

program

Advanced Power Semiconductor Subcommittee 10th Lecture
The 10th Meeting on Advanced Power Semiconductors

Sponsored by: Japan Society of Applied Physics, Advanced Power Semiconductor Subcommittee

Venue: ANA Crowne Plaza Hotel Kanazawa

Thursday, November 30th

| time | Venue A | Venue B | poster venue |
|-------------|---|--|-------------------|
| 9:55-10:00 | Opening speech | | |
| 10:00-11:30 | Session I Keynote speech <small>Masato Fukushima (Resonac Holdings) Tamotsu Hashizume (Nagoya University/Hokkaido University)</small> | | |
| 11:30-13:00 | lunch break | | |
| 13:00-14:00 | Session II Invited Lecture (SiC materials/evaluation technology) <small>Daichi Dojima (Kwansei Gakuin University) Yukihiko Hirai (National Institute of Advanced Industrial Science and Technology)</small> | Session Ⅲ Invited lecture (GaN materials/devices) <small>Hiroshi Fujjoka (University of Tokyo) Atsuyuki Tanaka (Nagoya University)</small> | |
| 14:00-14:15 | break | | |
| 14:15-15:15 | Industrial Session I | Industrial Session II | |
| 15:15-16:30 | | | Poster session IA |
| 16:30-17:45 | | | Poster session IB |
| 18:00-20:00 | Social gathering (ANA Crowne Plaza Hotel "Otori") | | |

Friday, December 1st

| time | Venue A | B Venue | poster venue |
|-------------|---|--|--------------------|
| 9:30-11:30 | Session Ⅳ Invited Lecture (SiC device system) <small>Masayoshi Yamamoto (Nagoya University) Junichi Ito (Nagaoka University of Technology) Shiro Hino (Mitsubishi Electric) Masahiro Masunaga (Hitachi, Ltd.)</small> | Session Ⅴ Invited Lecture (WBG material) <small>Kim Seong-woo (Orbray) Takashi Kanemura (Mirise Technologies) Motoki Kobayashi (Psychocs) Kiseiyo (National Institute of Advanced Industrial Science and Technology)</small> | |
| 11:30-13:00 | lunch break | | |
| 13:00-14:15 | | | Poster session IIA |
| 14:15-15:30 | | | Poster session IIB |
| 15:30-15:45 | break | | |
| 15:45-16:30 | Session Ⅵ Keynote speech <small>Hideji Shimizu (Director, Device and Semiconductor Strategy Office, Information Industry Division, Commerce and Information Policy Bureau, Ministry of Economy, Trade and Industry)</small> | | |
| 16:30-17:10 | Session VII Last year's Encouragement Award Commemorative Lecture <small>Shunya Shibata (Kyoto University) Takasumi Nakanuma (Osaka University)</small> | | |
| 17:10-17:30 | Encouragement Award Ceremony closing | | |

Thursday 30 November

Opening 9:55-10:00 ["Otori"]

9:55-10:00 Opening remarks

Secretary General Yasunobu Tanaka (National Institute of Advanced Industrial Science and Technology)

Session I: Keynote Speech 10:00-11:30 ["Otori"] Introducing

- 10:00-10:45 Resonac's carbon neutral efforts and examples
I-1 Carbon neutral initiatives and illustrations of Resonac
[Keynote speech] Masato Fukushima (Resonac Holdings Co., Ltd.)
- 10:45-11:30 Surface/interface control in GaN power transistors
I-2 - Progress of GaN HEMT and challenges of MOSFET -
[Keynote speech] Surface and Interface Control of GaN Power Transistors
Tamotsu Hashizume (Nagoya University)

(Lunch break: 11:30-13:00)

Session II: Invited lecture (SiC materials and evaluation technology) 13:00-14:00 [Venue "Otori" A]

- 13:00-13:30 Visualization of processed damaged layer remaining on large-diameter 4H-SiC(0001) wafer and influence on
II-1 epitaxial defects
[Invited lecture] Visualization of Sub-surface Damage Layer on 4H-SiC (0001) Wafers and Its Effect on Epitaxial Defects
Daichi Dojima (Kwansei Gakuin University)
- 13:30-14:00 Direct evaluation method of SiC trench MOS channel - 3D-VDP device
II-2 Direct evaluation technique for SiC trench MOS channel – 3D-VDP Yukihiro Hirai
[Invited lecture] (National Institute of Advanced Industrial Science and Technology)

Session III: Invited lecture (GaN materials/devices) 13:00-14:00 [Venue "Otori" B]

- 13:00-13:30 Fabrication of GaN and AlGaIn electronic devices by pulse sputtering
III-1 Preparation of GaN and AlGaIn electron devices by Pulsed Sputtering Hiroshi
[Invited lecture] Fujioka (University of Tokyo)
- 13:30-14:00 Laser slicing of GaN substrates and devices
III-2 Laser slicing of GaN substrates and
[Invited lecture] devices Atsuyuki Tanaka (Nagoya University)

(Break: 14:00-14:15)

Industrial Session 14:15-15:15 [Otori A/B Venue] 14:15-15:15 Industrial Session I/

II

Poster session I 15:15-17:45 [Poster venue "Zuiun"] 15:15-16:30 first half (YA)

16:30-17:45 second half (YB)

Social gathering 18:00-20:00 [ANA Crowne Plaza Hotel "Otori"] 18:00-20:00 Social

gathering

Friday 1 December

Session IV: Invited lecture (SiC devices/systems) 9:30-11:30 [Venue "Otori" A]

- 9:30-10:00 Low-loss SiC power semiconductor design guidelines and their implementation technology required for next-generation
IV-1 EVs
[Invited lecture] **Design Strategy of High Efficiency Power Semiconductor Devices and Its Packaging**
Techniques for Next Generation Electric Vehicle
Masayoshi Yamamoto (Nagoya University)
- 10:00-10:30 The future of power converters: USPM integration of power electronics systems
IV-2 Future of Power Converters: Power Electronics System Integration with USPM Junichi
[Invited lecture] Ito (Nagaoka University of Technology)
- 10:30-11:00 Development of SiC-MOSFET with built-in SBD
IV-3 Development of SBD-embedded MOSFET Shiro
[Invited lecture] Hino (Mitsubishi Electric Corporation)
- 11:00-11:30 Reliability and application of SiC-CMOS technology for harsh environments
IV-4 Reliability and Application of SiC-CMOS Technology for Harsh Environments Masahiro
[Invited lecture] Masunaga (Hitachi, Ltd.)

Session V: Invited Lecture (WBG Materials) 9:30-11:30 [Venue "Otori" B] Large-diameter

- heteroepitaxial diamond substrate fabrication and application 9:30-10:00 y-1
Fabrication of large area heteroepitaxial diamond substrates and its applications Seiyu
Kim (Orbray Co., Ltd.) [Invited lecture]
- 10:00-10:30 y-2 SiC crystal growth and carbon neutrality using high-temperature gas growth method for automotive
applications
[Invited lecture] SiC Crystal Growth by High Temperature Chemical Vapor Deposition Method for
Automotive Applications and Carbon Neutrality Takashi
Kanamura (Mirise Technologies Co., Ltd.)
- 10:30-11:00 y-3 Development of laminated substrate SiCkrest
Development of Bonded SiC Substrate "SiCkrest"
[Invited lecture] Motoki Kobayashi (SiCox Co., Ltd.)
- 11:00-11:30 Development and progress of 4H-SiC backfill growth technology using CVD method towards realization of
y-4 SiC SJ devices
[Invited lecture] The development and status on 4H-SiC CVD trench filling technology for super-junction devices Ki Seyo (National
Institute
of Advanced Industrial Science and Technology)

(Lunch break: 11:30-13:00)

Poster session II 13:00-15:30 [Poster venue "Zuiun"] 13:00-14:15 first half (IIA) 14:15-15:30

second half (IIB)

(Break: 15:30-15:45)

Session VI: Keynote Speech 15:45-16:30 ["Otori"] Semiconductor/

15:45-16:30 Digital Industrial Strategy
ÿ-1 The Strategy for Semiconductor and Digital IndustryHideji Shimizu (Director,
[Keynote speech] Device and
Semiconductor Strategy Office, Information Industry Division, Commerce and Information Policy Bureau, Ministry of Economy, Trade and Industry)

Session VII: Last year's Encouragement Award Commemorative Lecture 16:30-17:10 [Otori]

16:30-16:50 Fabrication of bottom-gate JFET by ion implantation into SiC substrate for high-temperature operation
VII-1 integrated circuits
[Invited lecture] Fabrication of bottom-gate JFETs by ion implantation into a SiC substrate for high-
temperature IC operation Shunya
Shibata, Taiga Matsuoka, Mitsuki Kaneko, Tsunenobu Kimoto (Kyoto University)

16:50-17:10 Control of SiC MOS interface single photon source for quantum technology applications
VII-2 Controlling The Properties of Single Photon Emitters at SiC MOS Interfaces for Quantum
[Invited lecture] ApplicationsTakasumi Nakanuma, Kosa Tahara, Katsuhiko Kuchiki, Kokou Shimura, Heiji Watanabe, Takuma
Kobayashi (Osaka University)

Encouragement Award Ceremony/Closing 17:10-17:30 ["Otori"] 17:10-17:30

Encouragement Award Ceremony Closing

Poster lecture (ÿ)

written in front of the speaker indicates the speaker, ÿ indicates the presentation is an application for the Encouragement Award)

[IA] (11/30 first half 15:15-16:30)

IA-1 Effect of H₂ and N₂ partial pressure on three-dimensional nuclei in high-temperature gas growth method

Effects of H₂ and N₂ partial pressures on three-dimensional nuclei in HTCVD Method

ÿ• Satoma Sakakibara¹ Keisho Horiai Hideyuki¹ Johigashi Nobuyuki¹ Oya Takahiro¹ Kanda Takashi Kanemura¹ Mirize¹,
Technologies¹
Co., Ltd.

IA-2 Study on improving processing speed in SiC wafer dicing using SF₆ plasma

Investigation of improving removal rate in SiC wafer dicing process with SF₆ plasma

ÿ• Shunto Idono Masaaki¹ Shima Kazuto Yamauchi¹ Department of¹, Yasuhisa Sano¹
Physics, Graduate School of Engineering, Osaka University

IA-3 Highly efficient etching of gallium nitride by atmospheric pressure plasma using hydrogen gas

High-speed etching of gallium nitride semiconductors using PCVM with hydrogen gas

ÿ• Genta Nakagami¹, Motoki Nahata¹, Junpei Yamada¹, Daisetsu Fuji¹, Kazuto Yamauchi¹, Yasuhisa Sano¹ Department¹
of Physics, Graduate School of Engineering, Osaka University

IA-4 Generation mechanism of basal plane dislocations in 150mm diameter thick film SiC epitaxial wafers

Formation mechanism of basal plane dislocations in 150mm diameter SiC wafers with thick epitaxial layers

ÿ• Fumihiko Fujisei¹, Koichi Murata¹, Tsubasa Shiono², Naoto Ishibashi², Yuichiro Mabuchi², Shuichi Tsuchida¹ Central¹
Research Institute of Electric Power Industry, 2 Resonac Co., Ltd.

IA-5 Omnidirectional photoluminescence and carrier lifetime evaluation for 4H-SiC free-standing epilayer

Evaluation of omnidirectional photoluminescence and carrier lifetime of 4H-SiC freestanding epilayers

ÿ• Hayao Makino Kengo¹ Suzuki Masafumi¹ Kato¹ Nagoya¹
Institute of Technology Graduate School of Engineering, 2 Hamamatsu Photonics Co., Ltd.

IA-6 Atomic and electronic structure analysis using first-principles calculations of basal plane dislocations (BPD) in 4H-SiC

-Elucidation of the physical origin of bipolar degradation phenomenon-

Atomic & electronic structures of basal plane dislocation (BPD) in 4H-SiC ÿAtomic origin of bipolar
degradation of SiC devicesÿÿ

ÿ• Masaki Sano Jun Kojima¹ Takashi Yoda² Takayuki Ohba Jun Oshiyama Shoichi Onda¹ Nagoya³ University² Kenji Shiraishi^{1, 2}
School of Engineering, 2 Nagoya University Institute for Future Materials and Systems, 3 Tokyo Institute of Technology WOW
alliance

IA-7 Formation of unalloyed ohmic electrodes on p-type SiC with high concentration Al ion implantation

Non-alloyed ohmic contacts formed on heavily Al⁺-implanted p-type SiC

ÿ• Kotaro Kuwahara Mitsuki¹ Karita Tetsuro¹ Kimoto Seitaro¹ Hara¹ Kyoto University¹,¹

IA-8 Reactive ion etching generates a bandgap near the surface of 4H-SiC that spans the entire band gap.

Analysis of depth distribution of deep levels

Depth profiles of deep levels in the whole band gap formed by reactive ion etching near the 4H-SiC surface

ÿ• Shota Kosakai¹, Kai Fujii¹, Mitsuki Kaneko¹, Tsunenobu Kimoto¹ Kyoto¹
University

IA-9 Formation of SiO₂/SiC structure by direct bonding of SiO₂ and SiC

Formation of SiO₂/SiC structure by direct bonding of SiO₂ and SiC

ÿ• Shinji Kambatake Heiji Watanabe¹ Osaka¹ Takuya Kobayashi¹ Shimura Kokou¹,¹

IA-10 Formation of SiO₂/SiC interface single photon source by low-temperature additional oxidation process

Generation of single photon emitters at SiO₂/SiC interfaces by low temperature reoxidation process

• Kentaro Onishi¹, Takasumi Nakanuma¹, Takako Shimura¹, Takuma Kobayashi¹, Okihiro Kossa², Takaharu Tahara², Katsuhiko Kuchiki², Heiji Watanabe¹,
¹ Osaka Central Research Institute

IA-11 Evaluation of hole traps at n-type GaN MOS interface by below-gap light irradiation

Hole traps in n-type GaN MOS structures evaluated by below-gap light excitation

• Kazuki¹, Takuma¹, Mikito Nozaki¹, Koko Shimura¹, Heiji Watanabe¹
¹ Tomigahara 1 Graduate School of Engineering, Osaka University

IA-12 Effect of post-annealing on fixed charges in SiO₂/GaOx/GaN structures

Effect of post anneal on the fixed charges in SiO₂/GaOx/GaN structures

• Yui Araki¹, Mikito Nozaki¹, Koko Shimura¹, Takuma Kobayashi¹, Heiji Watanabe¹
¹ Tomigahara 1 Graduate School of Engineering, Osaka University

IA-13 Formation of high-quality SiC MOS structure using a combined process of plasma nitriding, SiO₂ deposition, and CO₂ heat treatment

Formation of high-quality SiC MOS structures by plasma nitridation, deposition of SiO₂, and CO₂ annealing

• Hiroki Fujimoto¹ Osaka University¹, Takuma Kobayashi¹, Koko Shimura¹, Heiji Watanabe¹
¹ Graduate School of Engineering

IA-14 Analysis of different temperature dependence of mobility in SiC n/p channel MOSFET

Analysis of the different temperature dependence of mobility in SiC n- and p-channel MOSFETs

• Hirin Satoru Kaoru¹, Tachiki Kyota Mikami¹, Mitsuaki Kaneko¹, Tsunenobu Kimoto¹
¹ Graduate School of Engineering, Kyoto University

IA-15 Theoretical analysis of band arrangement and interfacial dipole formation at 4H-SiC/SiO₂ interface

Theoretical analysis for band alignments and formation of interfacial dipoles at 4H-SiC/SiO₂ interface

• Jun Matsuda¹, Toru Akiyama¹, Tetsuo Hatakeyama², Kenji Shiraishi³, Takashi Nakayama¹
¹ Mie University, ² Toyama Prefectural University, ³ Nagoya University, ⁴ Chiba University

IA-16 Understanding the influence of oxygen partial pressure on the reaction of nitrogen introduction into the 4H-SiC/SiO₂ interface by NO annealing

Understanding the Impact of Oxygen Partial Pressure on Nitrogen Incorporation Kinetics at the 4H-SiC/SiO₂ Interface Using NO Annealing

• Ryu Sasaki¹, Takashi Ono¹, Hiroyuki Kita^{1,2}
¹ Department of Materials Engineering, Graduate School of Engineering, The University of Tokyo, ² Graduate School of Frontier Sciences, The University of Tokyo
Materials major

IA-17 Analysis of electron binding state due to donor impurity at SiC MOS interface

Analysis of Electron Binding States by Donor Impurities at SiC MOS Interface

• Arai Shinya¹, Mori Hajime¹, Tanaka¹
¹ Osaka University

IA-18 Study of a method for promoting nitrogen introduction to the 4H-SiC/insulating film interface by introducing rare earth elements into the insulating film

Study on the method to enhance nitrogen incorporation on the 4H-SiC/oxide interface by incorporating rare earth elements to oxide

• Tatsumi Nakajima¹, Takashi Onoya¹, Hiroyuki Kita¹
¹ Department of Materials Science, Graduate School of Frontier Sciences, The University of Tokyo

IA-19 Study on short channel effect of SiC n-channel MOSFET on high-purity semi-insulating substrate

Short-channel effects of SiC n-channel MOSFETs fabricated on a high-purity semi-insulating substrate

• Toshimitsu Shione¹, Tachiki Kaoru¹, Tsunenobu Kimoto¹
¹ Graduate School of Engineering, Kyoto University

IA-20 Deterioration of SiC MOS interface due to gate stress application and influence on device characteristics

Degradation of SiC MOS interfaces by gate stress and its impact on device performance

• Kaho Koyanagi¹, Takuma Kobayashi¹, Yuhisa Hirai¹, Mitsuo Okamoto², Takashi Shimura², Hiroyuki Watanabe¹, Osamu Watanabe², Osaka University Graduate School of Engineering,¹ AIST²

IA-21 Evaluation of the relationship between on-resistance and parasitic capacitance of 4H-SiC lateral p-ch SJ-MOSFET

Relationship between on-resistance and parasitic capacitance in 4H-SiC lateral p-ch SJ-MOSFETs

• Kaito Mori¹, Noriyuki Iwamuro¹, Yuji Yano¹
of Tsukuba

IA-22 Effect of electron beam irradiation on SiC trench MOSFET

Electron Irradiation Effects on SiC Trench MOSFETs

• Kotaro Matsuki¹, Takashi Tsuji¹, Yuichi Onozawa², Noriyuki Iwamuro¹, Yuji Yano¹
of Tsukuba, ² Fuji Electric Co., Ltd.

IA-23 Variation in SiC MOSFET threshold voltage and subthreshold swing due to AC gate stress

evaluation

Evaluation of threshold voltage and subthreshold swing shifts in SiC MOSFETs by AC gate stress

• Yuya Enjoji¹, Noriyuki Iwamuro¹, Yuji Yano¹
University of Tsukuba

[IB] (11/30 second half 16:30-17:45)

IB-1 Development of high-efficiency gallium nitride substrate polishing method using photoelectrochemical reaction caused by ultraviolet light irradiation

High-efficiency Polishing Method of Gallium Nitride Using Photoelectrochemical Oxidation

• Sumito Kayao¹, Yasuhisa Sanbata¹, Tetsuya Fukagawa¹, Kazutoshi Inoue¹, Kazuo Yamauchi²
¹ Graduate School of Engineering, Osaka University, ² Attached to the Graduate School of Engineering, Osaka University
Precision Engineering Research Center

IB-2 Development of new dicing technology using scribe and break method for SiC power semiconductors

Development of New Dicing Technology using Scribing and Breaking for SiC Power Semiconductors

• Yuji Nagumo¹, Masashi Ueha¹, Masatake Nagaya¹, Ryoji Ueda¹, Hirokazu Fujiwara¹, Naoya Kiyama², Mitsuru², Masakazu Takeda²
Kitaichi¹ Mirize Technologies Co., Ltd., ² Mitsubishi Diamond Industries Co., Ltd.

IB-3 High-speed growth of ̸200mm 4H-SiC using high-temperature gas growth method

Fast growth of 200-mm 4H-SiC Grown by High Temperature Chemical Vapor Deposition Method

• Takeshi Okamoto¹, Daisuke Uematsu¹, Takahiro Kanda¹, Hideyuki Johigashi¹, Keiyoshi Horiai¹, Takashi Kanemura¹, Nobuyuki Oya¹
¹ Mirize Technologies Co., Ltd.

IB-4 Crystal growth process using total pressure for ̸6 inch 4H-SiC crystal growth using high temperature gas growth method window change

Relationship between input source gas flow rate and crystal growth rate in ̸6inch 4H-SiC crystal growth by high temperature Chemical Vapor Deposition Method

Kanda • Keiyoshi Horiai¹, Satoshi¹, Hideyuki Johigashi¹, Takahiro¹, Takashi Kanemura¹
Sakakibara¹ Mirize Technologies Co., Ltd.

IB-5 Effect of graphite crucible on SiC single crystal growth using sublimation method

Influence of graphite crucible on SiC single crystal growth by sublimation method

• Kensuke Kajikawa¹, Kiyoshi Saito¹, Shigeyuki Kubotani², Kazumasa Eto¹, Rie Tao¹, Tomohisa Kato¹
¹ Toyo Tanso Corporation, ² National Institute of Advanced Industrial Science and Technology

IB-6 Controllability of nitrogen doping in chemical vapor deposition of diamond crystals

Controllability of nitrogen doping in chemical vapor deposition of diamond crystals

• Noriyuki Terachi¹, Riki Mae¹
National Institute for Materials Science

IB-7 Leveling stacking fault expansion using UV-SCAN irradiation method

Leveling of stacking fault expansion by UV Scan irradiation method

• Yosuke Matsushita¹, Kazumi Takano¹, Takuya Morita¹, Chiyomi Shibata¹
ITES Co., Ltd.

IB-8 Structural analysis of basal plane dislocations with ultra-low expansion rate in 4H-SiC epilayer

Structural analysis on BPDs with extremely slow expansion rates in 4H-SiC epitaxial layers

• Joji Nishio¹, Chiharu Ota¹, Ryosuke Iijima¹
¹ Toshiba Corporation
Research and Development Center

IB-9 Silicon vacancies and vanadium impurities in SiC crystals for expanding the application environment of quantum sensors

Luminescence characteristics evaluation

Luminescence study of silicon vacancy and vanadium impurity in SiC crystal to broaden operating environment of quantum

• Koichi Murata¹, Seiichi Saeki², Satoshi Asada¹, Yuta Masuyama², Shinichiro Sato¹
¹ Central Research Institute, ² QST

IB-10 Polarization control of SiO₂/SiC interface single photon source by oxygen pressure during thermal oxidation

Polarization control of SiO₂/SiC interfacial single-photon sources by oxygen pressure during thermal oxidation

• Rinku Oyama¹, Yasuto Hijikata¹
¹ Saitama University Graduate School of Science and Technology

IB-11 Examination of cross-sectional fabrication method for SEM-cathodoluminescence of GaN substrate

Study of cross-sectional method for SEM-cathodoluminescence of GaN wafer

•Natsuko Asano Yuhei Nakajima Shunsuke Akihina 1 JEOL Ltd. ¹

IB-12 Evaluation of Ga₂O₃ surface structure subjected to nitrogen radical irradiation treatment

Evaluation of Ga₂O₃ Surface Structures Treated by Nitrogen Radical Irradiation

•Shoki Taniguchi¹, Kura Nakaoka¹, Masataka Higashiwaki^{1,2}

¹ Graduate School of Engineering, Osaka Public University, ² National Institute of Information and Communications Technology

IB-13 Improvement of electrical characteristics of Ga₂O₃ (100), (010) Schottky barrier diode by nitrogen radical irradiation

Improvement in Electrical Characteristics of Ga₂O₃ (100) and (010) Schottky Barrier Diodes by Nitrogen Radical Irradiation

•Teruo Eguchi¹ Osaka¹, Shota Sato¹, Zhenwei Wang², Masataka Higashiwaki^{1,2}

Public University Graduate School of Engineering, ² National Institute of Information and Communications Technology

IB-14 Examination of changes in oxygen vacancies near the γ -Ga₂O₃ surface due to SiO₂ film formation and annealing

Investigation of the change of oxygen deficiency caused by SiO₂ deposition and annealing near the surface of γ -Ga₂O₃

•Hiroo Katagiri¹, Takashi Onoya¹, Hiroyuki Kita¹ Department ¹

of Materials Science, Graduate School of Frontier Sciences, The University of Tokyo

IB-15 S Analysis of electrical conduction mechanism in ion-implanted SiC Schottky barrier diode

Analysis of carrier transport in S⁺-implanted SiC Schottky barrier diodes

•Aito Takayasu, Taiga Matsuoka, Mitsuaki Kaneko, Seidoh Hara, Toshihiro Kikuchi¹ Kyoto University ¹

IB-16 By combining high temperature nitriding process in N₂ atmosphere and low temperature annealing process in O₂ atmosphere

Improvement of 4H-SiC/SiO₂ interface quality

Improvement of 4H-SiC/SiO₂ interface quality by combining a high-temperature nitridation process in N₂ (+O₂) ambient and a low-temperature post-nitridation annealing in O₂

•Tianlin Yang¹, ¹ Dept. of Takashi Onoya², Koji Kita¹, ²

Materials Engineering, The Univ. of Tokyo, ² Dept. of Advanced Materials

Science, The Univ. of Tokyo

IB-17 Unalloyed ohmic contact based on understanding of metal/highly doped SiC interface tunneling phenomenon

Contact resistance reduction

Reduction of contact resistivity at non-alloyed ohmic contacts based on understanding of tunneling phenomena at metal/heavily-doped SiC interfaces

•Seitai Hara Tsunenobu Mitsuaki Kaneko¹ School of ¹

Engineering, Kyoto University

IB-18 Density of state analysis of SiC/SiO₂ interface defects using large-scale first-principles calculations

Density of state analysis of SiC/SiO₂ interface defects by large-scale ab initio calculations

•Hideki Saeki Yuki Uchi 1 Fuji Electric ¹

Co., Ltd.

IB-19 Effect of screen oxide film on channeling implantation into SiC

The influence of channeling implantation into 4H-SiC with SiO₂ thin film

•Ryota Wada¹, Takashi Kuroi¹, Tsutomu Nagayama¹, Shigeaki Hamamoto¹

Nissin Aeon Equipment Co., Ltd.

IB-20 Evaluation of radiation resistance characteristics of side gate type SiC JFET

Radiation Tolerance Evaluation of Side-Gate SiC JFETs

•Yuki Koizumi^{1,2}, Rice sake cup Tomoki^{1,2}, Akinori Takeyama³, Takahiro Makino³, Takeshi Oshima³, Hitoshi Umezawa¹,

Masayuki Yamamoto^{1,2}, Yasunobu Tanaka¹

¹ Advanced Power Electronics Research Center, National Institute of Advanced Industrial Science and Technology, ² Department of Electrical Engineering, Faculty of Engineering, University of Yamanashi

Department of Engineering, ³ Quantum Function Creation Research Center, National Institutes for Quantum and Radiological Science and Technology

IB-21 Operation demonstration of SiC transistor using two-dimensional electron gas of 3C/4H-SiC heterostructure

First demonstration of SiC transistor utilizing 2D electron gas in 3C/4H-SiC heterostructure

•Hiroyuki Sazawa¹, Shigeyuki Kubotani¹, Tomohisa Kato¹, Hitoshi Umezawa¹, Yasunobu Tanaka¹

Advanced Power Electronics Research Center, National Institute of Advanced Industrial Science and Technology

IB-22 Schottky barrier diode on GaN substrate fabricated by OVPE method

Schottky barrier diode on GaN substrate grown by OVPE method

•Kota Anzai¹, Shigeaki Tanaka¹, Takahiro Takino¹, Takaki Niwa¹, Toyoda Gosei Co., Ltd.,² Junya Nishii¹

Panasonic Holdings Co., Ltd.

IB-23 Surge current withstand capacity of SiC MOSFET with built-in SBD using conductivity modulation control ¹ Consideration of FSM improvement

Improvement of surge current capability IFSM of SBD-embedded SiC MOSFET by conductivity modulation control

•Teruyuki Ohashi¹, Hiroshi Kono¹, Shunsuke Asaba², Akihiro Ogata¹, Ryosuke Iijima¹

Toshiba Corporation Research and Development Center, 2 Toshiba Device Storage Corporation

[IIA] (12/1 first half 13:00-14:15)

IIA-1 Control of 3C-SiC/4H-SiC stacked structure in SLE method

Control of 3C-SiC/4H-SiC Stacking Structure in Simultaneous Lateral Epitaxy

•Hiroyuki Nagasawa¹, Kaho Aono¹, Shigeo Sato¹ CUSIC², Osaka University², Maki Suemitsu², Maki Suemitsu², Maki Suemitsu², Tohoku University², Maki Suemitsu¹

IIA-2 Study on practical application of high-speed polishing equipment using grinding wheel surface plate

Study on practical application of high-speed rotation machine applied stone lapping plate

•Minami Nakazawa¹, Chuichi Miyashita¹, Yuko Yamamoto¹, Junji Nagahashi², Atsunori Nozoe², Tomohisa Kato³
Fujikoshi Machinery Co., Ltd., 2 Mizuho Co., Ltd., 3 National Institute of Advanced Industrial Science and Technology

Damage-free dicing of SiC wafers using IIA-3 water-guided laser

Damage-free dicing method for SiC wafer using Water jet guided laser processing

•Shotaro Kadoya¹, Tetsu Takahashi¹, Masaki Michihata¹, Noboru Otani², Kozo Abe², Shunsuke Arimura¹
University of Tokyo, 2 Kwansei Gakuin University, 3 Makino Milling Works

IIA-4 Diamond abrasive-less flattening and carbonization of SiC wafers using electrical discharge machining

Development of Diamond-abrasive-free Planarization and Carbonization Technology for SiC Wafers by EDM

•Yosuke Kiryu, Takahiro Yoshimatsu, Yoshitaka Inui, Tomohisa Kato¹ Yasunaga Corporation, 2 National Institute of Advanced Industrial Science and Technology

IIA-5 Low power consumption of insulation material for SiC single crystal sublimation furnace using PAN fiber

Lower Power Consumption of Carbon Fiber insulation derived from PAN for Bulk SiC Single Crystal Sublimation Furnace

•Shingo Matsuoka, Takuya Higatani, Takeshi Yamada¹, Tomoki Ichikawa¹, Satoshi Shinohara¹, Kazuma Eto², Shigeyuki Kubotani², Tomohisa Kato¹ Nippon Carbon Co., Ltd. Technical Center, 2 National Institute of Advanced Industrial Science and Technology

IIA-6 Nitrogen content dependence of conversion of threading screw dislocations to basal plane defects during sublimation SiC growth

Conversion of threading screw dislocations to basal plane defects in SiC growth by PVT under various nitrogen doping conditions

•Kazuma Eto¹, Takeshi Mitani¹, Shigeyuki Kubotani¹, Tomohisa Kato¹ National Institute of Advanced Industrial Science and Technology

IIA-7 Structural analysis of the origin of polytype inclusions in 4H-SiC epiwafers

Structural Analysis of Polytype Inclusion Origin in 4H-SiC Epitaxial Wafer

•Shohei Hayashi, Hideki Sako, Kentaro Ohira, Kenji Kobayashi, Toshiyuki Isshiki¹, Toray Research Center, Inc., 2Hitachi High-Tech, Inc., 3 Kyoto Institute of Technology

IIA-8 Crystal defect distribution and mirror electron image of polishing damage introduced to the SiC wafer surface contrast relationship

Relationship between contrast formation in the mirror electron images and the distribution of crystal defects in polishing damage introduced on the surface of SiC wafers

•Hideki Sako, Isshiki Toshiyuki, Sako Kentaro, Ohira Kenji, Kobayashi Kenji, Hayashi Shohei, Isshiki Toshiyuki¹, Toray Research Center, Inc., 2Hitachi High-Tech, Inc., 3 Kyoto Institute of Technology

IIA-9 Raman imaging of 3C stacking faults in 4H-SiC epitaxial wafers

Raman imaging of 3C stacking faults in 4H-SiC epitaxial wafer

•Noriyuki Hasuike, Toshiyuki Isshiki, Kenji Kobayashi, Takeshi Fujitani¹ Kyoto Institute of Technology, 2 Hitachi High-Tech Corporation

IIA-10 Development of image analysis technology for SiC crystal growth development using process informatics

Development of Image Analysis in SiC Crystal Growth Development utilizing Process Informatics

•Daisuke Uematsu, Keisho Horiai¹, Takahiro Kanda¹, Takashi Kanemura¹ Mirize Technologies Co., Ltd.

IIA-11 Evaluation of optical and electrical properties of GaN epilayers on HVPE and OVPE substrates

Optical and electrical characterization on GaN epilayers on HVPE and OVPE substrates

•Yu Furuhashi, Tatsuya Ishii, Hiroshi Amano, Masashi Kato¹, Shigeyoshi Usami², Yusuke Mori², Hiroataka Watanabe³, Shugo Nitta³, Yoshio Honda³,
³
¹
Graduate School of Engineering, Nagoya Institute of

Technology, ² Graduate School of Engineering, Osaka University, ³ Future Research Institute, Nagoya University

IIA-12 Fabrication of GaN crystal plane slightly tilted from vertical by wet etching and MOS evaluation

Fabrication of slightly tilted GaN crystal face by wet etching and MOS characterization

•Yuhisa Hirai¹, Yoshinao Miura¹, Sho Nakajima¹, Mitsuo Okamoto Shinsuke¹, Harada¹ AIST¹
Advanced Power Electronics Research Center

IIA-13 Mobility and anisotropy of p-channel MOSFET fabricated on 4H-SiC nonpolar surface

Mobility and its anisotropy in 4H-SiC p-channel MOSFETs on nonpolar faces

•Kyota Mikami Mitsuaki¹, Kaneko Tsunenobu¹ Kyoto¹ Graduate¹
School of Engineering, Kyoto University

IIA-14 Thermal oxidation of SiC surfaces: Analysis of first-principles molecular dynamics data using data science

Thermal oxidation of SiC: Molecular dynamics trajectory analysis using machine learning

•Tetsuya Morishita¹, Ai Kayanuma¹, Tomohisa Kato¹ National Institute of²
Advanced Industrial Science and Technology CD-FMat, ² National Institute of Advanced Industrial Science and Technology ADPERC

IIA-15 Non-destructive electronic state analysis of Metal/SiC interface using 30 keV excited hard X-ray photoelectron spectroscopy

HAXPES with excitation energy up to 30 keV characterization of Metal-silicide/SiC interface formed by thermal annealing

•Satoshi Yasuno¹, Tappei Nishihara¹, Vuong Van Cuong², Shinichiro Kuroki¹ High²
Brightness Photon Science Research Center, ² Hiroshima University Nano Device Research Institute

Design of 60kW 3-phase interleaved LLC DCDC for high capacity EV fast charger using IIA-16 SiC

SiC-PowerMOSFET 60kW THREE-PHASE INTERLEAVED LLC DC/DC CONVERTER

•Noriaki Mukaide¹
¹ Wolfspeed Japan Co., Ltd.

IIA-17 Conceptual design of MMC for HVDC using ultra-high voltage SiC-IGBT

Conceptual design of HVDC-MMC using UHV SiC-IGBT

•Koji Nakayama¹, Yoshiyuki Yonezawa¹ National Institute¹
of Advanced Industrial Science and Technology

IIA-18 A study of the relationship between parasitic capacitance and high-speed switching characteristics in SiC power ICs

A study on the relationship between high-speed switching characteristics and parasitic capacitor of SiC
power IC

•Atsushi Yao¹, Mitsuo Okamoto¹, Daiki Yamaguchi¹, Hiroshi Sato¹
AIST Advanced Power Electronics Research Center

IIA-19 Comparison of static and dynamic characteristics of SiC SJ-MOSFET fabricated by multi-epi method and trench backfill epi method

Comparison Static and Dynamic Characteristics of SiC Superjunction MOSFETs Formed by Multi-epitaxial Growth and Trench-filling
Epitaxial Growth

•Ozono Kuniei^{1,2}, Mitsuru², Seyo Ki, Takeishi Tawara,² Tadao Morimoto², Tomohisa Kato², Kazusato Kojima²,
Someya,²
Shinsuke Harada¹ Phenitec Semiconductor Co., Ltd., ² National Institute of Advanced Industrial Science and Technology

Research on short channel effects of SiC MOSFET by IIA-20 TCAD

Study on short-channel effects in SiC MOSFETs by TCAD simulation

•Kaoru Tachiki Mitsuaki¹, Kaneko Tsunenobu¹ Kyoto¹ Graduate¹
School of Engineering, Kyoto University

IIA-21 New model for gate AC applied gate threshold shift in 4H-SiC MOSFET

A New Model for Gate Threshold Voltage Shift induced by Gate Switching Stress in 4H-SiC MOSFET

•Naoki Kumagai¹, Hiroshi Kimura¹, Fuji Electric¹, Takeshi Tawara², Yuichi Onozawa¹, Takashi Shiiki¹

Co., Ltd., 2 National Institute of Advanced Industrial Science and Technology

IIA-22 Radiation irradiation effect on 4H-SiC CMOS SRAM and 500 μ s high temperature driving

Gamma-Ray Radiation Effects and 500 μ s High Temperature Operation of 4H-SiC SRAM

•Shinichiro Kuroki¹, Touya Kai¹, Kazusato Kojima¹, Takeshi Oshima¹, Nanodevice², Hiroaki Takayama³, Hiroshima³, Yasunobu Tanaka²

University, 2 Advanced Power Electronics Research, National Institute of Advanced Industrial Science and Technology

Center, 3 Quantum Function Creation Research Center, Takasaki Quantum Applied Research Institute, National Institutes for Quantum and Radiological Science and Technology

IIA-23 TCAD channel mobility model construction for p-channel 4H-SiC MOSFET

Development of TCAD Channel Mobility Model for p-channel 4H-SiC MOSFETs

•Kazumasa Shimura¹, Tetsuo Hatayama¹, Dai Okamoto¹, University of¹

Prefecture

[IIB] (12/1 second half 14:15-15:30)

Fabrication of 4H-SiC single crystal/SiC bonded wafer using IIB-1 grinding

Fabrication of 4H-SiC/sintered SiC bonded wafer with using grinding
•Mitsuhiro Kushibe¹, Chiharu Ota¹, Ryosuke Iijima¹ Toshiba
Corporation Research and Development Center

IIB-2 SiC power semiconductor wafer processing using water guided laser technology

SiC power semiconductor wafer machining by water-guided laser
•Shunya Hirano¹, Maki Tabata¹, Kim Hyuk Tomohisa¹, Kato¹, Makino Milling Co., Ltd.,² (National Institute of
Advanced Industrial Science and Technology) National Institute of Advanced Industrial Science and Technology

IIB-3 Film-type edge polishing of SiC wafers using functional abrasive grains

Film-type edge polishing of SiC wafers using functional abrasives
•Tatsuya Ohashi¹, Naohiro Yamaguchi¹, Yuki Kumagai¹, Tomohisa Kato²
1 Mipox Co., Ltd., 2 National Institute of Advanced Industrial Science and Technology (AIST)

IIB-4 8-inch SiC crystal growth using solution growth method applying machine learning

Growth of 8inch SiC crystals by the solution method using machine learning
•Tomoaki Furusho^{1,2}, Hiromi Suzuki^{1,2}, Daiki Shimoda¹, Hiroshi² Agematsu, Keiichi¹ Wakamiya, Toru¹, Hinako Funo^{1,2},
Kenta Murayama³, Kazunori⁴ Kasahige¹, Ujihara^{1,2}
1 UJ-Crystal Co., Ltd., 2 Tokai National University Organization Nagoya University, 3 Mipox Co., Ltd., 4 Oki Co., Ltd.
side

IIB-5 Dislocation transformation at homoepitaxial diamond thin film/substrate interface

Dislocation conversion at homoepitaxial diamond film/substrate interface
•Kozen Ichikawa^{1,2}, Noriyuki Terachi¹
Kanazawa University, 2 National Institute for Materials Science

IIB-6 Numerical analysis of SiC thin film single crystal growth using liquid silicon and methane gas

Numerical simulation of SiC thin crystal growth using liquid phase silicon and methane gas
•Toshinori Taishi¹, Ryunosuke Shimada¹, Yusuke Terachi¹, Faculty of Engineering,¹ Yuki Kagami¹

IIB-7 Dependence of macrostep shape on solvent added elements in 4H-SiC solution growth

Variation of the macrostep shape in 4H-SiC solution growth with different solvent compositions
•Takeshi Mitani¹, Kazuma Eto¹, Shigeyuki Kubotani¹, Tomohisa Kato¹ National Institute of
Advanced Industrial Science and Technology

IIB-8 For suppressing forward bias deterioration of 4H-SiC PiN diodes formed on 4H-SiC bonded substrates related analysis

Analysis of Forward Bias Degradation Reduction in 4H-SiC PiN Diodes on Bonded Substrates
Motoki Kobayashi¹, Eiji Uchida¹, Seiji Ishikawa¹, Naoki Matsunie¹, Shunsuke Kurihara², Shinsuke Harada², Kazusuke Koyama², Cox, 2 National³,
Institute of Advanced Industrial²
Science and Technology, 3 Phenitec Semiconductor

IIB-9 Multimodal analysis of threading dislocations in SiC substrates using polarized light microscopy and X-ray topography

Multimodal Analysis of Threading Dislocations in SiC Wafers Using Polarized Light Observation and X-ray Topography
•Shunta Harada^{1,2}, Yasutaka Matsubara¹, Michio Kawase¹, Keisuke Seo¹, Seiya Mizutani³, Yuya Mizutani³,
Seiji Mizutani³ Murayama³ Institute³
for Future Materials and Systems, Nagoya University, 2 Department of Materials Process Engineering, Graduate School of Engineering, Nagoya University,
3 Mipox Co., Ltd.

IIB-10 Effect of H⁺ injection into SiC substrate before epitaxial growth on PiN diode

Effects of H⁺ implantation into SiC substrates before epi growth on PiN diodes
•Watanabe Wang, Shunta Harada, Jin Sakane¹ Nagoya², Masafumi Kato¹
Institute of Technology, 2 Nagoya University, 3 Sumishige Atex

IIB-11 Trap density reduction in boron ion implantation JTE structure for vertical GaN devices

Trap Density Reduction of Boron-Implanted JTE Structures for Vertical GaN Power Devices

•Yoshinao Miura¹, Yukihiro Hirai¹, Akira Nakajima¹, Shinsuke Harada¹, Advanced Power¹
Electronics Research Center, National Institute of Advanced Industrial Science and Technology

IIB-12 Effect of heat treatment on SiO₂/GaN interface gallium oxide layer

Deformation of Ga oxide layer at SiO₂/GaN interface by thermal treatment

•Mutsunori Kaminuma^{1,3}, Kentaro Onishi², Hiroto Tomiita², Mitsuru Tadamura³, Hazuki Naito³, Sota Kawamura³, Takuma Kobayashi³, Takuya Moriki³,
Mami Fujii³, Heiji Watanabe¹, AIST¹, Osaka University Graduate School of Engineering², Nara Institute of Science and Technology³, Kindai University², Yukiharu Uraoka³

IIB-13 Au/Ni/thin layer highly concentrated Mg-doped p-n-GaN Schottky contact using voltage-applied interface microphotoresponse method

two-dimensional evaluation of

Two-dimensional characterization of Au/Ni/thin heavily-Mg-doped p-n-GaN Schottky contacts under applied voltage by scanning internal photoemission microscopy

•Hiroki Imabayashi¹, Haruto Yoshimura¹, Hiroshi Ota², Tomoyoshi Mishima², Kenji Shiohama¹, University of Fukui¹, Hosei University²

IIB-14 Threshold value of vertical GaN trench MOSFET due to sub-bandgap light and positive bias stress

Mg concentration dependence of voltage fluctuation

Mg Concentration Dependence of Threshold Voltage Shift under Sub-Eg Light Illumination and Positive Bias Stress in Vertical GaN Trench MOSFETs

•Mitsuki Inagaki¹, Toru Oka^{2,3}, Nariaki Tanaka³, Kazuya Hasegawa³, Takatomi Izumi³, Tsutomu Ina³, Tsuyoshi Nishio³, Takaki Niwa³, Jun Suda^{1,2}

¹ Nagoya University Graduate School of Engineering, ² Nagoya University Future Research Institute, ³ Toyoda Gosei

IIB-15 Development of silicide formation process on p-type SiC using laser annealing for IGBT

Development of silicide formation process on p-type SiC by laser annealing for SiC IGBT

•Kumiko Konishi¹, Naoki Watanabe¹, Yasuyuki Okino¹, Akio Shima¹
Hitachi, Ltd.

IIB-16 Evaluation of MOS interface state and AC-BTI of SiC-MOSFET under different process conditions

Investigation of MOS Interface states and AC-BTI of SiC-MOSFETs under different process conditions

•Ryoya Takemura¹, Takuma Suzuki¹, Katsuhisa Tanaka¹, Hiroshi Kohno¹, Toshiba¹
Devices & Storage Corporation Advanced Semiconductor Device Development Center

IIB-17 Room temperature to low temperature ESR/EDMR evaluation of a-plane 4H-SiC MOS interface

Electron-spin-resonance(ESR)/electrically-detected ESR (EDMR) spectroscopy on a-face 4H-SiC MOS interface defects

Ren Kondo¹, U Sohiro¹, Mitsuru Someya^{2,3}, Yukihiro Hirai², Heiji Watanabe³, Yoshihide Umeda¹, University of Tsukuba²,
National Institute of Advanced Industrial Science and Technology, ³ Osaka University

IIB-18 Prototype production and evaluation of 64-pixel 4H-SiC CMOS image sensor

64-Pixels 4H-SiC CMOS Image Sensors

•Tatsuya Meguro¹, Akinori Takeyama², Takeshi Oshima², Yasunobu Tanaka¹, Hiroshima University³, Shinichiro Kuroki¹
Nano Device Research Institute, ² National Institute for Quantum Science and Technology Takasaki Quantum Applied Research Institute Quantum Function
Creative Research Center, ³ Advanced Power Electronics Research Center, National Institute of Advanced Industrial Science and Technology

IIB-19 Channel length dependence of charge pumping current in p-channel SiC MOSFET

Channel length dependence of charge pumping current in p-channel SiC MOSFETs

Okamoto Mitsuru¹, Someya¹, University of Toyama¹, National Institute², Yukihiro Hirai², Mitsuo Okamoto², Tetsuo Hatakeyama², Yudai Taguchi¹
of Advanced Industrial Science and Technology

IIB-20 TCAD simulation of channel length dependence of charge pumping current in SiC MOSFET

TCAD Simulation of Channel length dependence of charge pumping current in SiC MOSFETs

•Kenta Kimata¹, Dai Okamoto¹, Toyama¹, Tetsuo Hatakeyama¹
Prefectural University

IIB-21 Characteristic evaluation of 1.2 kV breakdown voltage SiC trench MOSFET using bonded SiC substrates

Electrical property of 1.2 kV-class SiC Trench MOSFETs on Bonded Substrates

• Seiji Ishikawa 1, Kuniei Ozono 2, Motoki Kobayashi 3, Mitsuo Okamoto 1, Shinsuke Harada 1, Kazusato Kojima 1, Tomohisa Kato¹, Yasunobu¹

Tanaka¹ National Institute of Advanced Industrial Science and Technology, 2 Phenitec Semiconductor Co., Ltd., 3 Cycox Co., Ltd.

IIB-22 Effect of depletion layer charge on threshold voltage shift of 4H-SiC JFET exposed to gamma rays

Effect of charges generated in depletion layer on the threshold voltage shift of gamma rays irradiated 4H-SiC junction field effect transistors

•Akinori Takeyama¹, Takahiro Makino¹, Yasunobu Tanaka², Shinichiro Kuroki³, Takeshi Oshima¹ National Institute of Quantum and Radiological Science and Technology, 2 National Institute of Advanced Industrial Science and Technology, 3 Nanodevice Institute, Hiroshima University

industrial session

Date and time: November 30, 2023 (Thursday) 14:15-15:15

Presentation time: 4 minutes per company [Punctuality]

Location: Venue A, Venue B (parallel session)

program:

Venue A

IS-A1 Toray Research Center Co., Ltd.

IS-A2 New Metals End Chemicals Corporation

IS-A3 Hitachi High-Tech Corporation

IS-A4 SGL Carbon Japan Co., Ltd.

IS-A5 Bruker Japan Co., Ltd.

IS-A6 Matsuda Sangyo Co., Ltd.

IS-A7 Apollo Wave Co., Ltd.

IS-A8 Novel Crystal Technology Co., Ltd.

IS-A9 Richmore International Co., Ltd.

IS-A10 Neoark Co., Ltd.

IS-A11 Oxford Instruments Co., Ltd.

B Venue

IS-B1 Kozu Seiki Co., Ltd.

IS-B2 Brimatec LLC

IS-B3 Ceramic Forum Co., Ltd.

IS-B4 CD Power Semiconductor Co., Ltd

IS-B5 JFE Techno Research Co., Ltd.

IS-B6 STR Japan Co., Ltd.

IS-B7 iCrystal Co., Ltd.

IS-B8 Tsukuba Power Electronics Constellation (TPEC)

IS-B9 Yuzan Co., Ltd.

IS-B10 Orbray Co., Ltd.

IS-B11 Pulstech Industries Co., Ltd.