

2022 IEEE International Interconnect Technology Conference (IITC 2022)

**San Jose, California, USA
27 – 30 June 2022**



**IEEE Catalog Number: CFP22ITR-POD
ISBN: 978-1-6654-8647-7**

**Copyright © 2022 by the Institute of Electrical and Electronics Engineers, Inc.
All Rights Reserved**

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

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

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

IEEE Catalog Number:	CFP22ITR-POD
ISBN (Print-On-Demand):	978-1-6654-8647-7
ISBN (Online):	978-1-6654-8646-0
ISSN:	2380-632X

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

TABLE OF CONTENTS

Pixel Pitch Hybrid Bonding and Three Layer Stacking Technology for BSI Image Sensor	5
<i>K. Tanida, S. Suzuki, T. Seo, M. Morinaga, H. Korogi, M. Tetani, M. Hamada, R. Eto, T. Yamashita, Y. Kato, N. Sato, T. Shimizu, T. Hanawa, H. Kubo, K. Ueda, F. Ito, Y. Noguchi, M. Nakamura, R. Mizukoshi, M. Takeuchi, M. Suzuki, N. Niisoe, I. Miyanaga, A. Ikeda, S. Matsumoto</i>	
TSV Fabrication Technology Using Direct Electroplating of Cu on the Electroless Plated Barrier Metal.....	10
<i>Shoso Shingubara, Tomohiro Shimizu, Kosuke Matsui, Yuko Miyake, Yuichiro Torinari, Makoto Motoyoshi, Shigeru Watariguchi, Hideki Watanabe</i>	
Carbon Plug Application in 3D NAND Fabrication.....	16
<i>Yu-Chih Chang, Liang-Yu Chen, Kuang-Wei Chen, Tuung Luoh, Ling-Wuu Yang, Ta-Hone Yang, Kuang-Chao Chen</i>	
Investigations at Low Temperature of 90 nm Pitch BEOL for Quantum Applications.....	19
<i>R. Segaud, P. Gergaud, S. Minoret, P. Neumann, F. Gustavo, A. Royer, C. Licitra, D. Mariolle, F. Nemouchi</i>	
Effects of Composition Deviation of CuAl ₂ on Electromigration	22
<i>Toshihiro Kuge, Masataka Yahagi, Junichi Koike</i>	
Dynamics of Electromigration Voids in Cu Interconnects: Investigation Using a Physics-Based Model Augmented by Neural Networks.....	25
<i>A. S. Saleh, H. Zahedmanesh, H. Ceric, K. Croes, I. De Wolf</i>	
Reliability Evaluation of Semi-Damascene Ru/Air-Gap Interconnect with Metal Pitch Down to 18 nm.....	28
<i>A. Lesniewska, O. Varela Pedreira, P. J. Roussel, G. Marti, A. Pokhrel, M. Van Der Veen, S. Decoster, M. O'Toole, G. Murdoch, I. Ciofi, S. Park, Z. Tokei, K. Croes</i>	
Reliability Benchmark of Various Via Prefill Metals	31
<i>O. Varela Pedreira, V. Simons, M. H. Van Der Veen, I. Ciofi, S. Park, Z. Tokei, K. Croes, S. Pethe, W. Lei, S. Hwang, Z. Wu, F. Chen, A. Jansen, J. Machillot, A. Cockburn</i>	
Failure Mode Analysis in Microsecond UV Laser Annealing of Cu Thin Films	34
<i>Remi Demoulin, Richard Daubriac, Louis Thuries, Emmanuel Scheid, Fabien Roze, Fuccio Cristiano, Toshiyuki Tabata, Fulvio Mazzamuto</i>	
Recent Progress in Graphene Processes for Metallization and RF Applications.....	37
<i>Kazuyoshi Ueno</i>	
Advanced Process Technologies for Continuous Logic Scaling Towards 2nm Node and Beyond (Invited).....	40
<i>Tomonari Yamamoto</i>	
Computational Analysis of the Role of Nanoconfinement on the Reliability of ULK Glasses.....	42
<i>Karsu I. Kilic, Reinhold H. Dauskardt</i>	

Improvement of Line-to-Line TDDDB by Cu and Barrier-Metal Recess Structure for High Voltage Circuit in 3D Flash Memory.....	45
<i>Mitsuhiko Noda, Kotaro Fujii, Naomi Yanai, Tsubasa Watanabe, Atsushi Kato, Kosuke Horibe, Eiru Yoshida, Tatsuhiko Koide, Hiroshi Fujita, Yumi Nakajima, Masayoshi Tagami, Kazuya Ohuchi</i>	
Enabling 3-Level High Aspect Ratio Supervias for 3nm Nodes and Below	48
<i>D. Montero, V. Vega-Gonzalez, Y. Feurprier, O. Varela Pedreira, N. Oikawa, G. T. Martinez, D. Batuk, H. Puliyalil, J. Versluijs, H. Decoster, N. Bazzazian, N. Jourdan, K. Kumar, F. Lazzarino, G. Murdoch, S. Park, Z. Tokei</i>	
Galvanic Corrosion Effect of Co Liner on ALD TaN Barrier	51
<i>Junki Jang, Changhyun Kim, Youngsoo Yoon, Yunki Choi, Hoon Kim, Jungil Park, Jaehyeong Park, Minguk Kang, Youngwoo Kim, Seonguk Jang, Junghwan Ahn, Eunyoung Park, Wonmin Jeong, Jeongjae Kim, Minhyuk Oh, Wonkyu Han, Dongwoo Shin, Wookhwan Kim, Jaeyoung Yang, Honglae Park, Segab Kwon, Jeonghoon Ahn, Jahum Ku</i>	
Metal-Induced Line Width Variability Challenge and Mitigation Strategy in Advanced Post-Cu Interconnects	55
<i>K. Motoyama, N. Lanzillo, S. Mukesh, B. Peethala, T. Spooner, D. Edelstein, K. Choi</i>	
Barrierless ALD Molybdenum for Buried Power Rail and Via-to-Buried Power Rail Metallization	58
<i>Anshul Gupta, Jan Willem Maes, Nicolas Jourdan, Chiyu Zhu, Sukanya Datta, Olalla Varela Pedreira, Quoc Toan Le, Dunja Radisic, Nancy Heylen, Antoine Pacco, Shouhua Wang, Moataz Mousa, Young Byun, Felix Seidel, Bart De Wachter, Gayle Murdoch, Zsolt Tokei, Eugenio Dentoni Litta, Naoto Horiguchi</i>	
MP18–26 Ru Direct-Etch Integration Development with Leakage Improvement and Increased Aspect Ratio	61
<i>Ankit Pokhrel, Giulio Marti, Martin O’Toole, Gayle Murdoch, Anshul Gupta, Stefan Decoster, Souvik Kundu, Elisabeth Camerotto, Quoc Toan Le, Arame Thiam, Alicja Lesniewska, Seongho Park, Zsolt Tokei</i>	
Balancing Interconnect Resistance and Capacitance at the Advanced Technology Nodes Based on Full Chip Analysis.....	64
<i>Da Eun Shim, Azad Naeemi</i>	
A New Methodology for Modeling Air-Gap TDDDB	67
<i>Yu Fang, I. Ciofi, P. Roussel, A. Lesniewska, R. Degraeve, D. Tierno, I. De Wolf, K. Croes</i>	
Stress and Thermal Stress Evolution in Mo and Ru Thin Films.....	70
<i>Valeria Founta, Jean-Philippe Soulie, Shibesh Dutta, Ingrid De Wolf, Joris Van De Vondel, Johan Swerts, Zsolt Tokei, Christoph Adelman</i>	
Improved Resistivity of NiAl Thin Films at Low Temperature for Advanced Interconnect Metallization.....	73
<i>Jean-Philippe Soulie, Zsolt Tokei, Johan Swerts, Christoph Adelman</i>	
Low Resistivity Titanium Nitride Thin Film Fabricated by Atomic Layer Deposition with TiCl ₄ and Metal-Organic Precursors in Horizontal Vias	76
<i>Cheng-Hsuan Kuo, Aaron J. McLeod, James Huang, Victor Wang, Seonguk Yun, Zichen Zhang, Jeffrey Spiegelman, Andrew C. Kummel</i>	
Integration of Al ₂ O ₃ Etch Stop Layer in 21nm Pitch Dual-Damascene BEOL Interconnects.....	79
<i>C. Wu, V. Vega-Gonzalez, H. De Coster, Q. T. Le, F. Schleicher, A. Lesniewska, G. Murdoch, S. Park, Z. Tokei</i>	

Developing a Low-Temperature Flip-Chip Bonding Technology with In/Au Microbumps to Suppress the Thermal Load on Spintronics Devices	82
<i>Hisashi Kino, Takafumi Fukushima, Tetsu Tanaka</i>	
Effect of Current on Ni Catalyst Layer Used for Current-Enhanced CVD of Multilayer Graphene.....	85
<i>Jumpei Tokida, Reno Hasumi, Kazuyoshi Ueno</i>	
Selective and Tunable Slurry for Advanced Packaging Epoxy Mold Compound.....	87
<i>Shogo Arata, Chiaki Noda, Yasuhiro Ichige, Satoyuki Nomura, T. S. Widodo, N. Tsunoda, X. F. Brun</i>	
Schottky Barrier Height Reduction by Oxide Layer Insertion in Al/n-GaN Structure.....	90
<i>Jiro Koba, Masataka Yahagi, Junichi Koike</i>	
A Novel Air-Gap Formation Method for Metal Interconnect	93
<i>Youngjoon Choi, Sungsik Cho</i>	
Wet Processes Deposition for HAR TSV Metallization Using Electroless Co Liner and Alkaline Cu Seed Layer.....	96
<i>Li-Na Qiu, Zi-Hong Ni, Xin-Ping Qu</i>	
Ru Electrodeposition and Behaviors of Additives for Advanced Technology Nodes.....	99
<i>Youjung Kim, Haneul Han, Jinhyun Lee, Bongyoung Yoo</i>	
Electromigration Degradation of Gold Interconnects: A Statistical Study.....	102
<i>H. Ceric, R. L. De Orio, S. Selberherr</i>	
Scaling Down Diffusion Barriers: Performance and Thickness Dependence of TaN and Two-Dimensional-Material-Based Barrier Layers.....	105
<i>Hippolyte P. A. G. Astier, M. M. Juvaid, Soumyadeep Sinha, Jing Yang Chung, Saurabh Srivastava, Chandan Das, John Sudijono, Silvija Gradecak</i>	
Change in Resistivity of Fine Metal Line by KrF Excimer Laser Annealing.....	108
<i>Yasutsugu Usami, Kaname Imokawa, Ryoichi Nohdomi, Kouji Kakizaki, Hakaru Mizoguchi</i>	
Cu to Cu Direct Bonding with Optimized Self-Annealing Behavior of the Electroplated Copper	111
<i>Haneul Han, Chaerin Lee, Sangwoo Park, Youjung Kim, Bongyoung Yoo</i>	
Conformal Copper ECD Metallization Process for Deep TSV	114
<i>Thomas Weidner, Volker Goetz, Theresa Roesch, Asmaa Bouhlal, Nik Wunder, Stephan Reinert, Kerst Griesbach, Manuela Goebelt, Hannes Mehner</i>	
Recent Advances in Ni-Based GeSn Metallization	117
<i>Andrea Quintero, Patrice Gergaud, Jean-Michel Hartmann, Vincent Reboud, Philippe Rodriguez</i>	
Ru ALD with Bulk-Like Resistivity for Interconnects.....	120
<i>Michael Breeden, Victor Wang, Ravindra Kanjolia, Mansour Moinpour, Jacob Woodruff, Harsono Simka, Andrew Kummel</i>	
Capacitive Impacts of Etch-Induced Dielectric Damage in Highly-Scaled Interconnect Architectures	123
<i>Janet M. Wilson, Nicholas A. Lanzillo</i>	
Performance Improvement for Cu Interconnects by SAM and ELD Technologies	126
<i>Y. Kikuchi, M. Iwashita, H. Nagai, H. Komatsu, Y. Ozaki, K. Fujita, G. Pattanaik, H. Kawasaki, K. Iwai</i>	

Low Resistance Cu Vias for 24nm Pitch and Beyond.....	129
<i>Marleen H. Van Der Veen, O. Varela Pedreira, N. Jourdan, S. Park, H. Struyf, Z. Tokei, C. Leal Cerantes, F. Chen, X. Xie, Z. Wu, A. Jansen, J. Machillot, A. Cockburn</i>	
EUV Minimum Pitch Single Patterning for 5nm Node Manufacturing	133
<i>Jungil Park, Yunki Choi, Jeong Hoon Ahn, Byung Je Jung, Hoyoun Lee, Jinho Kim, Eunyoung Park, Jaehyeong Park, Hyun-Ji Song, Miji Lee, Ja-Hum Ku</i>	
Evaluation of BEOL Scaling Boosters for Sub-2nm Using Enhanced-RO Analysis	136
<i>Anita Farokhnejad, Simone Esposito, Ivan Ciofi, Odysseas Zografos, Pieter Weckx, Julien Ryckaert, Pieter Schuddinck, Yang Xiang, Zsolt Tokei</i>	
Cryogenic CMOS Performance Analysis Including BEOL Characteristics at 4K for Quantum Controller Application.....	139
<i>K. Okamoto, T. Tanaka, M. Miyamura, H. Ishikuro, K. Uchida, T. Sakamoto, M. Tada</i>	
Dual Damascene 28nm-Pitch Single Exposure EUV Design Rules Evaluation by Voltage Contrast Characterization.....	142
<i>V. M. Blanco Carballo, D. Cerbu, F. Schleicher, J. Van De Kerkhove, P. Leray, N. N. Kissoon, E. P. De Poortere</i>	
ALD Mo for Advanced MOL Local Interconnects	145
<i>Maryamsadat Hosseini, Davide Tierno, Jan Willem Maes, Chiyu Zhu, Sukanya Datta, Young Byun, Moataz Mousa, Nicolas Jourdan, Eugenio Dentoni Litta, Naoto Horiguchi</i>	
Low Resistivity Tungsten and Ruthenium Through Textural Control Using Ion Beam Deposition.....	148
<i>Rutvik J. Mehta, Frank Cerio, Yuejing Crystal Wang, Paul Turner, Jinho Kim, Ashish Kulkarni, Mohammad Saghayezhian, Robert Caldwell</i>	

Author Index