0</sup> > in GaN**  
H. J. von Bardeleben<sup>1</sup>, J. L. Cantin<sup>1</sup>, H. Vrielinck<sup>2</sup>, L. Binet<sup>3</sup>, and U. Gerstmann<sup>4</sup>  
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**We-P-52** p.255  
**Structural Analysis of ZnO Thin Films Grown in Room Temperature on PET Film**  
H. Yamamoto, K. Idehara, R. Kimura, H. Nishizaki, N. Hasuike, H. Harima, and T. Isshiki  
Kyoto Institute of Technology, Japan

**We-P-53 Canceled** p.256

**We-P-54** p.257  
**Control of Graphene Doping through Hydrogenation of SiC Surface during CVD Growth**  
A. Michon<sup>1</sup>, B. Jabakhanji<sup>2</sup>, F. Cheynis<sup>3</sup>, P. Lefevre<sup>4</sup>, F. Bertran<sup>4</sup>, A. Tiberj<sup>2</sup>, J. -R. Huntzinger<sup>2</sup>, F. Leroy<sup>3</sup>, P. Müller<sup>3</sup>, S. Vézian<sup>1</sup>, D. Lefebvre<sup>1</sup>, T. Chassagne<sup>5</sup>, M. Zielinski<sup>5</sup>, A. Taleb-Ibrahimi<sup>4</sup>, M. Portail<sup>1</sup>, Y. Cordier<sup>1</sup>, and B. Jouault<sup>2</sup>  
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**We-P-55** p.258  
**Band Structure Engineering in Epitaxial Graphene on SiC(0001) by Atomic Intercalation**  
U. Starke<sup>1</sup>, S. Forti<sup>1</sup>, A. Stöhr<sup>1</sup>, T. Denig<sup>1</sup>, Y. R. Niu<sup>2</sup>, and A. A. Zakharov<sup>2</sup>  
<sup>1</sup>Max Planck Institute for Solid State Research, Germany, <sup>2</sup>Lund University, Sweden

**We-P-56** p.259  
**Adjusting the Electronic Properties and Gas Reactivity of Epitaxial Graphene by Thin Surface Metallizations**  
J. Eriksson, D. Puglisi, Y. Kang, R. Yakimova, and A. Lloyd Spetz  
Linköping University, Sweden

**We-P-57** p.260  
**Backside Monitoring of Graphene on SiC by Raman Spectroscopy**  
F. Fromm<sup>1</sup>, M. Hundhausen<sup>2</sup>, and T. Seyller<sup>1</sup>  
<sup>1</sup>TU Chemnitz, Germany, <sup>2</sup>University Erlangen, Germany

**We-P-58** p.261  
**Ion-Beam Irradiation Effect in the Growth Process of Graphene Using SiC-on-Insulator Substrates**  
M. Okano<sup>1</sup>, D. Edamoto<sup>1</sup>, K. Uchida<sup>1</sup>, I. Omura<sup>1</sup>, T. Ikari<sup>2</sup>, M. Nakao<sup>1</sup>, and M. Naitoh<sup>1</sup>  
<sup>1</sup>Kyushu Institute of Technology, Japan, <sup>2</sup>Ube National College of Technology, Japan

**We-P-59** p.262  
**Planarization of the Gallium Nitride Substrate Grown by the Na Flux Method Applying the Catalyst-Referred Etching**  
W. Yamaguchi, S. Sadakuni, A. Isohashi, H. Asano, Y. Sano, M. Imade, M. Maruyama, M. Yoshimura, Y. Mori, and K. Yamauchi  
Osaka University, Japan

**We-P-60** p.263  
**SiC-CNT One-Dimensional Linear Heterojunction Formed by Wick Effect of CNT Forests**

S. Cha, Y. Shin, and W. Bahng  
Korea Electrotechnology Research Institute, Korea

**We-P-61** p.264  
**First-Principles Study of Hydrolysis Reaction of Ga-Terminated GaN Surfaces and the Effect of Catalyst in the Process**

K. Inagaki, M. Oue, P. Bui, N. Kidani, K. Yamauchi, and Y. Morikawa  
Osaka University, Japan

<Late News: Processing>

**We-P-62** p.265  
**Suppression of Mobile Ion Diffusion with AlON/SiO<sub>2</sub> Stacked Gate Dielectrics for Improving Bias-Temperature Instability in SiC-MOS Devices**

A. Chanthaphan<sup>1</sup>, T. Hosoi<sup>1</sup>, Y. Nakano<sup>2</sup>, T. Nakamura<sup>2</sup>, T. Shimura<sup>1</sup>, and H. Watanabe<sup>1</sup>

<sup>1</sup>Osaka University, Japan, <sup>2</sup>ROHM Co., Ltd., Japan

**We-P-63** p.266  
**Multilevel Modeling of Threshold Voltage Degradation in MOSFETs**

I. Iskandarova, A. Knizhnik, A. Konovalov, A. Scherbinin, A. Vasiliev, and B. Potapkin  
Kintech Lab Ltd., Russia

## Thursday, October 3

### **Th-1A MOS Reliability 8:30-10:20**

Chairs: H. Yano (NAIST, Japan)

P. Godignon (CNM-CSIC, Spain)

Room: Tenzui

8:30 **Th-1A-1 <Invited> Canceled** p.267

9:00 **Th-1A-2** p.268

#### **Thin PSG Process for 4H-SiC MOSFET**

Y. K. Sharma<sup>1</sup>, A. C. Ahyi<sup>2</sup>, T. Issacs-Smith<sup>2</sup>, A. Modic<sup>2</sup>, Yi Xu<sup>3</sup>, E. Garfunkel<sup>3</sup>, M. R. Jennings<sup>1</sup>, C Fisher<sup>1</sup>, S. M. Thomas<sup>1</sup>, P. Mawby<sup>1</sup>, S. Dhar<sup>2</sup>, L. C. Feldman<sup>3</sup>, J. R. Williams<sup>2</sup>

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9:20 **Th-1A-3** p.269

#### **Depletion-Mode TDDDB for n-Type MOS Capacitors of 4H-SiC**

T. Watanabe, S. Hino, Y. Ebiike, N. Miura, M. Imaizumi, and S. Yamakawa  
Mitsubishi Electric Corporation, Japan

9:40 **Th-1A-4** p.270

#### **Threshold Voltage Instability of SiC-MOSFETs on Various Crystal Faces**

J. Senzaki<sup>1,2</sup>, A. Shimozato<sup>2</sup>, K. Kojima<sup>1,2</sup>, S. Harada<sup>1,2</sup>, K. Ariyoshi<sup>1</sup>, T. Kojima<sup>1</sup>, Y. Tanaka<sup>1,2</sup>, H. Okumura<sup>1,2</sup>

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10:00 **Th-1A-5** p.271

#### **Low Energy Proton Radiation Impact on 4H-SiC nMOSFET Gate Oxide Stability**

M. Florentin<sup>1</sup>, M. Alexandru<sup>1</sup>, A. Constant<sup>2</sup>, B. Schmidt<sup>3</sup>, and P. Godignon<sup>1</sup>

<sup>1</sup>CNM-IMB CSIC, Spain, <sup>2</sup>ON Semiconductor, Belgium, <sup>3</sup>HZDR, Germany

### **Th-1B Point Defects 8:30-10:20**

Chairs: M. Kato (Nagoya Institute Technology, Japan)

M. Krieger (University of Erlangen-Nürnberg, Germany)

Room: Juyo

8:30 **Th-1B-1 <Invited>** p.272

#### **The Carbon Vacancy in SiC**

N. T. Son<sup>1</sup>, X. T. Trinh<sup>1</sup>, K. Kawahara<sup>2</sup>, J. Suda<sup>2</sup>, T. Kimoto<sup>2</sup>, L. S. Løvlie<sup>3</sup>, B. G. Svensson<sup>3</sup>, K. Szasz<sup>4</sup>, T. Hornos<sup>4</sup>, A. Gali<sup>4</sup>, T. Umeda<sup>5</sup>, J. Isoya<sup>5</sup>, T. Makino<sup>6</sup>, T. Ohshima<sup>6</sup>, and E. Janzén<sup>1</sup>

<sup>1</sup>Linköping University, Sweden, <sup>2</sup>Kyoto University, Japan, <sup>3</sup>University of Oslo, Norway, <sup>4</sup>Wigner Research Center for Physics, Hungary, <sup>5</sup>University of Tsukuba, Japan, <sup>6</sup>Japan Atomic Energy Agency, Japan

9:00 **Th-1B-2** p.273

#### **Minority Carrier Transient Spectroscopy of As-Grown, Electron Irradiated, and Thermally Oxidized p-Type 4H-SiC**

G. Alfieri and T. Kimoto

Kyoto University, Japan

9:20 **Th-1B-3** p.274

#### **Si Related Intrinsic Defect Generation in SiC Induced by Oxidation**

K. Chokawa<sup>1</sup>, K. Kamiya<sup>1</sup>, and K. Shiraishi<sup>2</sup>

<sup>1</sup>University of Tsukuba, Japan, <sup>2</sup>Nagoya University, Japan

9:40 **Th-1B-4** p.275

#### **Annealing of Electron Irradiated, Thick, Ultrapure 4H SiC between 1100°C and 1500°C and Measurements of Lifetime and Photoluminescence**

W. M. Klahold<sup>1</sup>, R. P. Devaty<sup>1</sup>, W. J. Choyke<sup>1</sup>, T. Kimoto<sup>2</sup>, and T. Ohshima<sup>3</sup>

<sup>1</sup>University of Pittsburgh, USA, <sup>2</sup>Kyoto University, Japan, <sup>3</sup>Japan Atomic Energy Agency, Japan

10:00 **Th-1B-5** p.276

#### **Two E' Centers Which Limit the Performance of 4H SiC MOSFETs**

P. M. Lenahan<sup>1</sup>, J. J. Follman<sup>1</sup>, M. A. Anders<sup>1</sup>, C. J. Cochrane<sup>1</sup>, A. J. Lelis<sup>2</sup>, S. D. Arthur<sup>3</sup>, J. McMahon<sup>3</sup>, L. Yu<sup>3</sup>, and X. Zhu<sup>3</sup>

<sup>1</sup>Penn State University, USA, <sup>2</sup>U.S. Army Research Laboratory, USA, <sup>3</sup>GE Global Research, USA



**Th-2A High Voltage Devices 2 10:40-12:30**

Room: Tenzui

Chairs: P. Friedrichs (Infineon Technologies, Germany)  
Y. Tanaka (AIST, Japan)10:40 **Th-2A-1 <Invited>** p.277**Temperature Dependence of Impact Ionization Coefficients in 4H-SiC**H. Niwa, J. Suda, and T. Kimoto  
Kyoto University, Japan11:10 **Th-2A-2** p.278**19 kV 4H-SiC N-IGBTs**S. Ryu<sup>1</sup>, C. Capell<sup>1</sup>, C. Jonas<sup>1</sup>, M. O'Loughlin<sup>1</sup>, J. Clayton<sup>1</sup>, E. Van Brunt<sup>1</sup>, K. Lam<sup>1</sup>, J. Richmond<sup>1</sup>, A. Kadavelgu<sup>2</sup>, S. Bhattacharya<sup>2</sup>, A. Burk<sup>1</sup>, A. Agarwal<sup>1</sup>, D. Grider<sup>1</sup>, S. Allen<sup>1</sup>, and J. Palmour<sup>1</sup><sup>1</sup>Cree, Inc, USA, <sup>2</sup>North Carolina State University, USA11:30 **Th-2A-3** p.279**Fabrication of 10 kV PiN Diodes Using On-Axis 4H-SiC**A. Salemi<sup>1</sup>, B. Buono<sup>1, 2)</sup>, A. Hallén<sup>1</sup>, J. Hassan<sup>3)</sup>, J. P. Bergman<sup>3)</sup>, C. -M. Zetterling<sup>1</sup>, and M. Östling<sup>1</sup><sup>1</sup>KTH Royal Institute of Technology, Sweden, <sup>2</sup>Fairchild Semiconductor, Sweden, <sup>3</sup>Linköping University, Sweden11:50 **Th-2A-4** p.280**High Voltage and Fast Switching Reverse Recovery Characteristics of 4H-SiC PiN Diode**K. Nakayama<sup>1</sup>, S. Ogata<sup>1</sup>, T. Hayashi<sup>1</sup>, T. Hemmi<sup>1</sup>, A. Tanaka<sup>1</sup>, T. Izumi<sup>1</sup>, K. Asano<sup>1</sup>, D. Okamoto<sup>2)</sup>, Y. Tanaka<sup>2)</sup>, T. Mizushima<sup>2,3)</sup>, M. Yoshikawa<sup>2)</sup>, H. Fujisawa<sup>2,3)</sup>, K. Takenaka<sup>2,3)</sup>, M. Takei<sup>2,3)</sup>, Y. Yonezawa<sup>2)</sup>, K. Fukuda<sup>2)</sup> and H. Okumura<sup>2)</sup><sup>1</sup>Kansai Electric Power Co., Inc., Japan, <sup>2</sup>National Institute of Advanced Industrial Science and Technology, Japan, <sup>3</sup>Fuji Electric Co. Ltd., Japan12:10 **Th-2A-5** p.281**Study of 4H-SiC Schottky-Diode Designs for 3.3kV Applications**H. Bartolf<sup>1)</sup>, V. Sundaramoorthy<sup>1)</sup>, A. Mihaila<sup>1)</sup>, M. Berthou<sup>2)</sup>, P. Godignon<sup>2)</sup>, and J. Millan<sup>2)</sup><sup>1</sup>ABB Switzerland Ltd, Switzerland, <sup>2</sup>CNM, Spain**Th-2B MOS Fundamentals 10:40-12:30**

Room: Juyo

Chairs: T. Hatakeyama (AIST, Japan)  
K. Fukuda (AIST, Japan)10:40 **Th-2B-1 <Invited>** p.282**Intrinsic SiC Oxidation Problems Obtained by First Principle Calculations**K. Shiraishi<sup>1,2)</sup>, K. Chokawa<sup>2)</sup>, and K. Kamiya<sup>2)</sup><sup>1</sup>Nagoya University, Japan, <sup>2</sup>University of Tsukuba, Japan11:10 **Th-2B-2** p.283**Hall Factor Calculation for the Characterization of Transport Properties in n-Channel 4H-SiC MOSFETs**V. Uhnevionak<sup>1,4)</sup>, A. Burenkov<sup>1,4)</sup>, C. Strenger<sup>1,4)</sup>, V. Mortet<sup>3,4)</sup>, E. Bedel-Pereira<sup>3,4)</sup> F. Cristiano<sup>3,4)</sup>, A. J. Bauer<sup>1,4)</sup>, and P. Pichler<sup>1,2,4)</sup><sup>1</sup>Fraunhofer IISB, Germany, <sup>2</sup>Chair of Electron Devices, Germany, <sup>3</sup>CNRS, France, <sup>4</sup>The Wide Bandgap Semiconductor Alliance (WISEA)11:30 **Th-2B-3** p.284**Characterization of La,Hf<sub>2</sub>O Gate Dielectrics in 4H-SiC MOS Capacitor**J. -H. Xia<sup>1,2)</sup>, D. Martin<sup>1)</sup>, S. S. Suvanam<sup>1)</sup>, C. -M. Zetterling<sup>1)</sup>, and M. Östling<sup>1)</sup><sup>1</sup>KTH Royal Institute of Technology, Sweden, <sup>2</sup>Xi'an Jiaotong University, China11:50 **Th-2B-4** p.285**Si Emission into the Oxide Layer during Oxidation of Silicon Carbide**Y. Hijikata, Y. Akasaka, S. Yagi, and H. Yaguchi

Saitama University, Japan

12:10 **Th-2B-5 <Late News>** p.286**High Mobility 4H-SiC MOSFETs Using Lanthanum Oxide Interfacial Engineering and ALD Deposited SiO<sub>2</sub>**X. Yang, B. Lee, and V. Misra

North Carolina State University, USA

**Th-3A Etching & Polishing 13:45-15:25**

Room: Tenzui

Chairs: Y. Sano (Osaka University, Japan)

A. Schöner (Ascatron, Sweden)

13:45 **Th-3A-1** P.287**Single-Crystalline 4H-SiC Microcantilever Resonators with a 10 times Higher Quality Factor than 3C-SiC**K. Adachi<sup>1)</sup>, H. Okamoto<sup>2)</sup>, H. Yamaguchi<sup>2)</sup>, T. Kimoto<sup>1)</sup>, and J. Suda<sup>1)</sup><sup>1)</sup>Kyoto University, Japan, <sup>2)</sup>NTT Corporation, Japan14:05 **Th-3A-2** P.288**4H-SiC Planarization Using Catalyst-Referred Etching with Pure Water**A. Isohashi, Y. Sano, S. Sadakuni, and K. Yamauchi

Osaka University, Japan

14:25 **Th-3A-3** P.289**Junction Formation by Direct Bonding of Si and 6H-SiC**Y. Sasada, T. Kurumi, R. Araki, H. Shimizu, H. Kinoshita, and M. Yoshimoto

Kyoto Institute of Technology, Japan

14:45 **Th-3A-4** P. 290**Thinning of a Two-Inch SiC Wafer by Plasma Chemical Vaporization Machining Using a Slit Electrode**Y. Okada, H. Nishikawa, Y. Sano, K. Yamamura, and K. Yamauchi

Osaka University, Japan

15:05 **Th-3A-5** <Late News> **Canceled** p.291**Th-3B Graphene 2 13:45-15:25**

Room: Juyo

Chairs: W. de Heer (Georgia Institute of Technology, USA)

H. Kageshima (NTT, Japan)

13:45 **Th-3B-1** P.292**Bandgap Opening on Graphene Nanoribbons Grown on Vicinal 6H- and 4H-SiC Surfaces by Molecular Beam Epitaxy**T. Kajiwara<sup>1)</sup>, A. Visikovskiy<sup>1)</sup>, T. Iimori<sup>2)</sup>, F. Komori<sup>2)</sup>, K. Nakatsuji<sup>3)</sup> and S. Tanaka<sup>1)</sup><sup>1)</sup>Kyushu University, Japan, <sup>2)</sup>University of Tokyo, Japan, <sup>3)</sup>Tokyo Institute of Technology, Japan14:05 **Th-3B-2** P.293**Controlling the Carrier Concentration of Epitaxial Graphene by Ultraviolet Illumination**R. Pearce<sup>1)</sup>, V. Eless<sup>1)</sup>, O. Kazakova<sup>1)</sup>, R. Yakimova<sup>2)</sup>, and A. Tzalenchuk<sup>1)</sup><sup>1)</sup>NPL Hampton road, UK, <sup>2)</sup>Linköping University, Sweden14:25 **Th-3B-3** P.294**Electrical Nanocharacterization of Epitaxial Graphene/Silicon Carbide Schottky Contacts**F. Giannazzo<sup>1)</sup>, S. Hertel<sup>2)</sup>, A. Albert<sup>2)</sup>, A. La Magna<sup>1)</sup>, F. Roccaforte<sup>1)</sup>, M. Krieger<sup>2)</sup>, and H. B. Weber<sup>2)</sup><sup>1)</sup>CNR-IMM, Italy, <sup>2)</sup>University of Erlangen-Nürnberg, Germany14:45 **Th-3B-4** P.295**Carrier Mobility as a Function of Temperature in As-Grown and H-Intercalated Epitaxial Graphenes on 4H-SiC**M. Winters<sup>1)</sup>, E. B. Thorsteinsson<sup>2)</sup>, E. Ö. Sveinbjörnsson<sup>2)</sup>, H. P. Gislason<sup>2)</sup>, J. Hassan<sup>3)</sup>, E. Jánzén<sup>3)</sup>, and N. Rorsman<sup>1)</sup><sup>1)</sup>Chalmers University of Technology, Sweden, <sup>2)</sup> University of Iceland, Iceland, <sup>3)</sup>Linköping University, Sweden15:05 **Th-3B-5** <Late News> P.296**Thickness Determination of Graphene on SiC by Reflectivity Mapping**I. G. Ivanov<sup>1)</sup>, J. Hassan<sup>1)</sup>, T. Iakimov<sup>1)</sup>, A. Zakharov<sup>2)</sup>, R. Yakimova<sup>1)</sup>, and E. Jánzén<sup>1)</sup><sup>1)</sup>Linköping University, Sweden, <sup>2)</sup>Lund University, Sweden

**Th-IP-1 <Invited Poster>** p.6  
**Development of SiC Super-Junction (SJ) Device by a Multi-Epitaxial Growth**  
R. Kosugi<sup>1,2)</sup>, Y. Sakuma<sup>2)</sup>, K. Kojima<sup>1,2)</sup>, S. Itoh<sup>2)</sup>, A. Nagata<sup>2)</sup>, T. Yatsuo<sup>1,2)</sup>, Y. Tanaka<sup>1,2)</sup>, and H. Okumura<sup>1,2)</sup>  
<sup>1)</sup>R&D Partnership for Future Power Electronics Technology, Japan, <sup>2)</sup>National Institute of Advanced Industrial Science and Technology, Japan

<Epitaxy>

**Th-P-1** p.297  
**Understanding Residual Stresses and Their Gradients in Hetero-Epitaxial 3C-SiC on Silicon**  
F. Iacopi, L. Hold, G. Walker, L. Wang, N. Mishra, and A. V. Iacopi  
Griffith University, Australia

**Th-P-2** p.298  
**Optical Investigation of 3C-SiC Hetero-Epitaxial Layers Grown by Sublimation Epitaxy under Gas Atmospheres**  
P. Kwasnicki<sup>1)</sup>, V. Jokubavicius<sup>2)</sup>, J. Sun<sup>2)</sup>, H. Peyre<sup>3)</sup>, R. Yakimova<sup>2)</sup>, M. Syväjärvi<sup>2)</sup>, J. Camassel<sup>1)</sup>, and S. Juillaguet<sup>3)</sup>  
<sup>1)</sup>CNRS, L2C UMR 5221, France, <sup>2)</sup>Linköping University, Sweden, <sup>3)</sup>Universite Montpellier 2, France

**Th-P-3** p.299  
**Effect of Surface Roughness on Dislocation Conversion in 4° Off-Axis 4H-SiC Epitaxial Layers**  
M. Yazdanfar, H. Pedersen, O. Kordina, and E. Janzén  
Linköping University, Sweden

**Th-P-4** p.300  
**50 µm-Thick 100mm 4H-SiC Epilayer Growth by a Warm-Wall Planetary Reactor**  
Y. Sun, G. Feng, Z. Li, L. Lv, J. Luo, J. Wu, Y. Li, and J. Zhang  
EpiWorld International Co., LTD, China

**Th-P-5** p.301  
**Demonstration of High Quality 4H-SiC Epitaxy by Using the Two-Step Growth Method**  
Y. Mitani, N. Tomita, K. Hamano, M. Tarutani, T. Tanaka, A. Ohno, T. Kuroiwa, Y. Toyoda, M. Imaizumi, H. Sumitani, and S. Yamakawa  
Mitsubishi Electric Corporation, Japan

**Th-P-6** p.302  
**Simulation Study of High-Speed Wafer Rotation Effects in 150 mm Vertical 4H-SiC Epitaxial Reactor**  
M. Ito<sup>1)</sup>, H. Fujibayashi<sup>1,2)</sup>, H. Ito<sup>1,3)</sup>, I. Kamata<sup>1)</sup>, M. Naito<sup>2)</sup>, K. Hara<sup>2)</sup>, S. Yamauchi<sup>2)</sup>, K. Suzuki<sup>3)</sup>, M. Yajima<sup>3)</sup>, S. Mitani<sup>3)</sup>, K. Suzuki<sup>4)</sup>, H. Aoki<sup>4)</sup>, K. Nishikawa<sup>5)</sup>, T. Kozawa<sup>5)</sup>, and H. Tsuchida<sup>1)</sup>  
<sup>1)</sup>Central Research Institute of Electric Power Industry, Japan, <sup>2)</sup>DENSO corporation, Japan, <sup>3)</sup>NuFlare Technology, Inc., Japan, <sup>4)</sup>Toyota Motor Corporation, Japan, <sup>5)</sup>Toyota Central R&D Labs, Japan

**Th-P-7** p.303  
**Revisiting the Chemical Database - How Reliable Are They?**  
P. Sukkaew, L. Ojamäe, Ö. Danielsson, O. Kordina, and E. Janzén  
Linköping University, Sweden

**Th-P-8** p.304  
**Fast Growth Rate Epitaxy on 4° Off-Cut 4-Inch Diameter 4H-SiC Wafers**  
J. Ul Hassan<sup>1)</sup>, H. T. Bae<sup>2)</sup>, L. Lilja<sup>1)</sup>, I. Kim<sup>2)</sup>, I. Farkas<sup>1)</sup>, P. Stenberg<sup>1)</sup>, J. Sun<sup>1)</sup>, O. Kordina<sup>1)</sup>, J. P. Bergman<sup>1)</sup>, S. Ha<sup>2)</sup>, and E. Janzén<sup>1)</sup>  
<sup>1)</sup>Linköping University, Sweden, <sup>2)</sup>LG Innotek Co., Ltd., Korea

<Characterization>

**Th-P-9** p.305  
**Crystallographic Structure of 8H- and 10H-SiC Analyzed by Raman Spectroscopy and Diffraction Methods**  
T. Hatayama, R. Hori, H. Yano, and T. Fuyuki  
Nara Institute of Science and Technology, Japan

- Th-P-10** p.306  
**Correlation between Microwave Reflectivity and Excess Carrier Concentrations in 4H-SiC**  
M. Kato, Y. Mori, and M. Ichimura  
Nagoya Institute of Technology, Japan
- Th-P-11** p.307  
**Radiative and Nonradiative Recombination in 3C-SiC**  
P. Ščajev, M. Karaliūnas, E. Kuokštis, V. Grivickas, and K. Jarašiūnas  
Vilnius University, Lithuania
- Th-P-12** p.308  
**Carrier Density Dependence of Fano Type Interference in Raman Spectra of p-Type 4H-SiC**  
T. Mitani, S. Nakashima, M. Tomobe, J. Shi-yang, K. Kojima, and H. Okumura  
National Institute of Advanced Industrial Science and Technology, Japan
- Th-P-13** p.309  
**Diffusion of Alkali Metals in SiC**  
M. K. Linnarsson and A. Hallén  
KTH Royal Institute of Technology, Sweden
- Th-P-14** p.310  
**Comparison of Carrier Lifetime Measurements and Mapping Using Photoluminescence and  $\mu$ -PCD**  
B. Kallinger<sup>1</sup>, M. Rommel<sup>1</sup>, L. Lilja<sup>2</sup>, J. Hassan<sup>2</sup>, I. Booker<sup>2</sup>, E. Janzen<sup>2</sup>, and J. P. Bergman<sup>2</sup>  
<sup>1</sup>Fraunhofer IISB, Germany, <sup>2</sup>Linköping University, Sweden
- Th-P-15 Canceled** p.311
- Th-P-16** p.312  
**Temperature and Electrical Field Dependence of Ambipolar Mobility in n-Doped 4H-SiC**  
A. Hürner<sup>1</sup>, C. Bonse<sup>1</sup>, B. Kallinger<sup>2</sup>, H. Mitlehner<sup>2</sup>, T. Erlbacher<sup>2</sup>, V. Häublein<sup>2</sup>, A. J. Bauer<sup>2</sup>, and L. Frey<sup>1,2</sup>  
<sup>1</sup>University Erlangen-Nuremberg, Germany, <sup>2</sup>Fraunhofer IISB, Germany
- Th-P-17** p.313  
**Impact of Carrier Lifetime on Efficiency of Photolytic Hydrogen Generation by SiC**  
K. Miyake<sup>1</sup>, T. Yasuda<sup>1</sup>, M. Kato<sup>1</sup>, M. Ichimura<sup>1</sup>, T. Hatayama<sup>2</sup>, and T. Ohshima<sup>3</sup>  
<sup>1</sup>Nagoya Institute of Technology, Japan, <sup>2</sup>Nara Institute of Science and Technology, Japan, <sup>3</sup>Japan Atomic Energy Agency, Japan
- Th-P-18** p.314  
**Microscopic Mechanism of Band-Gap Variations in SiC Polytypes Based on *ab initio* Calculations: Roles of Peculiar Electron State Floating in Internal Space**  
Y. Matsushita<sup>1,2</sup> and A. Oshiyama<sup>1</sup>  
<sup>1</sup>The University of Tokyo, Japan, <sup>2</sup>Max-Planck Institute of Microstructure Physics, Germany
- Th-P-19** p.315  
**Light Absorption Loss in Fluorescent SiC**  
F. Teramae<sup>1,2</sup>, T. Maeda<sup>1</sup>, E. Akazawa<sup>2</sup>, Y. Kuroyanagi<sup>2</sup>, K. Naniwae<sup>1</sup>, M. Syväjärvi<sup>3</sup>, R. Yakimova<sup>3</sup>, M. Iwaya<sup>2</sup>, T. Takeuchi<sup>2</sup>, S. Kamiyama<sup>1,2</sup>, and I. Akasaki<sup>2</sup>  
<sup>1</sup>EL-SEED Corp., Japan, <sup>2</sup>Meijo University, Japan, <sup>3</sup>Linköping University, Sweden
- Th-P-20** p.316  
**Evaluation of Mechanical and Optical Properties of Hetero-Epitaxial Single Crystal 3C-SiC Squared-Membrane**  
R. Anzalone, G. D'Arrigo, M. Camarda, N. Piluso, and F. La Via  
IMM-CNR, Italy

<Processing>

**Th-P-21** p.317  
**Curvature Evaluation of Si/3C-SiC/Si Hetero-Structure Grown by Chemical Vapor Deposition**

R. Anzalone<sup>1</sup>, M. Camarda<sup>1</sup>, A. Severino<sup>2</sup>, N. Piluso<sup>1</sup>, and F. La Via<sup>1</sup>  
<sup>1</sup>IMM-CNR, Italy, <sup>2</sup>ST-Microelectronics, Italy

**Th-P-22** p.318  
**Removal of Mechanical-Polishing-Induced Surface Damages on 4H-SiC Wafers by Using Chemical Etching with Molten KCl+KOH**

Y. Yao, Y. Ishikawa, Y. Sugawara, and K. Sato  
Japan Fine Ceramics Center, Japan

**Th-P-23** p.319  
**Dicing of SiC Wafer by Atmospheric-Pressure Plasma Etching Process with Slit Mask for Plasma Confinement**

Y. Sano, H. Nishikawa, Y. Okada, K. Yamamura, S. Matsuyama, and K. Yamauchi  
Osaka University, Japan

**Th-P-24** p.320  
**Multi-Wire Electrical Discharge Slicing for Silicon Carbide Part 2: Improvement on Manufacturing Wafers by 40-Wire EDS**

A. Itokazu, H. Miyake, T. Hashimoto, and K. Fukushima  
Mitsubishi Electric Corporation, Japan

**Th-P-25** p.321  
**Barrier Heights Investigation of Dissociative Adsorption of HF on SiC Surfaces in Catalyst- Referred Etching**

P. V. Bui, K. Inagaki, Y. Sano, K. Yamauchi, and Y. Morikawa  
Osaka University, Japan

**Th-P-26** p.322  
**Effects of Machining Fluid on Electric Discharge Machining of SiC Ingot**  
N. Yamamoto<sup>1</sup>, S. Yamaguchi<sup>1</sup>, and T. Kato<sup>2,3</sup>

<sup>1</sup>Chubu University, Japan, <sup>2</sup>R&D Partnership for Future Power Electronics Technology, Japan, <sup>3</sup>National Institute of Advanced Industrial and Technology, Japan

**Th-P-27** p.323  
**Hydrogen Effects in ECR-Etching of 3C-SiC(100) Mesa Structures**  
L. Hiller<sup>1</sup>, T. Stauden<sup>1</sup>, R. M. Kemper<sup>2</sup>, J. K. N. Lindner<sup>2</sup>, D. J. As<sup>2</sup>, and J. Pezoldt<sup>1</sup>

<sup>1</sup>TU Ilmenau, Germany, <sup>2</sup>Universität Paderborn, Germany

**Th-P-28** p.324  
**Off-Orientation Influence on C-Face (0001) 4H-SiC Surface Morphology Produced by Etching Using Chlorine Trifluoride Gas**

Y. Fukumoto<sup>1</sup>, H. Habuka<sup>1</sup>, and T. Kato<sup>2</sup>  
<sup>1</sup>Yokohama National University, Japan, <sup>2</sup>National Institute of Advanced Industrial and Technology, Japan

**Th-P-29** p.325  
**A Novel Grinding Technique for 4H-SiC Single-Crystal Wafers Using Tribo-Catalytic Abrasives**

T. Kido<sup>1,2</sup>, M. Nagaya<sup>1,3</sup>, K. Kawata<sup>1,4</sup>, and T. Kato<sup>1,4</sup>  
<sup>1</sup>R&D Partnership for Future Power Electronics Technology, Japan, <sup>2</sup>Showa Denko K.K., Japan, <sup>3</sup>DENSO CORPORATION, Japan, <sup>4</sup>National Institute of Advanced Industrial Science and Technology, Japan

**Th-P-30** p.326  
**High-Speed Slicing of SiC Ingot by High-Speed Multi Wire Saw**  
H. Maeda<sup>1,3</sup>, R. Takanabe<sup>1,4</sup>, A. Takeda<sup>1,3</sup>, S. Matsuda<sup>1,3</sup>, and T. Kato<sup>1,2</sup>

<sup>1</sup>R&D Partnership for Future Power Electronics Technology, Japan, <sup>2</sup>AIST Advanced Power Electronics Research center, Japan, <sup>3</sup>Takatori Corporation, Japan, <sup>4</sup>Asahi Diamond Industrial Co., Ltd., Japan

- Th-P-31** p.327  
**Microstructure Characterisation of Ni/Si Contact Layers on n-Type 4H-SiC by Plan-View TEM and XEDS**  
M. Wzorek<sup>1)</sup>, A. Czerwinski<sup>1)</sup>, J. Ratajczak<sup>1)</sup>, M. Borysiewicz<sup>1)</sup>, A. V. Kuchuk<sup>2)</sup>, A. Piotrowska<sup>1)</sup>, and J. Kątecki<sup>1)</sup>  
<sup>1)</sup>Institute of Electron Technology, Poland, <sup>2)</sup>V. Lashkaryov Institute of Semiconductor Physics, Ukraine
- Th-P-32** p.328  
**Nano-Scale Native Oxide on 6H-SiC Surface and Its Effect to the Interface Band Bending**  
W. Huang<sup>1)</sup>, S. -H. Chang<sup>1)</sup>, X. -C. Liu<sup>1)</sup>, E. -W. Shi<sup>1)</sup>, W. -H. Zhang<sup>2)</sup>, and J. -F. Zhu<sup>2)</sup>  
<sup>1)</sup>Chinese Academy of Sciences, China, <sup>2)</sup>University of Science and Technology of China, China
- Th-P-33** p.329  
**Fabrication of Electrostatically Actuated 4H-SiC Microcantilever Resonators by Using n/p/n Epitaxial Structures and Doping-Selective Electrochemical Etching**  
K. Sato<sup>1)</sup>, K. Adachi<sup>1)</sup>, H. Okamoto<sup>2)</sup>, H. Yamaguchi<sup>2)</sup>, T. Kimoto<sup>1)</sup>, and J. Suda<sup>1)</sup>  
<sup>1)</sup>Kyoto University, Japan, <sup>2)</sup>NTT Basic Research Laboratories, Japan
- <Devices and Circuits>
- Th-P-34** p.330  
**V<sub>F</sub> Degradation of 4H-SiC PiN Diodes Using Low-BPD Wafers**  
C. Ota, J. Nishio, K. Takao, and T. Shinohe  
 Toshiba Corp., Japan
- Th-P-35** p.331  
**SiC Epi-Channel Lateral MOSFETs**  
C. Yen<sup>1,4)</sup>, M. Bakowski<sup>2)</sup>, C. Hung<sup>1,4)</sup>, S. Reshanov<sup>3)</sup>, A. Schoner<sup>3)</sup>, C. Lee<sup>1,4)</sup>, L. Lee<sup>1,4)</sup>, J. Wei<sup>1)</sup>, T. Chiu<sup>1)</sup>, and C. Huang<sup>1,5)</sup>  
<sup>1)</sup>Industrial Technology Research Institute, Taiwan, <sup>2)</sup>Acreo AB, Sweden, <sup>3)</sup>Ascatron AB, Sweden, <sup>4)</sup>Hestia Power Inc, Taiwan, <sup>5)</sup>National Tsing Hua University, Taiwan

- Th-P-36** p.332  
**Evaluation of Buried Grid JBS Diodes**  
J. -K. Lim<sup>1)</sup>, D. Pefitsis<sup>2)</sup>, D. -P. Sadik<sup>2)</sup>, M. Bakowski<sup>1)</sup>, and H. -P. Nee<sup>2)</sup>  
<sup>1)</sup>Acreo Swedish ICT AB, Sweden, <sup>2)</sup>Royal Institute of Technology, Sweden
- Th-P-37** p.333  
**13-kV, 20-A 4H-SiC PiN Diodes for Power System Applications**  
D. Okamoto<sup>1)</sup>, Y. Tanaka<sup>1)</sup>, T. Mizushima<sup>1,2)</sup>, M. Yoshikawa<sup>1)</sup>, H. Fujisawa<sup>1,2)</sup>, K. Takenaka<sup>1,2)</sup>, S. Harada<sup>1)</sup>, S. Ogata<sup>3)</sup>, T. Hayashi<sup>3)</sup>, T. Izumi<sup>3)</sup>, T. Hemmi<sup>3)</sup>, A. Tanaka<sup>3)</sup>, K. Nakayama<sup>3)</sup>, K. Asano<sup>3)</sup>, K. Matsumoto<sup>1)</sup>, N. Ohse<sup>1,2)</sup>, M. Ryo<sup>1,2)</sup>, C. Ota<sup>4)</sup>, K. Takao<sup>4)</sup>, M. Mizukami<sup>4)</sup>, T. Kato<sup>1)</sup>, M. Takei<sup>1,2)</sup>, Y. Yonezawa<sup>1)</sup>, K. Fukuda<sup>1)</sup>, and H. Okumura<sup>1)</sup>  
<sup>1)</sup>National Institute of Advanced Industrial Science and Technology, Japan, <sup>2)</sup>Fuji Electric Co. Ltd., Japan, <sup>3)</sup>Kansai Electric Power Co., Inc., Japan, <sup>4)</sup>Toshiba Corporation, Japan
- Th-P-38** p.334  
**Radiation-Induced Currents in 4H-SiC Dosimeters for Real-Time Gamma-Ray Dose Rate Monitoring**  
N. Fujita, N. Iwamoto, S. Onoda, T. Makino, and T. Ohshima  
 Japan Atomic Energy Agency, Japan
- Th-P-39** p.335  
**Characterization of SiO<sub>2</sub>/4H-SiC Interface by Device Simulation and Temperature Dependence of On-Resistance of SiC MOSFET**  
K. Ohtsuka, S. Hino, A. Nagae, R. Tanaka, Y. Kagawa, N. Miura, and S. Nakata  
 Mitsubishi Electric Corporation, Japan
- Th-P-40** p.336  
**On the TCAD Based Design Diagnostic Study of 4H-SiC Based IGBTs**  
M. Nawaz and F. Chimento  
 ABB Corporate Research, Sweden

- Th-P-41** p.337  
**SiC Etching and Sacrificial Oxidation Effects on the Performance of 4H-SiC BJTs**  
L. Lanni, B. G. Malm, M. Östling, and C. -M. Zetterling  
 KTH Royal Institute of Technology, Sweden
- Th-P-42** p.338  
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S. Jahdi, O. Alatise, and P. Mawby  
 University of Warwick, UK
- Th-P-43** p.339  
**SiC Current Limiting FET (CLFs) for DC Applications**  
D. Tournier<sup>1)</sup>, P. Godignon<sup>2)</sup>, S. Niu<sup>1)</sup>, and J. F. de Palma<sup>3)</sup>  
<sup>1)</sup>University of Lyon, France, <sup>2)</sup>CNM-CSIC, Spain, <sup>3)</sup>MERSEN FRANCE, France
- Th-P-44** p.340  
**Unexpected Effect of Thermal Storage Observed on SiC Power DMOSFET**  
Z. Chbili<sup>1)</sup>, P. Shreshta<sup>1)</sup>, J. P. Campbell<sup>1)</sup>, J. S. Suehle<sup>1)</sup>, D. E. Ioannou<sup>2)</sup>, and K. P. Cheung<sup>1)</sup>  
<sup>1)</sup>NIST, USA, <sup>2)</sup>George Mason University, USA
- Th-P-45** p.341  
**Optical and Electrical Simulation of Silicon Carbide-Based Photodiodes**  
S. Biondo, W. Vervisch, R. Ferone, and L. Ottaviani  
 IM2NP Aix-Marseille Université, France
- Th-P-46** p.342  
**Radiation-Induced Trapped Charging Effects in SiC Power MOSFETs**  
R. Green, A. J. Lelis, D. P. Urciuoli, M. S. Litz, and J. J. Carroll  
 U.S. Army Research Laboratory, USA
- Th-P-47** p.343  
**The Role of Substrate Compensation on DC Characteristics of 4H-SiC MESFET with Buffer Layer: A Combined Two-Dimensional Simulations and Analytical Study**  
 M. H. L. Rao and N. V. L. N. Murty  
 Indian Institute of Technology Bhubaneswar, India
- Th-P-48** p.344  
**Utilization of SiC MOSFET Body Diode in Hard Switching Applications**  
A. V. Bolotnikov, J. Glaser, J. Nasadoski, P. Losee, S. Klopman, and L. Stevanovic  
 General Electric Global Research Center, USA
- Th-P-49** p.345  
**Monolithic Integration of Power MESFET for High Temperature SiC Integrated Circuits**  
V. Banu<sup>1)</sup>, J. Montserrat<sup>2)</sup>, M. Alexandru<sup>2)</sup>, X. Jordà<sup>2)</sup>, J. Millán<sup>2)</sup>, and P. Godignon<sup>2)</sup>  
<sup>1)</sup>D+T Microelectrónica, Spain, <sup>2)</sup>IMB-CNM, CSIC, Spain
- <Graphene, GaN, and Related Materials>
- Th-P-50** p.346  
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S. Jiao<sup>1)</sup>, H. Fukidome<sup>1,2)</sup>, H. Nagasawa<sup>1)</sup>, S. Filimonov<sup>3)</sup>, M. Tateno<sup>4)</sup>, I. Makabe<sup>4)</sup>, T. Nakabayashi<sup>4)</sup>, and M. Suemitsu<sup>1)</sup>  
<sup>1)</sup>Tohoku University, Japan, <sup>2)</sup>JST-CREST, Japan, <sup>3)</sup>Tomsk State University, Russia, <sup>4)</sup>Sumitomo Electric Industries. Ltd., Japan
- Th-P-51** p.347  
**Influence of Atomic Step Structures on Epitaxial Graphene Growth on SiC(0001)**  
M. Inoue<sup>1)</sup>, Y. Kangawa<sup>1)</sup>, H. Kageshima<sup>2)</sup>, S. Tanaka<sup>1)</sup>, and K. Kakimoto<sup>1)</sup>  
<sup>1)</sup>Kyushu University, Japan, <sup>2)</sup>NTT Basic Research Laboratories, Japan

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**Optimizing the Vacuum Growth of Epitaxial Graphene on 6H-SiC**  
T. Hopf<sup>1)</sup>, K. V. Vassilevski<sup>1)</sup>, E. Escobedo-Cousin<sup>1)</sup>, N. G. Wright<sup>1)</sup>, A. G. O'Neill<sup>1)</sup>, A. B. Horsfall<sup>1)</sup>, J. P. Goss<sup>1)</sup>, A. J. Barlow<sup>1)</sup>, G. Wells<sup>2)</sup>, and M. R. Hunt<sup>2)</sup>  
<sup>1)</sup>Newcastle University, UK, <sup>2)</sup>Durham University, UK

**Th-P-53** p.349  
**Formation of Graphene onto Atomically Flat 6H-SiC**  
G. Rius<sup>1)</sup>, N. Mestres<sup>2)</sup>, Y. Tanaka<sup>1)</sup>, O. Eryu<sup>1)</sup>, and P. Godignon<sup>3)</sup>  
<sup>1)</sup>Nagoya Institute of Technology, Japan, <sup>2)</sup>Institut Ciencia de Materials, Spain, <sup>3)</sup>Centro Nacional de Microelectronica, Spain

**Th-P-54** p.350  
**Growth Control of Carbon Nanotubes Using Ion-Beam Irradiation in the SiC Surface Decomposition Method**  
K. Seo<sup>1)</sup>, H. Takedo<sup>1)</sup>, M. Naitoh<sup>1)</sup>, and T. Ikari<sup>2)</sup>  
<sup>1)</sup>Kyushu Institute of Technology, Japan, <sup>2)</sup>Ube National College of Technology, Japan

**Th-P-55** p.351  
**Intermediate C-Rich (Sqrt [3] x Sqrt [3]) R30 Structure Preceding Graphene Buffer Layer Formation on SiC (0001)**  
S. Hayashi, A. Visikovskiy, T. Kajiwara, and S. Tanaka  
Kyushu University, Japan

**Th-P-56** p.352  
**Polytype Dependence of Graphene Growth on SiC (000-1)**  
Z. R. Robinson<sup>1)</sup>, K. Bussmann<sup>1)</sup>, G. G. Jernigan<sup>1)</sup>, L. O. Nyakiti<sup>1)</sup>, R. L. Myers-Ward<sup>1)</sup>, V. D. Wheeler<sup>1)</sup>, A. Nath<sup>2)</sup>, M. V. Rao<sup>2)</sup>, C. R. Eddy Jr.<sup>1)</sup>, and D. K. Gaskill<sup>1)</sup>  
<sup>1)</sup>U. S. Naval Research Laboratory, USA, <sup>2)</sup>George Mason University, USA

**Th-P-57** p.353  
**Solid Phase Growth of Graphene on Silicon Carbide by Nickel Silicidation: Graphene Formation Mechanisms**  
E. Escobedo-Cousin, K. Vassilevski, T. Hopf, N. Wright, A. O'Neill, A. Horsfall, and J. Goss  
Newcastle University, UK

**Th-P-58** p.354  
**Silicon Intercalation at the SiC-Graphene Interface**  
S. Kimoto, T. Kajiwara, A. Visikovskiy, and S. Tanaka  
Kyushu University, Japan

<Epitaxy>

**Th-P-59** (moved from Mo-P-12) p.355  
**Generation of Surface Defects during SiC Epitaxy**  
Z. H. Zhang<sup>1)</sup>, Y. M. Fan<sup>1)</sup>, and T. S. Sudarshan<sup>2)</sup>  
<sup>1)</sup>Chinese Academy of Sciences, China, <sup>2)</sup>University of South Carolina, USA

<Processing>

**Th-P-60** (moved from We-P-29) p.356  
**Analysis of C-Face 4H-SiC MOS Capacitors with ZrO<sub>2</sub> Gate Dielectric**  
L. Chan, C. Chung, Y. Chang, and K. Lee  
National Taiwan University, Taiwan

<Late News: Epitaxy>

**Th-P-61** p.357  
**Simulation Studies on Giant Step Bunching Accompanying Trapezoid-Shape Defects in 4H-SiC Epitaxial Layer**  
Y. Ishida and S. Yoshida  
National Institute of Advanced Industrial Science and Technology, Japan



**Th-P-62**

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**Characterization of 4H-SiC Homoepitaxial Layers Grown on 100-mm-Diameter 4H-SiC/Poly-SiC Bonded Substrates**

J. Suda<sup>1)</sup>, T. Okuda<sup>1)</sup>, H. Uchida<sup>2)</sup>, A. Minami<sup>2)</sup>, N. Hatta<sup>2)</sup>, T. Sakata<sup>2)</sup>, T. Kawahara<sup>2)</sup>, K. Yagi<sup>2)</sup>, Y. Kurashima<sup>3)</sup>, and H. Takagi<sup>3)</sup>

<sup>1)</sup>Kyoto University, Japan, <sup>2)</sup>SICOXS Co., Japan, <sup>3)</sup>National Institute of Advanced Industrial Science and Technology, Japan

<Late News: Processing>

**Th-P-63**

p.359

**Development of Multi-Wire Electric Discharge Machining for SiC Wafer Processing**

M. Ogawa<sup>1)</sup>, K. Mine<sup>1)</sup>, Y. Ohshita<sup>1)</sup>, S. Fuchiyama<sup>1)</sup>, Y. Tawa<sup>1)</sup>, and T. Kato<sup>1,2)</sup>

<sup>1)</sup>R&D Partnership for Future Power Electronics Technology, Japan, <sup>2)</sup>National Institute of Advanced Industrial Science and Technology, Japan

**Banquet 18:30-21:00**

“Shosenkyu Green Garden” in the Sheraton Grande Ocean Resort Hotel

(If it rains, the venue will be changed to “Summit Hall (“Tenzui” and “Juyo”)” on the 4th floor of the Convention Center.)

## Friday, October 4

### **Fr-1A Package & Applications 8:40-10:30**

Chairs: S. Tanimoto (Nissan Motor, Japan)

K. Matocha (Monolith Semiconductor, USA)

Room: Tenzui

8:40 **Fr-1A-1 <Invited>** p.360

**SiC Power Devices as Enabler for High Power Density – Aspects and Prospects**

P. Friedrichs

Infineon Technologies AG, Germany

9:10 **Fr-1A-2** p.361

**High Temperature Resistant Packaging for SiC Power Devices Using Interconnections Formed by Ni Micro-Electroplating**

N. Kato, A. Shigenaga, and K. Tatsumi

Waseda University, Japan

9:30 **Fr-1A-3** p.362

**Research of Silver Sintering Process and Reliability for High Temperature Operation of SiC Power Module**

Z. Zhang and T. Nakamura

ROHM Co., Ltd, Japan

9:50 **Fr-1A-4** p.363

**SiC Power Module for Home Appliances**

K. Yamashita, K. Kato, H. Ikeuchi, J. Tanaka, R. Arakawa, and T. Sasaoka

Panasonic Corporation, Japan

10:10 **Fr-1A-5** p.364

**Inverter-Rectifier Using SiC Power Devices for Bidirectional Wireless Power Transfer System of Electric Vehicles**

M. Hachisuka, T. Fukuhara, Y. Kaneko, and S. Abe

Saitama University, Japan

### **Fr-1B Advanced Characterization 8:40-10:30**

Chairs: P. Bergman (Linköping University, Sweden)

I. Kamata (CRIEPI, Japan)

Room: Juyo

8:40 **Fr-1B-1 <Invited>** p.365

**Nanoscale Characterization of SiC Interfaces and Devices**

F. Giannazzo<sup>1)</sup>, P. Fiorenza<sup>1)</sup>, M. Saggio<sup>2)</sup>, and F. Roccaforte<sup>1)</sup>

<sup>1)</sup>CNR-IMM, Italy, <sup>2)</sup>STMicroelectronics, Italy

9:10 **Fr-1B-2** p.366

**Three-Dimensional Imaging of Extended Defects in 4H-SiC by Optical Second-Harmonic Generation**

R. Tanuma and H. Tsuchida

Central Research Institute of Electric Power Industry, Japan

9:30 **Fr-1B-3** p.367

**Identification of Dislocations in 4H-SiC Epilayers and Substrates using Photoluminescence Imaging**

C. Kawahara, J. Suda, and T. Kimoto

Kyoto University, Japan

9:50 **Fr-1B-4** p.368

**Zero-Field Spectroscopy in SiC Based Systems**

C. J. Cochrane<sup>1)</sup>, M. Anders<sup>1)</sup>, P. M. Lenahan<sup>1)</sup>, and A. J. Lelis<sup>2)</sup>

<sup>1)</sup>The Pennsylvania State University, USA, <sup>2)</sup>US Army Research Lab, USA

10:10 **Fr-1B-5** p.369

**C-Face Interface Defects in 4H-SiC MOSFETs Studied by Electrically Detected Magnetic Resonance**

T. Umeda<sup>1)</sup>, M. Okamoto<sup>2)</sup>, R. Arai<sup>1)</sup>, Y. Satoh<sup>1)</sup>, R. Kosugi<sup>2)</sup>, S. Harada<sup>2)</sup>, H. Okumura<sup>2)</sup>, T. Makino<sup>3)</sup>, and T. Ohshima<sup>3)</sup>

<sup>1)</sup>University of Tsukuba, Japan, <sup>2)</sup>National Institute of Advanced Industrial Science and Technology, Japan, <sup>3)</sup>Japan Atomic Energy Agency, Japan

***Fr-PL Plenary***      ***11:00-11:45***

Room: Tenzui

Chairs: T. Kimoto (Kyoto University, Japan)

T. Shinohe (Toshiba, Japan)

11:00    **Fr-PL-1 <Invited>**

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**High Speed Rail Awaits the Next Breakthrough of Power Semiconductors**

T. Uzuka and E. Masada

Railway Technical Research Institute, Japan

***Closing***      ***11:45-12:30***

Room: Tenzui

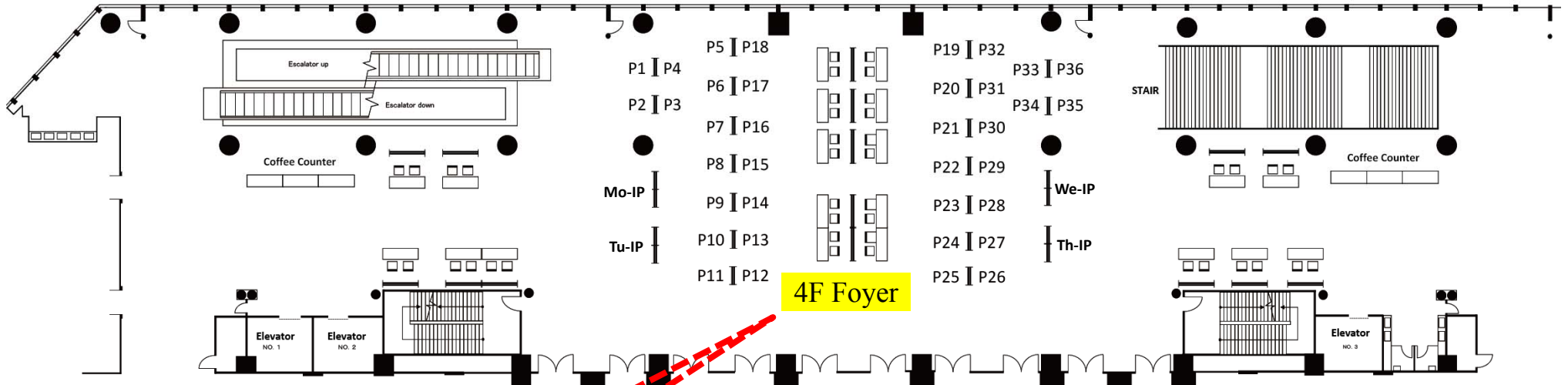
Chair: H. Itoh (JAEA, Japan)

**Closing Remarks**

**ECSCRM 2014 Announcement**

**ICSCRM 2015 Announcement**

# Poster Presentation Map



4th Floor

