

2019 6th International Workshop on Low Temperature Bonding for 3D Integration (LTB-3D 2019)

**Kanazawa, Japan
21-25 May 2019**



**IEEE Catalog Number: CFP1918S-POD
ISBN: 978-1-7281-0387-7**

**Copyright © 2019, JSPS 191st Committee on Innovative Interface Bonding
Technology
All Rights Reserved**

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

IEEE Catalog Number:	CFP1918S-POD
ISBN (Print-On-Demand):	978-1-7281-0387-7
ISBN (Online):	978-4-9047-4307-2

Additional Copies of This Publication Are Available From:

Curran Associates, Inc
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: (845) 758-0400
Fax: (845) 758-2633
E-mail: curran@proceedings.com
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

CONTENTS

Oral Presentation

[OPENING REMARKS]

22O-01

[Keynote] Microsystem Integration and Packaging – A Chronicle of the Surface Activated Bonding and its Future Outlook 1

T. Suga

Meisei University

[Surface Activated Bonding (SAB)] (1)

22O-02

Impact of Ar Atom Irradiation on the Crystallinity of GaAs/Si Interfaces Fabricated by Surface Activated Bonding at Room Temperature..... 2

Y. Ohno¹, R. Miyagawa², H. Yoshida³, S. Takeda³, J. Liang⁴ and N. Shigekawa⁴

¹Tohoku University, ²Nagoya Institute of Technology, ³Osaka University, ⁴Osaka City University

22O-03

Effect of Annealing Temperature on Diamond/Si interfacial Structure 3

J. Liang¹, Y. Zhou², S. Masuya³, F. Guemann², M. Singh², J. Pomeroy², S. Kim⁴, M. Kuball², M. Kasu³ and N. Shigekawa¹

¹Osaka City University, ²University of Bristol, ³Saga University, ⁴Adamant Namiki Precision Jewel Co., Ltd.

[Surface Activated Bonding (SAB)] (2)

22O-04

SiC-SiC Temporary Bonding Compatible with Rapid Thermal Annealing at 1000 °C 4

F. Mu^{1,2}, T. Suga¹, M. Uomoto², T. Shimatsu³, K. Iguchi⁴ and H. Nakazawa⁴

¹Meisei University, ²Waseda University, ³Tohoku University, ⁴Fuji Electric Co., Ltd.

22O-05

SOI Wafer Fabricated with Extra Thick Deposited BOX Layer Using Surface Activated Bonding at Room Temperature for Customized Power Devices 5

Y. Koga and K. Kurita

SUMCO CORPORATION

22O-06

Tiny Integrated Laser by Room Temperature Surface Activated Bonding 6

A. Kausas¹, L. Zheng¹ and T. Taira^{1,2}

¹Institute for Molecular Science, ²RIKEN

22O-07	
Oxide Removal for Low-Temperature Metal Thermo-Compression Wafer Bonding	
.....	7
B. Rebhan and V. Dragoi	
<i>EV Group</i>	
22O-08	
High Yield Chip-on-Wafer Low Temperature Plasma Activated Bonding for III-V/Si Hybrid Photonic Integration	
.....	8
T. Kikuchi ^{1,2} , L. Bai ² , T. Mitarai ² , H. Yagi ¹ , T. Amemiya ² , N. Nishiyama ² and S. Arai ²	
¹ <i>Sumitomo Electric Industries, Ltd.</i> , ² <i>Tokyo Institute of Technology</i>	
[Roles of Low-temperature Bonding in 3D and Hetero-Integration]	
23O-01	
[Keynote] Where is the Sweet Spot for Panel Level Packaging?	
.....	9
T. Braun ¹ , K. Becker ¹ , O. Hoelck ¹ , S. Voges ¹ , M. Woehrmann ¹ , L. Boettcher ¹ , M. Toepper ¹ , L. Stobbe ¹ , R. Aschenbrenner ¹ , M. S-Ramelow ² and K. Lang ²	
¹ <i>Fraunhofer IZM</i> , ² <i>Technical University Berlin</i>	
23O-02	
Low Temperature Cu-Cu Gang Bonding for RDL-First Fan-Out Panel Level Package	
.....	10
K. Yang ^{1,2} , T. Chou ² , C. Ko ¹ , C. Lin ¹ , Y. Chen ¹ , T. Tseng ¹ , W. Wu ² and K. Chen ²	
¹ <i>Unimicron Technology Corp.</i> , ² <i>National Chiao-Tung University</i>	
23O-03	
[Invite] Robustness and Reliability Achievements for Direct Hybrid Bonding Integration: A Review	
.....	11
S. Moreau ¹ , J. Jourdon ^{1,2,3} , S. Lhostis ² , D. Bouchu ¹ , Y. Henrion ² , L. Arnaud ¹ , A. Jouve ¹ , V. Balan ¹ , F. Fournel ¹ , P. Lamontagne ² , S. Chéramy ¹ and L. Di Cioccio ¹	
¹ <i>Univ. Grenoble Alpes</i> , ² <i>STMicroelectronics</i> , ³ <i>University of Bordeaux</i>	
23O-04	
Effect of N₂ Plasma Treatment in Cu/SiO₂ Hybrid Bonding Using Ultra-Thin Manganese Film	
.....	12
K. Tsumura ¹ , K. Uchida ¹ , K. Nakamura ¹ , T. Nagata ² , K. Higashi ¹ , A. Kojima ¹ and H. Shibata ¹	
¹ <i>Toshiba Corporation</i> , ² <i>NIMS</i>	
[Fundamentals of Nano-bonding]	
23O-05	
[Invite] Room Temperature GaN-Si Bonding via an Intermediate Atomic-Layer-Deposition Al₂O₃ Layer by Using O Ion Beam	
.....	13
X. Wang, S. Zhu, B. Jiao, S. Huang, K. Wei, H. Yin, J. Fan and X. Liu	
<i>Chinese Academy of Sciences</i>	

23O-06

Pre-Bonding Characterization of SiCN Enabled Wafer Stacking 14

L. Peng, S.-W. Kim, S. Iacovo, F. Inoue, J. De Vos, E. Smeckx, A. Miller, G. Beyer and E. Beyne
IMEC

23O-07

Defect Identification in Bonding Surface Layers by Positron Annihilation Spectroscopy 15

F. Inoue¹, L. Peng¹, S. Iacovo¹, F. Nagano^{1,2}, E. Smeckx¹, G. Beyer¹, A. Uedono³ and E. Beyne¹
¹IMEC, ²KU Leuven, ³University of Tsukuba

[Bonding Technologies for 3D Integration (1)]

23O-08

[Keynote] Die to Wafer Direct Bonding: from Fundamental Mechanisms to Optoelectronic and 3D Applications 16

F. Fournel, L. Sanchez, B. Montmayeul, C. Castan, M. Laugier, L. Bally, V. Larrey, G. Mauguen, S. Cheramy, A. Jouve, E. Rolland, C. Morales, B. Szlag, K. Hassan, L. Adelinini and F. Rieutord
Univ. Grenoble Alpes

23O-09

Multichip Thinning Technology with Temporary Bonding for Multichip-to-Wafer 3D Integration 17

S. Lee, R. Liang, Y. Miwa, H. Kino, T. Fukushima and T. Tanaka
Tohoku University

23O-10

[Invite] Die to Wafer/Die DBI Hybrid Bonding for A True 3D Interconnect 18

B. Haba
Xperi Corp

[Power Applications and Solder Bonding]

23O-11

[Invite] Low-Temperature Silver Sintering for Bonding 3D Power Modules 19

G. Lu^{1,2}, Y. Mei², M. Wang² and X. Li²
¹Virginia Tech, ²Tianjin University

23O-12

[Invite] Wafer Bonding, A Key Stage for Power Devices 20

L. Di Cioccio, J. Widiez, A. Cibié, J. De Vecchy and K. Vladimirova
Univ. Grenoble Alpes

23O-13

Impact of Emitter Thermal Shunt for InP-Based Double-Heterojunction Bipolar Transistors on SiC Substrate 21

Y. Shiratori, T. Hoshi, M. Ida and H. Matsuzaki
NTT Corporation

23O-14	
Room Temperature Bonding of GaN on Diamond by Using Mo/Au Nano-Adhesion Layer	22
K. Wang, K. Ruan, W. Hu, S. Wu and H.Wang <i>Xi'an Jiaotong University</i>	
23O-15	
[invite] Thermodynamic and Kinetic Effects on Microstructure Evolution in Hybrid Low Temperature Solder/High-Sn Solder Joints	23
Y. Fan ¹ , Y. Wu ¹ , J. Blendell ¹ , N. Badwe ² and C. Handwerker ¹ ¹ Purdue University, ² Intel Corporation	
23O-16	
[Invite] Low Temperature Soldering: Enabling Advancements in Packaging	24
M. Ribas, S. Sarkar and C. Bilgrien <i>MacDermid Alpha Electronics Solutions</i>	
23O-17	
Precise Control of Electroplated 3D Solder Bumps for MEMS Packaging Applications	25
X. Wei, J. Liu, H. Liu, L. Tu and J. Fan <i>Huazhong University of Science and Technology</i>	
[Low-temperature Bonding for MEMS and Micro-fluidic Devices]	
24O-01	
[Keynote] Flexible Sensors – Materials, Interfaces and Surfaces	26
M. Jamal Deen and A. Alam <i>McMaster University</i>	
24O-02	
[Invite] System Integration of Nanostructured Materials for Point-of-Care Immune Biosensing	27
Y. Park, B. Ryu, X. Liang and K. Kurabayashi <i>University of Michigan</i>	
24O-03	
Wafer Level Low Temperature Bonding of Industrial Glass Substrates for Life Science	28
A. Sanz-Velasco, G. Thorwarth, R. Nadler, I. Drmic and W. Arens <i>IMT Masken und Teilungen AG</i>	
24O-04	
Adhesive Wafer Bonding for CMOS Based Lab-on-a-Chip Devices	29
W. Karl ¹ , M. Schikowski ¹ , J. Thon ¹ and R. Knechtel ² ¹ X-FAB MEMS Foundry Itzehoe GmbH, ² X-FAB MEMS Foundry GmbH	

24O-05
Low Temperature Covalent Wafer Bonding for X-ray Imaging Detectors 30
N. Razek¹, J. Neves¹, H. Von Känel¹, P. Le Corre¹, P. Rüedi², R. Quaglia² and Y. Dasilva³
¹*G-Ray Medical & Industries*, ²*CSEM*, ³*EMPA*

[Bonding Technologies for Hetero-Integration]

24O-06
[Invite] Heterogeneous Material Integration and Manufacturing Using Wafer Bonding Technology 31
I. Radu
SOITEC

24O-07
Ohmic InP/Si Direct Bonding 32
R. Inoue and K. Tanabe
Kyoto University

24O-08
High Bonding Yield and Brighter Integrated GaN LED and Si-CMOS 33
K. Lee¹, L. Zhang¹, Y. Wang¹, K. Lee¹, S. Chua^{1,2}, E. Fitzgerald^{1,3} and C. Tan^{1,4}
¹*Singapore-MIT Alliance for Research and Technology (SMART)*, ²*National University of Singapore*,
³*Massachusetts Institute of Technology*, ⁴*Nanyang Technological University*

24O-09
[Invite] Micro-Transfer-Printing for Heterogeneous Integration 34
B. Corbett¹, Z. Li¹, K. Buehler², F. Naumann², U. Krieger³, S. Wicht³ and C. Bower⁴
¹*University College Cork*, ²*Fraunhofer Institute for Microstructure of Materials and Systems IMWS*,
³*X-FAB MEMS Foundry GmbH*, ⁴*X-Celeprint Inc.*

24O-10
[Invite] Integration of Two-Dimensional Materials: Recent Advances and Challenges 35
M. Howlader
McMaster University

[Bonding Technologies for 3D Integration (2)]

24O-11
[Invite] Electroplated Cu Bump with Ultra-Large Grain without Thermal Annealing and Kirkendall Void at the Interface of Cu/Sn Joint 36
W. Dow and P. Chan
National Chung Hsing University

24O-12
Microstructural Effects on Electrodeposited Copper Direct Bonding 37
J. Song¹, Z. Xie¹, D. Tarn² and C. Hung²
¹*National Chung Hsing University*, ²*Advanced Semiconductor Engineering Group*

24O-13	
[Invite] Low-Temperature Cu-to-Cu Direct Bonding Enabled by Highly (111)-Oriented and Nanotwinned Cu.....	38
C. Chen ¹ , J. Juang ¹ , S. Chang ¹ , K. Shie ¹ , Y. Li ¹ and K. Tu ²	
<i>¹National Chiao Tung University, ²University of California Los Angeles</i>	
24O-14	
Low Temperature Direct Bonding of Nanotwinned Ag Thin Films	39
F. Ouyang ¹ , L. Chang ¹ and S. Huang ²	
<i>¹National Tsing Hua University, ²Industrial Technology Research Institute (ITRI)</i>	
24O-15	
Light Enhanced Cu to Cu Bonding with Different Electromagnetic Radiations.....	40
Y. Chiu ¹ , D. Tarn ¹ , C. Hung ¹ , S. Liang ² and J. Song ²	
<i>¹Advanced Semiconductor Engineering Group, ²National Chung Hsing University</i>	
24O-16	
Study on Role of Inserted Pt Intermediate Layer Deposited by Atomic Layer Deposition for Cu-Cu Quasi-Direct Bonding	41
K. Yamada ¹ , H. Kuwae ¹ , T. Kamibayashi ¹ , S. Shoji ¹ , W. Momose ² and J. Mizuno ¹	
<i>¹Waseda University, ²ALD Japan, Inc.</i>	
[Characterization and Emerging Technologies]	
24O-17	
[Keynote] Non-Destructive Characterization of Advanced IC Packages with Buried Features Using 3D X-ray	42
T. Gregorich	
<i>Carl Zeiss SMT Inc.</i>	
24O-18	
[Keynote] Attachment and Anti-Attachment Structures in Plants as Concept Generators for Bioinspired Technical Materials Systems	43
T. Speck	
<i>University of Freiburg</i>	

Short Presentation for Poster 1

[Bonding Technologies for 3D and Hetero-Integration]	
22P-01	
Wafer-Level Hybrid Bonding for Cu/Interlayer-Dielectric Bonding	44
M. Fujino, K. Takahashi and K. Kikuchi	
<i>AIST</i>	

22P-02	
Triple-Stacked Wafer-to-Wafer Hybrid Bonding for 3D Structured Image Sensors	45
Y. Honda ¹ , M. Goto ¹ , T. Watabe ¹ , M. Nanba ¹ , Y. Iguchi ¹ , T. Saraya ² , M. Kobayashi ² , E. Higurashi ² , H. Toshiyoshi ² and T. Hiramoto ²	
<i>¹NHK Science and Technology Research Laboratories, ²The University of Tokyo</i>	
22P-03	
Evaluation of Adhesive Fracture Energy of Polyimide Interlayer Dielectric Film for Redistribution Layer of Semiconductor Package	46
K. Ono and Y. Kariya	
<i>Shibaura Institute of Technology</i>	
22P-04	
Cure Shrinkage Behavior Analysis in Ultraviolet Curable Adhesive Using Finite Element Method	47
Y. Sato and Y. Kariya	
<i>Shibaura Institute of Technology</i>	
22P-05	
Fatigue Life Prediction of BGA Solder Joint with Consideration of Microstructural Coarsening	48
K. Moroka and Y. Kariya	
<i>Shibaura Institute of Technology</i>	
22P-06	
Effect of Nitride Passivation on Cu Surface for Low Temperature Cu-to-Cu Bonding	49
H. Park, H. Seo and S. Kim	
<i>Seoul National University of Science and Technology</i>	
22P-07	
Copper Direct Bonding with Short Time and Excellent Electrical Property by <111>-Oriented Nano-Twinned Copper	50
K. Shie, J. Juang and C. Chen	
<i>National Chiao Tung University</i>	
22P-08	
Low Temperature Cu-to-Cu Direct Bonding with Thin Gold Capping on Highly -Orientated Nanotwinned Cu Films	51
F. Chen, Y. Wu and C. Chen	
<i>National Chiao Tung University</i>	
22P-09	
Low Temperature Au-Au Direct Bonding with Highly <111>-Oriented Au Films	52
W. Hsu, J. Wu and C. Chen	
<i>National Chiao Tung University</i>	

22P-10	
Low Temperature All-Cu Bonding via Cu-Nanoparticle Paste Sintering in Pt-Catalyzed Formic Acid Vapor	53
F. Mu ^{1,2} , H. Ren ³ , S. Shin ² , M. Akaike ² , L. Liu ³ , G. Zou ³ , M. Yoshida ¹ and T. Suga ²	
¹ Waseda University, ² Meisei University, ³ Tsinghua University	
22P-11	
Low Temperature Copper-Copper Bonding in Ambient Air Using Hydrogen Radical Pretreatment	54
S. Shin ¹ , E. Higurashi ^{1,2} and T. Suga ¹	
¹ The University of Tokyo, ² AIST	
[Surface Activated Bonding (SAB)]	
22P-12	
Artifacts in the Structural Analysis of SAB-Fabricated interfaces by Using Focused Ion Beam	55
Y. Ohno ¹ , H. Yoshida ² , N. Kamiuchi ² , R. Aso ² , S. Takeda ² , Y. Shimizu ¹ , N. Ebisawa ¹ , Y. Nagai ¹ , J. Liang ³ and N. Shigekawa ³	
¹ Tohoku University, ² Osaka University, ³ Osaka City University	
22P-13	
Atom Probe Tomography of GaAs Homointerfaces Fabricated by Surface-Activated Bonding	56
Y. Shimizu ¹ , N. Ebisawa ¹ , Y. Ohno ¹ , J. Liang ² , N. Shigekawa ² , K. Inoue ¹ and Y. Nagai ¹	
¹ Tohoku University, ² Osaka City University	
22P-14	
Fabrication of Diamond/Cu Direct Bonding for Power Device Application	57
S. Kanda ¹ , S. Masuya ² , M. Kasu ² , N. Shigekawa ¹ and J. Liang ¹	
¹ Osaka City University, ² Saga University	
22P-15	
Electrical Properties of p+-GaAs//Patterned Metal Layer/n+-Si Junctions	58
T. Hishida, J. Liang and N. Shigekawa	
Osaka City University	
22P-16	
Bonding Strength Evaluation of Al Foil/AlN Junctions by Surface Activated Bonding	59
S. Horikawa ¹ , S. Morita ¹ , J. Liang ¹ , Y. Kaneko ¹ , Y. Nishio ² , M. Matsubara ² , H. Asahi ² and N. Shigekawa ¹	
¹ Osaka City University, ² Toyo Aluminium K.K.	
22P-17	
A Polyimide Film/Aluminum Foil Junction by Modified Surface Activated Bonding	60
H. Akazawa ¹ , J. Liang ¹ , M. Matsubara ² , H. Asahi ² , Y. Nishio ² and N. Shigekawa ¹	
¹ Osaka City University, ² Toyo Aluminium K.K.	

22P-18

Lithium Niobate-on-Insulator Waveguide on Si Substrate Fabricated by Room Temperature Bonding 61

R. Takigawa¹, K. Kamimura², K. Nakamoto² and T. Asano¹

¹Kyushu University, ²Tokyo University of Agriculture and Technology

22P-19

Room-Temperature Pressureless Wafer Sealing Using Ultrathin Au Films Activated by Ar Plasma 62

M. Yamamoto^{1,2}, Y. Kunimune¹, T. Matsumae², Y. Kurashima², H. Takagi², T. Suga¹, T. Itoh¹ and E. Higurashi^{1,2}

¹The University of Tokyo, ²AIST

[Atomic Diffusion Bonding (ADB)]

22P-20

Oxidation of Bonded Thin Ti Films Using Oxide Underlayers in Atomic Diffusion Bonding Process for Optical Applications 63

G. Yonezawa¹, Y. Sato¹, S. Abe², M. Uomoto³ and T. Shimatsu³

¹Sony Corp., ²Sony Global Manufacturing & Operations Corporation, ³Tohoku University,

22P-21

Novel Sputter Film Deposition to Fabricate Thick Films with Extremely Smooth Surface Suitable for Room Temperature Bonding 64

T. Saito¹, H. Makita¹, T. Moriwaki¹, Y. Suzuki¹, N. Kato¹, S. Wakayanagi¹, A. Miura², M. Uomoto² and T. Shimatsu²

¹Canon Anelva Corporation, ²Tohoku University

22P-22

Atomic Diffusion Bonding of Wafers Using Thin Nb Films 65

M. Uomoto and T. Shimatsu

Tohoku University

22P-23

Atomic Diffusion Bonding of Wafers Using a-Ge Films with Extremely Low Electrical Conductivity 66

A. Muraoka, M. Uomoto, M. Abe and T. Shimatsu

Tohoku University

22P-24

Rearrangement of Crystal Lattice Occurred at Ag/Ag Bonded Interface in Atomic Diffusion Bonding 67

S. Matsuda, M. Uomoto, A. Miura and T. Shimatsu

Tohoku University

Short Presentation for Poster 2

[Related Technologies for Low-temperature Bonding]

22P-25

Leading Edge Review: What is An Important Factor of CMP Consumables for 3D Integration Bonding? 68

M. Uneda¹, M. Fujino² and K. Takahashi²

¹Kanazawa Institute of Technology, ²AIST

22P-26

III-Nitride Epitaxy by Ion Filtered Inductively Coupled Plasma MOCVD 69

Y. Luo, W. Yu, J. Wang, J. Yu, Z. Zhang, L. Wang, Z. Hao, C. Sun, Y. Han, B. Xiong and H.Li

Tsinghua University

[New Processes for Low-temperature Bonding]

22P-27

Hydrophilic Direct Bonding of Monocrystalline (111) Diamond Substrate onto Si Wafer..... 70

T. Matsumae, Y. Kurashima, H. Umezawa and H. Takagi

AIST

22P-28

Plasma-Activated Direct Bonding of Coated Optical Glasses 71

P. Birckigt^{1,2}, C. Rothhardt¹, K. Grabowski¹, K. Jorke¹, R. Schlegel¹, F. Dreisow¹, G. Kalkowski¹, S. Risse¹ and R. Eberhardt¹

¹Fraunhofer Institute for Applied Optics and Precision Engineering, ²Friedrich-Schiller-University Jena

22P-29

Wavelength-Conversion Material-Mediated Semiconductor Bonding 72

K. Kishibe, S. Hirata and K. Tanabe

Kyoto University

22P-30

Solution-Process ZnO-Mediated Semiconductor Bonding 73

T. Yamashita, S. Hirata, R. Inoue, K. Kishibe and K. Tanabe

Kyoto University

22P-31

Hydrogel-Mediated Semiconductor Bonding 74

K. Kishibe and K. Tanabe

Kyoto University

22P-32

Low Temperature Polyimide-to-Polyimide Direct Bonding 75

H. Liu and C. Chen

National Chiao Tung University

[MEMS and Power Applications]

22P-33

Sweat Glucose Sensing by Directly Bonded Thin Films 76

M. Alam, A. Alam and M. Howlader

McMaster University

22P-34

Novel Gratings for Astronomical Observations Fabricated by Latest Technologies 77

N. Ebizuka¹, T. Okamoto¹, M. Sasaki², I. Tanaka³, M. Uomoto⁴ and T. Shimatsu⁴

¹RIKEN, ²Toyota Technological Institute, ³National Astronomical Observatory of Japan, ⁴Tohoku University

22P-35

Evaluation of Au-Au Bonding After Annealing for Getter Activation -Fabrication of All-Sapphire Cs Gas Cell for Miniature Atomic Clock- 78

Y. Kurashima^{1,2}, T. Matsumae^{1,2}, S. Yanagimachi^{1,2}, K. Harasaka^{1,3} and H. Takagi^{1,2}

¹NMEMS Technology Research Organization, ²AIST, ³Ricoh Co., Ltd.

22P-36

Stacking 4" Si Wafer with Parallel 3-Stepped Micro-Trenches to Deposit Superconducting Material for Magnetic Energy Storage 79

M. Sasaki¹, Y. Suzuki², T. Hioki² and T. Motohiro²

¹Toyota Technological Institute, ²Nagoya University

22P-37

Deformation Behavior of Pressurized Sintered Ag Nanoparticles in Discrete Type Power Semiconductor Device 80

K. Nagata¹, Y. Kariya¹ and S. Horie²

¹Shibaura Institute of Technology, ²Sanken Electric Co., Ltd.

22P-38

High Temperature Fatigue Crack Propagation Characteristics of Pressureless Sintered Silver Nanoparticles 81

K. Osaki¹, Y. Kariya¹, N. Mizumura² and K. Sasaki²

¹Shibaura Institute of Technology, ²NAMICS Corporation

22P-39

Fracture Analysis of Vertical Direction Crack in Die Attach Joint for Power Semiconductor Device 82

H. Sugimoto¹, Y. Kariya¹, R. Hanada², A. Fukumoto², Y. Ito² and S. Soda²

¹Shibaura Institute of Technology, ²Mitsubishi Electric Corporation

[Surface Activated Bonding (SAB)]

22P-40

Low Temperature Wafer Bonding with Gas Cluster Ion Beams..... 83

N. Toyoda and S. Ikeda

University of Hyogo

22P-41

Room Temperature Wafer Bonding with Titanium Thin Films Based on Formation of Ti/Si Amorphous Layers 84

E. Higurashi^{1,2}, H. Azuma^{1,2}, M. Yamamoto², T. Matsumae¹, Y. Kurashima¹, H. Takagi¹ and T. Suga²

¹AIST, ²The University of Tokyo

22P-42

Room Temperature Bonding of Quartz Glass Using Aluminum Oxide Intermediate Layer..... 85

K. Takeuchi¹, F. Mu^{2,3}, Y. Matsumoto⁴ and T. Suga³

¹The University of Tokyo, ²Waseda University, ³Meisei University, ⁴Lantechnical Service Co.,Ltd.

22P-43

Room Temperature SiC Wafer Bonding Using SAB Methods..... 86

F. Mu^{1,2}, Y. Wang^{3,4}, K. Iguchi⁵, H. Nakazawa⁵ and T. Suga²

¹Waseda University, ²Meisei University, ³Institute of Microelectronics of Chinese Academy of Science, ⁴University of Chinese Academy of Sciences, ⁵Fuji Electric Co., Ltd.

22P-44

GaN-SiC and GaN-Diamond Integration via Room Temperature Bonding..... 87

F. Mu^{1,2} and T. Suga¹

¹Meisei University, ²Waseda University

22P-45

The Integration of Ga₂O₃ on SiC at Room Temperature by Surface Activated Bonding Method..... 88

Y. Xu^{1,2,3}, F. Mu¹, Y. Wang^{2,3}, D. Chen^{2,3} and T. Suga¹

¹The University of Tokyo, ²Institute of Microelectronics of Chinese Academy of Science, ³University of Chinese Academy of Sciences

22P-46

Analysis of SiC/Si Bonding Interface with Thermal Annealing Treatment by XPS 89

Z. Wan, J. Liang and N. Shigekawa

Osaka City University

22P-47

Directly Bonded n+-InGaP/n+-Si Junctions with A Low Interface Resistance 90

M. Sakihara, J. Liang and N. Shigekawa

Osaka City University