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The 2021 IEEE 71st Electronic Components and Technology Conference

PROGRAM & REGISTRATION

June 1 - July 4, 2021

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WELCOME TO THE 71st ECTC FROM THE GENERAL CHAIR AND PROGRAM CHAIR

On behalf of the Program Committee and Executive Committee, it is our pleasure to welcome you to the 71st Electronic Components and Technology Conference (ECTC), which will be held virtually on a digital platform from June 1 until July 4, 2021. This premier international conference brings together key stakeholders of the global microelectronics packaging industry, such as semiconductor companies, foundry and OSAT service providers, equipment manufacturers, materials suppliers, research institutions and universities all under one roof.

The virtual platform will allow for recorded presentations of all technical session talks to be available on-demand throughout the conference. During the last two weeks of the conference, a live teleconferencing meeting for each session will be held by the session chairs; all the presenters of the session will be available live to field questions from the attendees. The special sessions will be held live during the first two weeks of the conference. Each panelist will pre-record their talks for the session; these talks will be broadcast live which will be followed immediately by the live panel discussion during which attendees will be able to ask questions. The special sessions will be made available for on-demand streaming from the date of the session until the end of the conference.

For the 71st ECTC, the ECTC Program Committee has selected over 350 papers which will be presented in 46 technical sessions including one session exclusively featuring papers by student authors. The technical sessions will feature selected papers on key topics and industry trends, from wirebonding, wafer- and panel-level packaging, flip chip, 2.5D and 3D integration, to advanced substrates and interposers, embedded technologies, system in package and heterogeneous integration.

Authors from over twenty five countries are expected to present their work at the 71st ECTC, covering ongoing technology development within established disciplines or emerging topics of interest for our industry such as mobile, 5G, medical wearables and automotive applications including autonomous driving, flexible and printed electronics, to high-speed communications, wireless, Li-Fi, photonics, highperformance and quantum computing, and artificial intelligence (AI) hardware.

Sam Naffziger, Senior Vice President of AMD, will deliver the first keynote speech entitled, "What the Chiplet-Based Future of Compute Means for Components and Technology." The second keynote speech entitled "Transitioning to a Renewable Energy-Based Grid," will be delivered by Pedro Arsuaga, the Renewable Energy Business Program Manager at GE Research. Additionally, a half-day workshop on Heterogeneous Integration Roadmap, chaired by Bill Chen and Bill Bottoms, will be held. ECTC will also feature a record twelve special sessions with invited industry experts covering several important and emerging topic areas. Rozalia Beica and Ed Sperling will chair a special session covering "Market Trends and Geopolitical and Economic Outlook" addressing market trends in the semiconductor industry, emerging applications, economic and geopolitical uncertainties, and impact on the global supply chain in microelectronics packaging. The ECTC Panel Session will be chaired by IEEE EPS President Christopher Bailey and IEEE EPS Vice President of Conferences Sam Karikalan. This panel session will hear from several leading companies who will discuss their future vision for advanced electronics packaging.

We are continuing our tradition and bringing back the networking events focused on young professionals and diversity. Yan Liu and Adeel Bajwa will chair the Young Professionals Virtual Meetup. This is a great networking opportunity for young engineers, researchers, and students, to meet senior EPS members and professionals, learn more about industry activities, receive career guidance, and engage through a series of activities. The ECTC Diversity Panel - started a few years ago as a women-focused panel - has now evolved into a Diversity and Career focused Panel. The panel, chaired by Allyson Hartzell and Kitty Pearsall, will have a focus on the correlation between diversity in workplace and enhanced business performance. This year's ECTC Plenary Session entitled, "Transformation of the Electronics Industry in a Post-Covid World," will be chaired by Jan Vardaman, Kimberly Yess, and Mark Poliks. In this plenary session, experts will address the evolution and challenges of our industry in light of the pandemic, and expectations that will drive packaging developments in the future. Our colleagues from Japan, Yasumitsu Orii and Shigenori Aoki, will be chairing the IEEE EPS Seminar entitled, "Latency: Are High-Bandwidth Optical Networks a Silver Bullet?" The seminar will focus on the permissible latency in certain systems, and how high-bandwidth optical networks are critically important for satisfying latency requirements.

Following the industry trends and a growing interest in photonics, ECTC 2021 will feature a special session titled "Pathogen Detection and Eradication" to be chaired by Chris Bower and Mark Beranek. In this ECTC Special Session, a panel of experts will provide their perspectives on the studies and technological improvements needed for safely detecting and eradicating pathogens on surfaces and spaces. A reliabilityfocused ECTC Special Session entitled "Low Temperature Solder (LTS) – Packaging Challenges of a Next-Generation SMT Interconnect" will be chaired by Kevin Byrd and Keith Newman. This session will highlight LTS research areas most critical to component suppliers to improve compatibility with surface mount technology (SMT) LTS processing and to enhance solder joint reliability. Kotlanka Rama Krishna and Ahyeon Koh will chair an ECTC Special Session entitled "Home Use Medical Devices and Packaging in Wearable Technologies." This session will focus on some of the challenges associated with packaging sensors and the electronic signal chain into these emerging, at-home clinical-grade wearables. The fourth ECTC Special Session has the title "Materials and Technologies for Advanced Packaging (5G, RF, Power, Harsh environment)," and will be chaired by Karsten Meier and Przemyslaw Gromala. The ECTC Special Session "Rising to the Chiplet Challenge" will be chaired by Kanad Ghose and Dale Becker. Finally, Dave Armstrong and Robert Patti will chair the ECTC Special Session entitled "Test in Heterogeneous Integration."



Nancy Stoffel 71st ECTC General Chair General Electric Research Center stoffel@ge.com

Supplementing the technical program, ECTC also offers Professional Development Courses (PDCs). The 71st ECTC will offer fourteen PDCs, organized by the PDC Committee chaired by Kitty Pearsall and Jeffrey Suhling.

Whether you are an engineer, a manager, a student, or a business and marketing professional or an executive, ECTC offers something unique for everyone in the microelectronics packaging and components industry. We invite you to make your plans now to join us and to be a part of all the exciting technical and professional opportunities offered at this event. We would also like to take this opportunity to thank our sponsors, exhibitors, authors, speakers, PDC instructors, session chairs, and program committee members, as well as all the volunteers who help make the 71st ECTC a success. We look forward to virtually meeting all of you on June 1, 2021.



Ibrahim Guven 71st ECTC Program Chair Virginia Commonwealth University iguven@vcu.edu

WELCOME FROM ECTC SPONSORING ORGANIZATION



On behalf of the IEEE Electronics Packaging Society, I am delighted to welcome you to the 71st Electronic Components and Technology Conference – the world's premier event for electronics packaging.

Starting 71 years ago, ECTC continues to grow, innovate, and serve our community with an exciting technical program detailing the latest advances

in electronics packaging. Building upon the outstanding event from last year, we expect attendance at ECTC 2021 to well exceed 2,000 packaging professionals. This is a fantastic achievement. Our conference portfolio continues to find innovative ways to grow and serve our community. Together with ECTC and our Asia-Pacific flagship conference EPTC, to be held in December, EPS expects to reach over 7,000 conference attendees world-wide in 2021.

These achievements would not be possible without the dedication and commitment of our conference organisers and volunteers. I would like to express my sincere thanks to the ECTC Executive and Program Committees, members of the

EPS Board of Governors, volunteers from the EPS Society, and the ECTC and EPS staff for their outstanding efforts in bringing you this year's exciting event. We are fortunate to have such an enthusiastic team that keeps finding new ways to serve the electronic packaging community.

May I also thank our authors, presenters, and sponsors for their contributions to this year's event. It is very rewarding to see the significant benefits that events such as ECTC have on the Electronics Packaging Society, our industry, and our members.

In addition to conferences, EPS has been implementing its exciting plans for membership, chapters, publications, education, and technology to provide a unique service to our members worldwide. You can find more information about these activities at the EPS website.

Finally, may I thank you for attending this year's ECTC. Enjoy the conference, and I look forward to meeting you again at one of our future events.

is Bailay

Christopher Bailey EPS President 2020-2021

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Heterogenous

Integration

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- Excellent adhesion on ABF and PI with lowest Rc performance for fine line designs

Substrate drawings source: Status of the Advanced Packaging Industry report, Yole Développement, 2020

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Keynote Week 1

What the Chiplet-Based Future of Compute Means for Components and Technology

Sam Naffziger – AMD, Senior Vice President, Corporate Fellow, and Produce Technology Architect



Chiplet architecture is now becoming mainstream, and recognized as fundamental to enabling the continued economically viable growth of power efficient computing. We will cover the benefits of these approaches in enabling lower costs from smaller die combined

with modularity to scale performance and configuration, taking examples from industry products. The costs of splitting and modularizing an SOC into chiplets will be discussed, which include the high-bandwidth and low-latency communication requirements between die, overheads of testing and power-managing what used to be individual SOC modules as standalone chips, and engineering the package substrate to provide routing and power delivery resources for the complex integration. Today's solutions will be evaluated in the context of what will be required from packaging and silicon technologies over the next decade to achieve the true potential of chiplet architecture.

Keynote Week 2

Transitioning to a Renewable Energy-Based Grid

Pedro Arsuaga – GE Research, Renewable Energy Business Program Manager



After the Paris Agreement was adopted and ratified by the overwhelming majority of member states, most nations are taking actions to reduce their carbon footprint. In the area of power generation, this means that a very significant transition is taking place from fossil fuel based power

generation to renewable energy based power generation. This energy transition is shaking the foundation of how the grid was created and has been operating for the last century, as both wind and solar technologies connect to the grid using power electronics. In addition, the exponential growth of distributed energy resources and electric vehicles, drives the need for increased visualization and control of these resources, in order to keep a reliable energy supply. In this session we will discuss the role that digital technologies, power electronics and controls will play in the energy transition.

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Conference organizers reserve the right to cancel or change this program without prior notice.

SPECIAL SESSIONS



Chairs: Bill Chen - ASE and Bill Bottoms - 3MTS

Heterogeneous Integration uses packaging technology to integrate dissimilar chips, devices or components with different materials and functions, and from different fabless design houses, foundries, wafer materials, feature sizes and companies into a system or subsystem. 23 Technical working groups will present on their areas of expertise. This workshop is a half-day pre-recorded event with a planned follow-up live Q/A session. Workshop Segments:

- 1. Overview Bill Chen and Bill Bottoms: Heterogeneous Integration Is the Future
- 2. Moderator Bill Bottoms: High Performance Computing & Data Centers; 2D-3D & Interconnect; Thermal Management; Integrated Photonics; Test & Cyber Security
- 3. Moderator Tom Salmon, SEMI: Automotive; MEMS & Sensors Integration; SiP & Module; Supply Chain; Integrated Power Electronics
- 4. Moderator Ravi Mahajan, Intel Corporation: 5G & Future Communications; WLP (Fan-In & Fan-Out); Aerospace & Defense; Mobile; Materials & Emerging Research Materials; IoT
- Moderator Amr Helmy, U. Toronto: Medical, Health & Wearables; Emerging Research Devices; Single Chip and Multi Chip Integration; Co-Design; Modeling & Simulation; Reliability







2021 ECTC PLENARY SESSION

Transformation of the Electronics Industry in a Post-Covid World

Chairs: E. Jan Vardaman – TechSearch International, Inc., Mark D. Poliks – Binghamton University, and Kimberly Yess – Brewer Science, Inc.

Panelists:

Jie Xue, Cisco Systems, Inc.

Rama Divakaruni, IBM Corporation

Thorsten Meyer, Infineon

Ram Trichur, Henkel

Yadunath Zambre, Air Force Research Laboratory

David Davenport, General Electric Research

Craig Orr, Samsung Foundry USA



2021 SPECIAL SESSION Market Trends and Geopolitical & Economic Outook

Chairs: Rozalia Beica – AT&S and Ed Sperling – SemiEngineering

Panelists:



Carolyn Evans, Intel Corporation Duncan Meldrum, Hilltop Economics Risto Puhakka, VLSI Research Jean Christophe Eloy, Yole Developpement





Diversity Does Matter and Can Drive Enhanced Business Performance

Chairs: Allyson Hartzell – Philips and Kitty Pearsall – Boss Precision, Inc.

Panelists:

Joyce Wu, Analog Devices

Viktor Tymchenko, Intel Corporation

Alezandra Gualdino, PMD Technologies

Adeel Bajwa, Kulicke and Soffa Industries, Inc.



2021 IEEE EPS PRESIDENT'S PANEL

Future Vision of Electronics Packaging -Industry Perspective

Chairs: Chris Bailey – EPS President, University of Greenwich and Sam Karikalan – EPS VP Conferences, Broadcom

Panelists: Bryan Black, AMD Raj Pendse, Facebook Pooya Tadayon, Intel Corporation Mark Kuemerle, Marvell Semiconductor



2021 ECTC YOUNG PROFESSIONALS MEETUP

Chairs: Yan Liu – Medtronic and Adeel Bajwa – Kulicke and Soffa Industries, Inc.

This event is designed just for you – young professionals, including current graduate students. In this active event, you will interact with senior EPS members and professionals through a series of active and engaging activities. You will have opportunities to learn more about packagingrelated topics, ask career questions, and meet some professional colleagues.

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SPECIAL SESSIONS



2021 IEEE EPS SEMINAR

Latency: Are High-Bandwidth Optical Networks a Silver Bullet?

Chairs: Yasumitsu Orii - NAGASE and Shigenori Aoki – LINTEC

Panelists:





2021 ECTC SPECIAL SESSION

Low Temperature Solder – Packaging **Challenges of a Next-Generation SMT** Interconnect

Chairs: Kevin Byrd - Intel Corporation and Keith Newman – AMD



Panelists Traian C. Cucu, MacDermidAlpha

Luke Wentlent, Universal Instruments Richard Coyle, Nokia Bell Labs Carol A. Handwerker, Purdue University Eric Cotts, Binghamton University

2021 SPECIAL SESSION

Pathogen Detection & Eradication via Photonics

Chairs: Chris Bower - X Display Company and Mark Beranek – NAVAIR

Panelists:

James Malley, University of New Hampshire

Gary Eden, University of Illinois & Eden Park Illumination

Benjamin Miller, University of Rochester Zlatko Sitar, North Carolina State University

Ling Zhou, Bolb Inc.

Thomas Baer, Stanford Photonics Research Center



2021 ECTC WOMEN'S LUNCHEON Virtual Women's Luncheon Table

Chairs: Jean Trewhella - GLOBALFOUNDRIES and Tanja Braun – Fraunhofer IZM

Are you missing the networking connections you are used to making at ECTC?

If so this event is for you! Join Jean and Tanja for a roundtable "Virtual Women's Luncheon Table"!

Find out where people are from and where they are in their careers. Talk about what is great about the virtual conference and what could be better. Hear how people are involved in ECTC, EPS, how to get involved, and how to make ECTC and EPS even more compelling to get women engaged. Of course, just as for the ECTC in-person Women's Luncheon

Tables, ALL ARE INVITED.











2021 ECTC SPECIAL SESSION

Materials and Technologies for Advanced Packaging (5G, RF, Power, Harsh Environment)

Chairs: Karsten Meier – TU Dresden and Przemyslaw Gromala – Robert Bosch GmbH Panelists:

Claudio-Maria Villa, ST Micro

Vanessa Smet, Georgia Institute of Technology

Wilson Maia, Thales Xueren Zhang, Xilinx

Helmut Kroener, Showa Denko Materials (Europe) GmbH

2021 ECTC SPECIAL SESSION

Heterogeneous Integration Roadmap: Rising to the Chiplet Challenge

Chairs: Kanad Ghose - Binghamton University and Dale Becker – IBM

Panelists: Bryan Black, AMD Bapi Vennakota, OCP/ODSA & Broadcom David Kehlet, Intel CP Hung, ASE Shin-Puu Jeng, TSMC Madhavan Swaminathan, Georgia Tech lie Xue, Cisco Systems, Inc.

2021 ECTC SPECIAL SESSION

Heterogeneous Integration Roadmap: Test in Heterogeneous Integration

Chairs: Dave Armstrong – Advantest and Robert Patti – NHanced Semiconductors

Panelists:

Michael Alfano, AMD Pooya Tadayon, Intel Phil Nigh, Broadcom Bapi Vinnakota, ODSA Calvin Cheung, ASE



2021 SPECIAL SESSION

Home Use Medical Devices and Packaging in Wearable Technologies

Chairs: Kotlanka Rama Krishna – Analog Devices and Ahyeon Koh – Binghamton University

Panelists:

David Bolognia, Analog Devices

Kelvin Pun, Compass Technologies

Aghogho Obi, GE

Wei Gao, California Institute of Technology

Benjamin C. K. Tee, National University of Singapore











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PROFESSIONAL DEVELOPMENT COURSES • For more details see www.ectc.net/courses		
1. Achieving High Reliability of Lead-Free Solder Joints Materials Considerations	8. Wafer-Level Chip-Scale Packaging (WCSP) Fundamentals	
Course Leader: Ning-Cheng Lee – Indium Corporation	Course Leader: Patrick Thompson – Texas Instruments, Inc.	
2. Fundamentals of Glass Technology and Applications for Advanced Semiconductor Packaging Course Leaders: Prakash Gajendran and Joseph Canale – Corning, Inc.	9. Additive Flexible Hybrid Electronics – Manufacturing and Reliability Course Leader: Pradeep Lall – Auburn University	
3. Fundamentals of RF Design and Fabrication Processes of Fan-Out Wafer/Panel Level Packages and Interposers	10. Fan-Out Wafer/Panel Level Packaging and 3D Chiplet Heterogeneous Integrations Course Leader: John Lau – Unimicron Technology Corporation	
Course Leaders: Ivan Ndip and Markus Wöhrmann — Fraunhofer IZM		
4. Eliminating Package Failure Mechanisms for Improved Reliability	11. Polymers in Wafer-Level Packaging Course Leader: Jeffrey Gotro – InnoCentrix, LLC	
Course Leader: Darvin Edwards – Edwards Enterprises		
5. Characterization of Advanced EMCs for FO-WLP, Heterogeneous Integration, and	12. Reliability Mechanics and Modeling for IC Packaging	
Course Leaders: Przemysław Gromala – Robert Bosch GmbH	Course Leaders: Ricky Lee - HKUST and Xuejun Fan – Lamar University	
6. Reliable Integrated Thermal Packaging for Power Electronics	13. From Wafer to Panel-Level Packaging Course Leaders: Tanja Braun and Michael Töpper – Fraunhofer	
Course Leader: Patrick McCluskey – University of Maryland	IZM	
7. Flip Chip Technologies Course Leaders: Eric Perfecto – IBM Corporation and Shengmin Wen – Synaptics Inc.	14. Thermal Management of Electronics Course Leader: Jaime Sanchez – Intel Corporation	

IEEE ELECTRONICS PACKAGING SOCIETY MAJOR AWARDS



Electronics Manufacturing Technology: Yong Liu

Extensive research and development in the field of analog and power packaging manufacturing assembly process modeling, reliability prediction and innovation.



Outstanding Sustained Technical Contribution: Wilmer R. Bottoms

For outstanding entrepreneurship and sustained visionary leadership that continues to foster microelectronics packaging innovation and comprehensive technology roadmapping.



Exceptional Technical Achievement: Tanja Braun

Beth Keser For seminal contributions and leadership in Fan-out Wafer Level Packaging.





David Feldman Outstanding Contribution Award: Paul Svasta

For strongly promoting and implementing Electronic Packaging and IEEE EPS activities in Europe, Region 8, for establishing a functional networking bridge from Academia to Industry.



Outstanding Young Engineer:

Bo Song For outstanding contribution to the development of advanced packaging materials and nanofabrication technology, as well as his service to the IEEE EPS society.



Regional Contributions: 10 Ranjan Rajoo

For growing R10 flagship conference EPTC through strategic partnerships with the entire microelectronics supply chain, and for contributions to the Singapore EPS Chapter.



EPS PhD Student Fellowship Abhishek Deshpande

For his contributions in the development of multiaxial microscale solder joint test specimens and cyclic test setups for demonstrating the differences in solder joint vulnerability to tensile fatigue vs. shear fatigue.

IEEE ELECTRONIC PACKAGING SOCIETY TRANSACTION AWARDS

Advanced Packaging Technologies Category

Thin Film Metallization Stacks Serve as Reliable Conductors on Ceramic-based Substrates for Active Implants

VOL. 10, ISSUE 11 NOVEMBER 2020 Patrick Kiele, Paul Čvančara, Michael Langenmair, Matthias Mueller, Thomas Stieglitz

Electronics Manufacturing Category

Effects of Thickness and Crystallographic Orientation on Tensile Properties of Thinned Silicon Wafers VOL. 10. ISSUE 2 FEBRUARY 2020

Sangmin Lee, Jae-Han Kim,

Young Suk Kim, Takayuki Ohba, Taek-Soo Kim

Components: Characterization & Modeling Category

Experimental Study of Relationship between Arc Light Intensity and Temperature in Low Voltage Switching Devices

VOL. 10, ISSUE 11 NOVEMBER 2020 Dongkyu Shin, Thomas G. Bull, John W. McBride

AND

Steady-State Parametric Optimization and Transient Characterization of Heat Flow Regulation with Binary Diffusion VOL. 10, ISSUE 12 DECEMBER 2020

Tanya Liu, James W. Palko, Joseph S. Katz, Feng Zhou, Ercan M. Dede, Mehdi Asheghi, Kenneth E. Goodson

Best Associate Editor Awards

Wendem Beyene, Intel Corporation Abhijit Chandra, Iowa State University Cemal Basaran, SUNY at Buffalo Xiaobing Luo, Huazhong Univ. of Science & Technology Chuan Seng Tan, Nanyang Technological University Paragkumar Thadesar, QUALCOMM Inc.

EPS ECTC STUDENT TRAVEL AWARDS

Ramon Sosa - Georgia Institute of Technology Session 9: Low-temperature all-Cu interconnections formed by pressure-less sintering of Cu pillars with nanoporous-Cu caps

Claudio Alvarez - Georgia Institute of Technology Session 29: Demonstration of a High-Inductance, High-Density, and Low DC Resistance Compact Embedded Toroidal Inductor for IVR

Yuki Susumago - Tohoku University Session 1: FOWLP-Based Flexible Hybrid Electronics with 3D-IC Chiplets for Smart Skin Display

Woosol Lee - University of Florida Session 29: 3D integrated high gain rectenna in package with metamaterial superstrates for high efficiency wireless power transfer applications

Tomo Odashima - Tohoku University Session 12: Wafer-Level Flexible 3D Corrugated Interconnect Formation for Scalable In-Mold Electronics with Embedded Chiplets Peng Zhao - Nanyang Technological University Session 7: Heterogeneous Integration of Silicon Ion Trap and Glass Interposer for Scalable Quantum Computing Enabled by TSV, Micro-bumps, and RDL

Kai-Cheng Shie - National Chiao Tung University Session 10: Hybrid bonding of nanotwinned copper/organic dielectrics with low thermal budget

Seokkan Ki - Kyung Hee University Session 14: Rapid Enhancement of Thermal Conductivity by Incorporating Oxide-Free Copper Nanoparticle Clusters for Highly Conductive Liquid Metal-based Thermal Interface Materials

Sunil Kumar Panigrahy - National Tsing Hua University Session 32: Study on an Artificial Intelligence Based Kernel Ridge Regression Algorithm for Wafer Level Package Reliability Prediction

Jia Juen Ong - National Chiao Tung University Session 5: Two-step fabrication process for die-to-die and dieto-wafer Cu-Cu bonds

25 YEARS ECTC VOLUNTEER AWARD

J Rao Bonda - Amkor Technology

Craig Gaw - NXP Semiconductor

Eric Perfecto - IBM Research

Suresh K Sitaraman - Georgia Institute of Technology

Jan Vardaman - TechSearch International

10 YEARS ECTC VOLUNTEER AWARD

Wendem Beyene - Intel Corporation Abhilash Goyal - Velodyne LIDAR, Inc.

Vikas Gupta - ASE US, Inc.

Ibrahim Guven - Virginia Commonwealth University

Robert Kao - National Taiwan University

Wei Koh - Pacrim Technology

Nancy Stoffel - GE Research

Shaw Fong Wong - Intel Corporation

2020 ECTC BEST PAPERS

Best Session Paper InFO_SoW (System-on-Wafer) for High Performance Computing Shu-Rong Chun, Tin-Hao Kuo, Hao-Yi Tsai, Chung-Shi Liu, Chuei-Tang Wang, Jeng-Shien Hsieh, Tsung-Shu Lin, Terry Ku, Douglas Yu - Taiwan Semiconductor Manufacturing

Best Interactive Presentation Paper

Embedded 3D-IPD Technology based on Conformal 3D-RDL: Application for Design and Fabrication of Compact, High-Performance Diplexer and Ultra-Wide Band

Ayad Ghannam, Alessandro Magnani, David Bourrier, Thierry Parra - 3DiS Technologies

Outstanding Session Paper

10 and 7 μm Pitch Thermo-Compression Solder Joint, Using a Novel Solder Pillar and Metal Spacer Process Jaber Derakhshandek, Giovanni Capuz, Vladimir Cherman, Funnihiro Inoue, Inge De Preter, Lin Hou, Pieter Bex, Carine Gerets, Fabrice Duval, Thomas Webers, Julien Bertheau, Stefaan Van Huylenbroeck, Alain Phommahaxay, Ehsan Shafahian, Geert Van der Plas, Eric Beyne, Andy Miller, Gerald Beyer - IMEC

Outstanding Interactive Presentation Paper

Processing Glass Substrate for Advanced Packaging Using Laser Induced Deep Etching

Rafael Santos, Jean-Pol Delrue, Norbert Ambrosius, Roman Ostholt, Stephan Schmidt - LPKF Laser & Electronics AG

Intel Best Student Session Paper A Comprehensive Study of Electromigration in Lead-free Solder Joint

Jiefeng Xu, Chongyang Cai, Vanlai Pham, Ke Pan, Huayan Wang, Seungbae Park -Binghamton University

TECHNICAL SESSIONS • For more details see www.ectc.net/program

Packaging Technologies Subcommittee	Interconnections Subcommittee
Session 1: 2D and 3D Chiplets Interconnects in	Session 7: 3D TSV and Interposer
FO-WLP/PLP	Session 8: Chiplet Integration and Fan-Out
Session 2: Wafer/Panel Level System Integration	Interconnections
and Process Advances	Session 9: Advances in Cu Bonding
Session 3: Advanced Heterogeneous Chiplet and Integration for HPC	Session 10: Surface Preparation for Cu Bonding
Session 4: Heterogeneous Integration Using 2.xD/3D	Session 11: Advanced Chip to Chip/Package Interconnections for 3D and Heterogeneous
Packaging Technologies	Integration
Session 5: Technologies for Advanced Substrates and Flip-Chip Bonding	Session 12: Flexible Interconnects and Low- Temperature Sintering
	Assembly & Manufacturing Technology Subcommittee
RF, High-Speed Components & Systems Subcommittee	Session 23: Heterogeneous Integration Processes and Manufacturing
Session 26: Antenna-in-Package for 5G/6G and Padar Systems	
Radar Systems	Session 24: Fan-Out Wafer Level Packaging Developments and Applications
Session 27: Novel High-Frequency Integrated Modules and Systems	Session 25. Advances in Assembly Methods
	Session 20. Advances in Assembly Freehous
Session 28: High-Speed Signal Integrity and	
Interconnections	Materials & Processing Subcommittee
Session 29: 3D Power Components and Power	Session 13: Dielectric Materials for High-Speed Wireless Communications
Integrity	Session 14: Enhancements in Sintering Technology and Power Applications
Emerging Technologies Subcommittee	Session 15: Material and Process Advancements for Interconnects and Metallurgy Reliability
Session 34: Flexible Hybrid Sensors and Electronics	Session 16: Innovation on Bonding and Hybrid Bonding Materials and Processing
Session 35: Emerging Quantum and Advanced	
Interconnects	Session 17: Latest Trends in Fan-Out Packaging and Substrate Technology
Session 36: Packaging, Machine Learning, and Integration Technologies	Session 18: Emerging Technology Advancements in Applications and Processing
	1/1////////////////////////////////////

TECHNICAL SESSIONS • For more details see www.ectc.net/program			
Thermal/Mechanical Simulation & Characterization Subcommittee	Photonics Subcommittee		
Session 22: Advanced Package Modeling and Reliability	Session 6: Advanced Optoelectronics Packaging		
	Applied Reliability Subcommittee		
Session 30: Package to System Level Thermo- Mechanical Reliability Modeling	Session 19: Enhanced Reliability Characterization and Methodologies		
Session 31: Analyses on Chip Package Interaction and Thermal Management for Heterointegration	Session 20: Reliability of Automotive Electrification and Autonomous Electronic Components		
Session 32: Novel Approaches for Reliability and Process Modeling	Session 21: Advances in Interconnect Reliability		
Session 33: Flexing and Warpage Characterization and Modeling	Session 22: Advanced Package Modeling and Reliability		

TOPICAL SESSIONS HOSTED BY THE INTERACTIVE PRESENTATIONS TECHNICAL SUBCOMMITTEE

Session 37: Photonics, 5G, mm Wave Applications & Techniques	Session 42: Topics in Advanced Packaging	
Session 38: Reliability Analysis of New Materials in	Session 43: Manufacturing Techniques for Emerging	
Modern Packaging	Packaging Requirements	
Session 39: High-Speed Channel Design, Power	Session 44: Thermo-mechanical Analysis for	
Delivery and Analysis	Reliability in Packaging Technology	
Session 40: Materials and Techniques in High-Speed	Session 45: Heterogeneous Integration, Flex and	
Interconnects	Emerging Technologies	
Session 41: Characterization and Performance Analysis of Packaging Materials	Session 46: Student Session	

INTRODUCING CARBON CAPACITORS:



SEM picture of the CNF-MIM capacitor die



SEM picture shows side-view of the CNF-MIM die

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Learn more about "the thinnest capacitors in the world" on www.smoltek.com/ectc2021. Or visit our virtual booth at www.ectc.net for more in detail information.



PIONEERING CARBON NANOTECHNOLOGY

2021 VIRTUAL EXHIBITION

ECTC will be holding a virtual exhibition event that will be online for the entirety of the ECTC virtual conference this year. The virtual exhibit event provides companies the opportunity to connect with conference attendees virtually or in live chat/video interactions and present information in video and print formats on their products and services. The format for each company's virtual exhibit is an easy-to-navigate webpage, accessible only through the ECTC virtual conference platform, that makes getting connected quick and easy. Participation as a virtual exhibitor also includes one free virtual conference registration, making this a cost effective way for your company to participate in the entire virtual conference experience. To reserve your exhibit page for the 2021 ECTC virtual event, please contact:

Alan Huffman, ECTC Exhibits Chair

Alan.Huffman@micross.com

&

Jodi Towner, ECTC Exhibits & Registration

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FIRST CALL FOR PAPERS

IEEE 72nd Electronic Components and Technology Conference www.ectc.net • May 31 - June 3, 2022

The Electronic Components and Technology Conference (ECTC) is the premier international electronics symposium that brings together the best in packaging, components and microelectronic systems science, technology and education in an environment of cooperation and technical exchange. ECTC is sponsored by the Electronics Packaging Society (EPS) of the IEEE. You are invited to submit abstracts that provide non-commercial information on new developments, technology and knowledge in the areas including, but not limited to the topics listed those given below for each technical program committee name. Authors are encouraged to review the sessions of the previous ECTC programs to determine the committee selection for their abstracts.

Applied Reliability

Emerging product reliability including LED, memory, IoT and autonomous vehicles, medical/wearable electronics; Interconnect reliability in flip chip, wire & hybrid bonded packages; Novel reliability test methods, life models, FA techniques & materials characterization; Package board-level reliability in computing, telecommunications, automotive & harsh environments; Reliability of TSV, 2.5D, 3D, fan-out, WLCSP, WLFO, PLFO, & Heterogeneous Integration.

Assembly and Manufacturing Technology

Advanced dicing and bonding; Advanced encapsulation and embedding technology; Assembly and manufacturing process improvement; Assembly and manufacturing advances in flexible and printed electronics; Assembly and manufacturing challenges for 5G/RF packaging and integration; Fan-out and panel level assembly; Heterogeneous integration process & manufacturing; Package warpage and substrate; Thermal enhanced packaging and assembly.

Emerging Technologies

Emerging, novel, and unique packaging and material technologies for: soft and intelligent packaging, flexible/stretchable hybrid electronics, implantable biosensors and bioelectronics, extreme harsh environment, green/bio-resorbable packaging, nanomanufacturing, paper sensors/electronics pop-up/origami, MEMS & NEMS, CLOSE-TO-MOTOR high-voltage power electronics, packaging for wide band gap devices, anti-tamper, cryptography, additive manufacturing, packaging for quantum computing and electro-optical integration, recyclable and sustainable electronics packaging, packaging for quantum computing and electro-optical integration, recyclable and sustainable electronics packaging, packaging for quantum computing and electro-optical integration, recyclable and sustainable electronics packaging, AI, ML and computer vision for packaging, point-of-care diagnostic packaging, packaging for quantum computing/sensing/communication, and space hardened packaging technologies.

RF, High-Speed Components & Systems

5G, IoT, cloud computing, autonomous vehicles, Al/machine learning; Antennas, sensors, power transfer, EM shielding, wired/wireless communications, RF to THz; Electrical and multi-physics modeling, simulation and characterization of interconnects, components, modules, and heterogeneous integration; Signal/ power integrity, chip/package/board co-design.

Interconnections

Interconnection Technology and Processing: Fan-out, panel-level, chiplets, SiP, flipchip, 2.5D/3D, Si/glass/organic interposers, TSV, micro-bump, Cu pillar, wirebonds, high I/O thermo-compression/hybrid bonding, fine-pitch/multi-layer RDL, printable interconnects, flexible substrates; Interconnect Material, Characterization and Reliability: Conductive/non-conductive adhesives, low temperature solder, underfill, molding compounds, thermal interface materials, thermal/mechanical/electrical tests and reliability; Interconnects design and technology for emerging applications: HPC, mobile, 5G, IoT, power and rugged electronics, medical and health, automotive, aerospace, flexible hybrid electronics, micro-LED display

Materials & Processing

Conductive and Non-Conductive Adhesives, 3D Materials and Thin Wafer Processing, Solder Alloys, Dielectrics, Underfills, Molding Compounds, Thermal Interface Materials, Novel Materials and Processing, Emerging Materials.

Thermal/Mechanical Simulation & Characterization

Component, Board and System Level Modeling for Microelectronics, e.g., 3D Interconnects (TSV, Stacked Die, etc.), 2.5D Packaging (Si, Glass, Flexible Interposer, etc.), flexible substrates/systems, Wafer-Level-Package (WLP), Ball-Grid-Array (BGA), Fan-Out Packages, Embedded Packages with Active and Passive Components, System-in-Package (SiP), Chiplet Systems/Packages, Panel Level Packaging (PLP), Power Electronic Modules, LED Packaging, RF materials (substrates, EMC, solder mask) & RF/5G systems, and MEMS; Reliability modeling related fracture mechanics, fatigue, Electromigration, warpage, delamination, moisture, drop test, material constitutive relations and characterization; Chip-Package Interaction, Wafer Fabrication Process Related Modeling; Novel modeling techniques including Multi-Scale Physics, and Co-Design Approaches, and Wide Range Strain Rate Solutions; Measurement methodologies, characterization and correlations, model order reduction, sensitivity analysis, optimization, probability, machine learning and digital twin; Fab/thin wafer handling, wire bonding and assembly manufacture process.

Packaging Technologies (formerly Advanced Packaging)

2.5 & 3D, TSV & interposer; Advanced flip-ship, SiP, CSP, PoP, MEMS, sensors & loT; Automotive & power electronics, Bio, medical, flexible & wearable packaging; Embedded & advanced substrates; Fan-out, wafer & panel level process; Heterogeneous integration.

Photonics

Photonics components packaging for computing, communications, data processing, mobility. Photonics components packaging for healthcare, green energy, security, environment, climate. Photonics components packaging for space, atmosphere, automobile, underwater, defense. Photonics packaging technology for process integration, co-packaging, free space optics. Photonics packaging technology for 3D printing, microscopy, advanced spectroscopy. Photonics packaging technology for micro-optics, quantum interconnects. Packaging of new photonics materials. Characterization of packaging components. Equipment and tools for photonics packaging.

Interactive Presentations

Abstracts may be submitted related to any of the nine major program committee topics listed above. Interactive presentations of technical papers are highly encouraged at ECTC. They allow for significant interaction between the presenter and attendees, which is especially suited for material that benefits from more explanation than is practical in oral presentations. Interactive presentation session papers are published and archived in equal merit with the other ECTC conference papers.

You are invited to submit an abstract of no more than 750 words that describes the scope, content, and key points of your proposed paper via the website at www.ectc.net.

lf you have any questions, contact: Karlheinz Bock, 72nd ECTC Program Chair TU Dresden Email: karlheinz.bock@tu-dresden.de

Abstracts must be received by October 10, 2021. All abstracts must be submitted electronically at www.ectc.net. You must include the affiliation, mailing address, business telephone number, and email address of all authors with your submission. The authors will be notified about the abstract selection outcome by December 20, 2021.

Professional Development Courses

Proposals are solicited from individuals interested in teaching educational, four-hour long Professional Development Courses (PDCs) on topics described on the previous page. From the proposals received, 18 PDCs will be selected for offering at the 72nd ECTC on Tuesday, May 31, 2022. Each selected course will be given a minimum honorarium of \$1,000. In addition, instructors of the selected courses will be offered the speaker discount rate for the conference. Attendees of the PDCs will be offered Continuing Education Units (CEUs). These CEUs are recognized by employers as a formal measure of participation and attendance in "noncredit" self-study courses, tutorials, symposia, and workshops.

Using the format "Course Objectives/Course Outline/Who Should Attend," 200-word proposals must be submitted via the ECTC website at www.ectc.net by October 24, 2021. Authors will be notified of course acceptance with instructions by December 20, 2021. If you have any questions, contact:

If you have any questions, contact: Kitty Pearsall, 72nd ECTC Professional Development Courses Chair Boss Precision, Inc. • Phone: +1-512-845-3287 • E-mail: kitty.pearsall@gmail.com



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	Speaker or Chair (full ECTC conference)	\$250	\$250
Non-IEEE Member	Attendee (full ECTC conference)	\$300	\$350
	Speaker or Chair (full ECTC conference)	\$250	\$250
Student	Attendee or Speaker (full conference)	\$175	\$175
Professional Developme	nt Courses (PDCs)		
IEEE Member	One (1) PDC	\$250	\$250
	Two (2) PDCs	\$400	\$400
	Three (3) PDCs	\$600	\$600
	Four (4) PDCs	\$800	\$800
Non-IEEE Member One (1) PDC Two (2) PDCs	One (1) PDC	\$300	\$300
	Two (2) PDCs	\$450	\$450
	Three (3) PDCs	\$650	\$650
	Four (4) PDCs	\$850	\$850
Student	One (1) PDC - Two (2) PDCs	\$90	\$90
	Three (3) - Four (4) PDCs	\$150	\$150
Other Registration Fees			
Cancellation Fee		\$50	\$50

71st Electronic Components & Technology Conference

Please log onto www.ectc.net/registration to register for the 2021 ECTC.

There will be no refunds or cancellations after May 14, 2021. Please note that a \$50 cancellation fee will be in effect for all cancellations made on or prior to May 14, 2021. Substitutions can be made at any time.

For additional information about registration or ECTC please contact us at: Renzi & Company, Inc. Phone: +1-703-863-2223 Email: reg.ectc@gmail.com

*If you join IEEE **BEFORE** you register for the 2021 ECTC you can save on registration fees and get the Electronics Packaging Society (EPS) add-on membership free for the rest of the year!

To take advantage of this offer, simply go to: https://www.ieee.org/membershipcatalog/productdetail/showProductDetailPage.html?product=MEMEP021

At destination, create your IEEE Web Account. Once complete, proceed to the Shopping Cart and enter EPSFREE2021 in the promotion code box. Click "Apply" and the Shopping Cart will be updated to show the discount. Use your new IEEE membership ID number and register for ECTC at the discounted IEEE Member Rate. *Non-IEEE members can join IEEE and save on ECTC registration and receive EPS Society membership free for 2021. IEEE members can join the EPS Society free for the remainder of 2021 with ECTC registration.

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