The 73rd ECTC Conference.

Submitted by Przemyslaw Gromala, Assistant Program Chair, IEEE EPS ECTC 2024

This year's IEEE EPS Electronic Components and Technology Conference (ECTC) took place in Orlando, Florida, at the newly renovated JW Marriott Orlando, Grande Lakes hotel, from May 30 to June 2, 2023. The conference brought together a total of 1,619 industry professionals, academics, and students in attendance from 26 countries.

The 73rd ECTC included 369 technical presentations, which were organized into 36 oral sessions and five interactive presentation (IP) sessions. There were 10 special sessions including two panels, one plenary session and a keynote opening the conference. The 13 professional development courses (PDCs) were attended by 325 attendees. The conference had 118 exhibitors at the Technology Corner Exhibit, a tribute to the quality of the conference and its attendees. The conference benefited from a strong number of sponsors and sponsorship, further testament to the value delivered by this flagship IEEE EPS conference.

Preparations for the 73rd ECTC conference began on 3–4 November 2022 in Dallas, where the ECTC Executive Committee and representatives of 10 technical sub-committees met and decided about the conference sessions based on 618 abstracts received, of which 335 were from first-time ECTC authors. In the end, 60% of the submissions were accepted. 56% of the submitted abstracts were from industry, and 44% were from academia and research institutions. In a testimony to the diversity of the industry and the conference, abstracts were received from 26 countries with the United States, Taiwan, China and South Korea leading the way in number of abstract submissions.

Based on the feedback from the participants of the 72nd ECTC and lively discussion during the preparation meeting in Dallas a series of novelties were introduced in this year's ECTC program:

- We have introduced a two-stage submission process to allow reviewers to streamline the peer-review process.

- Accommodation of the larger rooms with the full-time AV support at the conference.
- A full program of special sessions on Tuesday.
- On Wednesday morning at 8 am, we had for the first time, a plenary session with our ECTC 2023 keynote speaker.
- Six parallel technical sessions followed at 9:30 am. Technical presentations were shortened to 20 minutes including Q&A.
- Other plenary sessions were organized at 8 am on Thursday with our EPS Seminar, and on Friday with EPS President's Panel session.
- Breaks between technical sessions were extended to give all ECTC participants more opportunities for networking.

73rd ECTC conference kicked off on Tuesday, May 30, 2023. Each day at ECTC begins with the Speakers Breakfast in which the presenters and session chairs meet and take care of the preparatory work for their respective sessions. The PDC Chair, Kitty Pearsall, provided instructions to the PDC instructors and proctors on Tuesday morning, and Florian Herrault, the Program Chair, hosted these breakfast meetings on Wednesday till Friday.

As usual, the first day of the conference, the Tuesday following Memorial Day, featured PDCs, a workshop related to heterogeneous integration roadmap (HIR) and a variety of special sessions. This year, the conference had seven morning PDCs, running from 8 a.m. to noon, and another six afternoon PDCs, running from 1:30 to 5:30 p.m. The total number of PDC attendees was 325. The courses continued to serve a convenient way for students

and engineers to quickly get "up to speed" on the current topics of importance in electronics packaging. A total of two PDCs were new.

On Tuesday morning, parallel to the PDC we had an opportunity to contribute to the IEEE EPS Heterogeneous Integration Roadmap (HIR) special workshop chaired by William Chen, Bill Bottoms and Ravi Mahajan. The workshop started at 8:00 am and lasted until 4:30 pm. Session has been divided into four topics: AI/ML in package Co-Design for Chiplets Perspective; Heterogeneous Integration of MEMS & Sensors – Challenges and Opportunities; The Chips and Science Act; and Additively Manufactured Electronics for Heterogeneous Integration.

Similarly, as during the 72nd ECTC in San Diego, on Tuesday there were four special sessions 90 mins long, a networking panel for young professionals, and an IEEE EPS seminar. In the morning, from 8:30 to 10:00 am, Tanja Braun - Fraunhofer IZM and Przemyslaw Gromala - Robert Bosch GmbH, held a special session on Advanced Packaging and HIR for Harsh Environments - Current Status and Opportunities, with seven invited panelists from GM, Bosch, Samsung, ASE, Amkor, Henkel and Georgia Tech, covering the entire supply chain. Attendees were offered an overview of why SW-defined vehicles and highly automated driving require consumer-inspired electronics, such as CPUs and GPUs, and the challenges of qualifying these electronic components for harsh environments.

Next, at 10:30 am to 12:00 pm, Jan Vardaman – TechSearch International, Thomas Gregorich – Infinera and Chaoqi Zhang – Qualcomm, led a session Copper Hybrid Bond Interconnections for Chip-to-Wafer Applications. Presenters from IMEC, Intel, Synopsis, AMD, EVG and BeSi discussed the challenges and solutions for the expanded use of C2W copper hyper bonds. The topic of the panel interested so many conference participants that many of them stood and listened to the discussion at the door of the auditorium.

After lunch, there was another emerging topic that brings every year more contributions and interests at the ECTC Conference. Stephane Bernabe – CEA LETI, and Hiren Thacker – Cisco, organized a special session entitled: Photonic Integrated Circuit Packaging: Challenges, Pathfinding, and Technology Adoption. Six leading practitioners from industry and academia – CEA Leti, Teramount, IBM, Tyndall National Institute and FiconTEC Service GmbH – discussed the greatest challenge for photonic integrated circuit (PIC) – packaging technologies to reach high volume manufacturing and high throughput and yield.

CHIPS Act is an important milestone to strengthen the US manufacturing of electronics packaging in North America. Nancy Stoffel – GE Research, Jan Vardaman – TechSearch International and William Chen - ASE, invited speakers from industry: Marvel, Promex Industries, Micron; academia: University of California; and funding agencies: NIST, DARPA to discuss how to revitalize manufacturing of advanced packaging in North America. Participants had a chance to review the targets and developing plans of the US government, funded through the Chips Act.

The ECTC Student Reception, sponsored by Texas Instruments, was traditionally held on Tuesday from 5:00 to 6:00 pm. A steady stream of student attendees took advantage of the opportunity to mingle and network with professionals in the field. Right after this, the General Chair's Speakers Reception was given from 6:00 to 7:00 pm for Speakers and Session Chairs. These receptions provided a great start to the conference and helped prepare everyone for the following three days filled with technical presentations and networking opportunities. The Young Professionals Networking Panel and Reception took place from 7:00 to 7:45 pm and was chaired by Yan Liu – Medtronic. The IEEE EPS board members were present to discuss with attendees about various ways to develop their professional network and career paths.

The Tuesday program ended with a room full of attendees for the IEEE EPS Seminar on High Density Substrates from 7:45 to 9:15 pm, chaired by Takashi Hisada – IBM, and Yasumitsu Orii – Rapidus. Panelists were invited from Shinko, Unimicron, Dai

Nippon Printing, Penn State University and IBM. ECTC participants had a chance to learn about ultra-fine-pitch substrate technologies for chiplets and heterogeneous integration, trends, challenges, requirements, and latest technical achievements.

On Wednesday, we started the conference day with the Keynote presentation. Ibrahim Guven – Virginia Commonwealth University and ECTC 2023 General Chair introduced this year's keynote speaker Prof. Michael J. Manfra from Purdue University. The title of the keynote was: Unlocking the Potential of Quantum Computers: Challenges and Opportunities in Electronic Devices, Interconnects, and Packaging. In his keynote, Prof. Manfra emphasized that quantum computing will require advancements in new materials, innovations in interconnect and packaging technologies and novel thermal management, which are the core topics of the ECTC conference.

After the keynote, we started with the six technical sessions running in parallel throughout each of the three days. Each oral session featured seven paper presentations, and the interactive presentation sessions featured between 20 and 29 papers. Wednesday morning started with large crowds in the six sessions with titles "Heterogenous Chiplet Integration", "High-Performance Packaging Materials", "Advancements in Copper/Silicon-Oxide Hybrid Bonding", "Assembly and Manufacturing Process Enhancement", "Underfilling and Chip-Package Interaction", and "Co-packaged Optical Assembly". In parallel, the first of five interactive sessions took place from 10:00 am–12:00 pm, with 20 paper presentations.

During lunch, Patrick Thomson, ECTC Finance Chair who is attending ECTC already for a 40th time, shared a magnificent 73-year history of the ECTC conference. It gave a chance to all of us to learn how the conference evolved and how large the impact of this conference is on the entire microelectronics industry. Afterwards, Awards for Best and Outstanding Papers from the 72nd ECTC 2022 and the Intel Best Student Paper Award were presented by Kitty Pearsall.

In the afternoon, high attendance in the sessions was noticeable, with the topics "Large Formfactor Dense System Integration by Fan-Out", "Novel Reliability Test Methods", "Innovations in Copper Chip-to-Wafer Bonding", "Packaging Interconnections", "Additive Manufacturing and Packaging for Flexible Electronics", and "mm Wave Antenna-in-Package and Arrays". In parallel to the technical session, the second interactive session took place from 2:30–4:30 pm, with 29 paper presentations. On Thursday, Interactive presentations session in the morning with 28 presentations and afternoon with 26 presentations. Last conference day, Friday, we had only a morning session with student interactive presentations having 23 presentations. Attendees of the ECTC rated all oral and interactive session paper ratings only through the ECTC mobile app "Whova".

The Technology Corner exhibit area hosted 118 exhibitors. Exhibitors had multiple resources available within their booth, offering introductions, brochure materials, staff contact information, and an opportunity to submit inquiries and discuss directly with exhibit members their latest developments, tools, and services. In the late Wednesday's afternoon we had a chance to meet all the exhibitors during the exhibition reception and enjoy the excellent food and atmosphere of the venue hotel.

On Wednesday evening, co-organized with iTherm, we had a Diversity and Career Growth Panel: Diversifying our Technical Workforce to meet National Needs including the CHIPS Act Initiative. The Panel was chaired by Kim Yess – Brewer Science/ECTC, Nancy Stoffel – GE Research/ECTC, and Christina Amon – University of Toronto/iTherm. Discussion included four panelists from: University of Texas Arlington, NetFlex, GE Foundation, NIST CHIPS. Panel discussed the development of initiatives,

2022 ECTC Best Paper Awards

1) Best Session Paper
Advanced Fan-Out Packaging Technology for Hybrid Substrate Integration
Lihong Cao, Teck Chong Lee; Rick Chen; Yung-Shun Chang; Hsingfu Lu; Nicholas Chao; Yen-Liang Huang; Chen-Chao Wang; Chih-Yi Huang—ASE Group

2) Best Interactive Presentation Paper
Novel Zero Side-Etch Process for <1μm Package Redistribution Layers
Pratik Nimbalkar, Pragna Bhaskar, Christopher Blancher, Mohanalingam Kathaperumal, Madhavan Swaminathan, and Rao Tummala—Georgia Institute of Technology

3) Outstanding Session Paper
Organic Interposer CoWoS-R+ (plus) Technology
M. L. Lin, M. S. Liu, H. W. Chen, S. M. Chen, M. C. Yew, C. S. Chen, and Shin-Puu Jeng—Taiwan Semiconductor Manufacturing Company

4) Outstanding Interactive Presentation Paper
Scalable through Mold Interconnection Realization for Advanced Fan Out Wafer Level Packaging Applications
Aurélia Plihon, Edouard Déschaseaux, Rémi Franiatte, Jérome Dechamp, Simon Vaudaine, Jennifer Guillaume, Catherine Brunet-Manquat, Stéphane Moreau, and Perceval Coudrain—CEA-LETI

5) Intel Best Student Session Paper
Co-Design of Thermal Management with System Architecture and Power Management for 3D Ics.
Rishav Roy, Purdue University—School of Mechanical Engineering (G077); co-authors: Shidhartha Das, Benoit Labbe, Rahul Mathur, Supreet Jeloka—ARM,Inc.

policies and programs to increase and diversify the workforce, along with the metrics to assess progress.

On Thursday from 8:00 to 9:15 am, the ECTC Plenary session on "mm-Wave Phased Array Packaging for Next-Generation Communication and Radar Systems" took place. Kevin Gu – Metawave Corporation and Ivan Ndip – Fraunhofer IZM/Brandenburg University of Technology chaired the panel. Panelists were from Teledyne Scientific, Northrop Grumman Space Systems, Penn State University, Nokia Bell Labs and IBM Research. Top researchers and industry representatives discussed the current state-of-the-art, rapidly emerging research and latest advancement in integration and packaging technologies for design and implementing phased array front-end radar modules.

Thursday's technical morning sessions were well attended and covered the topics "Wafer/Panel-Level and Advanced Substrate Technologies", "Advances in Heterogeneous Integration Bonding Technology", "Innovative Interpose and Through-Via Technologies", "Sintering and Soldering for High-Power, High-Reliability, and RF Devices", "Advanced Reliability Modeling and Characterization", and "Advanced Photonic Packaging and Interconnect".

The IEEE Electronics Packaging Society President, Kitty Pearsall, presided over the luncheon on Thursday and presented the EPS Society Awards and introduced the society to new Fellow. The recipients were each presented with a certificate and warm applause from the audience.

After luncheon we continued the technical sessions including: "Advances in 3D integration and Hybrid Bonding", "Automotive/Board-Level Reliability", "Fine-Pitch and Intermetallic Considerations in Advanced Solder Interconnections", "Large substrate process integration challenges", "Next generation quantum, AI

and Secure System Design", and "High Speed Signal and Power Integrity".

The 73rd ECTC 2023 Technical Program Committee meeting was held on Thursday at 5:30 p.m. Michael Mayer, who will serve as the Program Chair for 74th ECTC 2024, chaired this meeting and presented the statistics of the 73rd ECTC and the timeline for the run up to the 74th ECTC that is planned to be held in Denver next year. Michel Mayer also introduced Przemyslaw Gromala of the Robert Bosch GmbH as the Assistant Program Chair of the 74th ECTC. This meeting also enabled the ECTC technical program subcommittees to get in touch with potential new members of their committees.

The traditional ECTC Gala Reception takes place on Thursday evening. It was the highlight of the week for the conference attendees, exhibitors, sponsors, and their guests. It is an excellent place for networking, meeting friends or partners, and starting new professional relationships. During the evening there was live music played on the stage. It was a fabulous time allowing celebration of the success of the ECTC by socializing and enjoying the excellent food and beverages that were supported by the Gala Reception Gold and Silver sponsors.

On the last day of the conference, President of the IEEE EPS Kitty Pearsall, together with David McCann – Lyte, chaired a panel discussion entitled "How Can Photonics Enable the Bandwidth Densities with Lower Energy per Bit in Emerging SIP". Amr Halmy from the University of Toronto led a panel composed of invited academia and industry experts from Lightmatter, University of Southern California and AT&S. Panelists discussed the tools, technologies and approaches that will enable the industry to enhance the bandwidth density of interconnections in SiPs supported by photonics.

The Friday morning technical sessions were also well attended, covering the topics "Next Generation High-Performance Computing Architectures", "Materials Reliability", "Next Generation Wafer-to-Wafer Copper Bonding", "Process Enhancements in 3D, FOWLP and TSV Technologies", "AI-based Prediction for Heterogeneous Integration and Advanced Packaging", and "Trends in Encapsulants and Low Dk/Df Dielectrics".

During Friday's luncheon we had a traditional Raffle chaired by Alan Huffman - ECTC Exhibit Chair, having several prizes from our sponsors including a hotel stay, free conference registration, IEEE EPS membership, books, and many other cool gadgets.

Friday afternoon included the sessions "MEMS sensor, Bio, and Advanced Interconnect Reliability", "Thermo-Mechanical Modelling and Characterization", "Advances in RDL, Via, TSV Technologies for Chiplet Integration", "Bonding Assembly – Novel Packaging, Process, and Characterization", "Packaging and Materials for Flexible Medical Technologies", and "RF, Heterogenous, and Chiplet Modules".

Overall, the 73rd ECTC was an amazing experience, giving us an opportunity to meet in an excellent location, and have a lot of discussions regarding future development of electronic components. This was the second largest ECTC conference in respect of participation with the record attendance in Orlando. ECTC became a four-day conference. Changes were introduced in the program, such as special sessions on Tuesday and Wednesday to Friday morning. One of the many highlights was Wednesday's keynote about Quantum Computing. Shortening technical presentations make the discussion much more dynamic. We also had a very strong exhibitor presence, excellent sponsorship, and many high-quality technical presentations with excellent presentation attendance. The ECTC Executive Committee sincerely thanks all the attendees, exhibitors, and conference sponsors (ECTC 2023 platinum sponsors: Amkor, ASE, JCET) for their support as well as all the committee

members and chairs who are volunteering their time to help organize the technical sessions and make ECTC such a success every year. Very special thanks also to our excellent event management team for bringing back the in-person reality flawlessly. See all the conference pictures at Flicker and keep in touch with the ECTC through LinkedIn.

The 74th ECTC will be held at Gaylord Rockies Resort & Convention Center, Denver, Colorado, USA, May 28–31, 2024. Karlheinz Bock from Technical University Dresden will be the General Chair of this conference. The Call for Papers and PDC Proposals will be available at www.ectc.net, and the abstract submission will close on October 09, 2023. So get those abstracts ready and submit them as soon as abstract submission opens.

I look forward to meeting you at Gaylord Rockies Resort and Convention Center, Denver, Colorado, May 28–31, 2024.

25th Electronics Packaging Technology Conference (EPTC2023)

The IEEE EPS Electronics Packaging Technology Conference (EPTC) is an international event organized by the IEEE RS/EPS/EDS Singapore Chapter and co-sponsored by the IEEE Electronics Packaging Society (EPS). Since its inauguration in 1997, EPTC has been established as a highly reputable international electronics packaging conference and is the IEEE EPS flagship conference in the Asia and Pacific Region.

The 25th Electronics Packaging Technology Conference (EPTC2023) will take place from 5th December to 8th December 2023 at Grand Copthorne Waterfront Hotel, Singapore. It will feature keynotes, technical sessions, invited talks, panels, workshops, exhibitions, and networking activities. Topics include modules, components, materials, equipment technology, assembly, reliability, interconnect design, device and systems packaging, heterogeneous integration, wafer-level packaging, flexible electronics, LED, IoT, 5G/6G, emerging technologies, 2.5D/3D integration technology, smart manufacturing, automation, MEMs, sensors and AI.

As this year marks the 25th anniversary of EPTC, a special 4-day program has been arranged including many keynotes, panels, invited talks and a great social program. The following keynotes have been confirmed to date:

Confirmed Keynotes:

1) Dr. Douglas C. H. Yu, VP of R&D, TSMC

Title: Advanced System Integration Technology Trend

Abstract: HPC and AI/ML technologies have profound impact on human society. Semiconductor technology plays critical roles to realize these. Recent progress in generative AI drives AI/ML's impact to a new height. Higher performance computing with ever-increasing model size requires much higher level of computation performance, communication and memory bandwidth, all at higher energy efficiency (EE). Advanced nodes Si scaling is expected to continue providing higher performance computing with higher EE. Advanced heterogeneous system integration technologies, however, can provide even more values than before for the HPC and AI/ML systems. This can be achieved by the scaling up of classical(microelectronics)-based system integration, advanced photonics-based system integration, as well the two integrated.

2) Dr. Radha Nagarajan, Marvell Senior VP, CTO

Title: 2.5D/3D Heterogeneous Integration for Silicon Photonics Engines