ICEPT 2026 – Joint Session

ICEPT-ICEP China & Japan Packaging Exchange Forum

Prof. Chuantong CHEN

Professor, Joint Research Institute for 3D Electronic Packaging, Osaka University, Japan

Topic: Cu Paste for Bonding Applications in Advanced and Power Semiconductor Devices

Biography: Prof. Chuantong Chen is a full-time professor at the Joint Research Institute for 3D Electronic Packaging, Osaka University. He is a Senior Member of IEEE, leader of the Japan Wide Bandgap Semiconductor Industry Alliance, a Kansai regional committee member of the Japan Institute of Electronics Packaging, a member of the International Standardization Committee for Wide Bandgap Semiconductors in Japan, and a committee member of IEEE ICEP, IEEE ICEPT, and the IEEE EPS 'Power & Energy' Technical Committee. He has published more than 250 SCI/EI papers, obtained more than 20 Japanese and international patents as well as 8 U.S. patents, and contributed to 10 books. He has received multiple honors, including the Best Paper Award of the Chinese Mechanical Engineering Society, the Japan Institute of Electronics Packaging Award, the IEEE ICEP Outstanding Technical Paper Award, the IEEE EMPC Best Poster Award, and the IEEE CPMT Japan Chapter Young Award.

Abstract: Low-temperature copper (Cu) sinter-joining technology has attracted increasing attention in high-power electronic device packaging due to its low material cost and excellent electrical and thermal conductivity. Additionally, fine-pitch copper (Cu) pillar interconnects have been widely adopted in flip-chip packaging to enable high-density integration. In this talk, recent research on low-temperature Cu sinter-joining technology will be reviewed, including its background, development, challenges, and future perspectives in high-power electronics. Furthermore, its applications in advanced packaging will also be summarized.

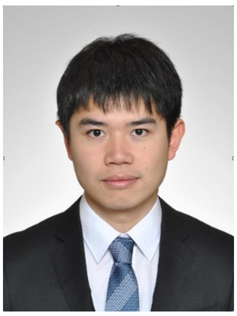
Mr. Zihao LI

Process Engineer, KOKUSAI ELECTRIC CORPORATION, Japan

Topic: Thin Film Applications via Atomic Layer Deposition (ALD) in Advanced Packaging Processes

Biography: Mr. Zihao Li earned a B.S. in Materials Science and Engineering from Dalian University of Technology in Dalian, China, and an M.S. in Materials Science from Tohoku University in Sendai, Japan. He currently works as a Process Engineer in the Advanced Technology Development Division at KOKUSAI ELECTRIC CORPORATION in Yokohama, Japan. His research focuses on applying atomic layer deposition (ALD) to advanced packaging, particularly for underfill flow control and thermal management.

Abstract: We propose the application of atomic layer deposition (ALD)-based thin films as a versatile solution for advanced packaging processes in next-generation 3D heterogeneous integration. As chiplet architectures evolve toward larger die sizes, finer pitches, and narrower gaps, increasingly complex interfacial conditions introduce critical challenges in underfill processing, including prolonged filling time, void formation, and reduced process reliability and productivity. Moreover, variations in surface materials often require multiple underfill formulations, increasing cost and reducing yield. To address these issues, ALD is introduced as a surface engineering technique capable of forming conformal, low-temperature thin films on diverse materials, thereby homogenizing interfacial conditions. By tuning surface wettability through post-treatment, the flow behavior of underfill materials can be systematically controlled, improving filling performance and suppressing defects. In addition, the ALD liner on microbump surfaces is expected to suppress metal migration, enhancing reliability in fine-pitch interconnects. This study also highlights a novel direct bonding approach utilizing ALD-deposited Al2O3 as an adhesive layer. Although hybrid bonding enables fine-pitch scaling, higher bandwidth, and improved power efficiency, it still faces process complexity and cost challenges. Conventional materials such as SiO2 and SiCN require plasma activation and show degraded bonding strength with increasing queue time. The proposed approach eliminates plasma activation and mitigates queue-time dependence. Experiments using 300 mm wafers with queue times up to 60 days demonstrated stable bonding performance. A 5 nm Al2O3 film deposited at low temperature enabled direct bonding, with consistent bonding strength and no voids. These results demonstrate a robust, queue-time-free hybrid bonding approach, enabling flexible die-to-wafer integration and supporting scalable, cost-effective heterogeneous integration.



Dr. Bin XU

Lecturer, University of Tokyo, Japan

Topic: Composite Materials for Effective Heat Dissipation Application

Biography: Bin Xu received his PhD in Electrical Engineering from Tohoku University in 2018. He is currently a lecturer at the University of Tokyo, where his research centers on thermal energy engineering. His work covers thermal management for electronic devices, thermoelectric energy harvesting based on phonon-engineering strategies, and the fundamental physics of phonon transport in low-dimensional material systems. These studies have been published in leading journals, including Science Advances, Advanced Functional Materials, and Acta Materialia. He has also received awards on these works, such as the Outstanding Young Researcher Award, the Young Researcher Award from the Heat Transfer Society of Japan, and the Osawa Young Researcher Award from the FNTG Society.

Abstract: Rapid advances in electronics demand heat spreaders with high thermal

conductivity and suitable mechanical compliance. To address this need, we developed copper-based composites using diamond and graphite, targeting enhanced heat dissipation through two complementary strategies: interfacial engineering and thermal routing. For Cu/diamond composites, the main challenge is the low thermal boundary conductance (TBC) caused by weak interfacial bonding and poor vibrational density of states (vDOS) matching between copper and diamond. We introduced a self-assembled monolayer (SAM) as a controllable interfacial layer and first investigated its morphology, including thickness and binding strength, in a planar Cu/SAM/diamond model using time-domain thermoreflectance (TDTR). The results showed that improving vDOS overlap is more effective than simply strengthening interfacial bonding for enhancing TBC in highly mismatched systems. Guided by this understanding, we optimized the SAM structure and applied it to Cu/diamond composites fabricated by plasma sintering. The resulting composite achieved a thermal conductivity of 711 W m-1 K-1, representing a record value among studies using diamond fillers with similar size and volume fraction. As a lower-cost alternative, we also explored graphite/Cu composites. Although graphite has excellent in-plane thermal conductivity, its low cross-plane conductivity limits its use in heat spreaders. To overcome this anisotropy, we designed three-dimensional graphite layouts to route heat effectively. Finite element modeling identified a double-decker structure, consisting of two graphite blocks with mutually perpendicular c-axes, as the optimal design. This structure was fabricated using a high-temperature process with a Cu microparticle interlayer containing 1 wt% Cr to bond the graphite blocks. Laser flash measurements and device-level tests confirmed that the composite dissipates heat nearly isotropically and performs similarly to an isotropic conductor with an effective thermal conductivity of 900 W m-1 K-1. These results demonstrate that interfacial engineering and thermal routing are effective strategies for developing high-performance heat spreader composites, providing both fundamental insights and practical solutions for advanced thermal management.

Mr. Weiqiang SHEN

Sales Manager, Sekisui (Shanghai) International Trading Co., Ltd.

Topic: Advanced Wafer Temporary Bonding and Debonding Tape Solutions for 3D Packaging

Biography: Mr. Shen is a Sales Manager at Sekisui (Shanghai) International Trading Co., Ltd., responsible for semiconductor material sales in China. With prior working experience at Sekisui Chemical’s Japan headquarter and an Economics degree from Osaka University, he focuses on providing practical material support for advanced packaging processes.

Abstract: As 3D packaging technologies drive the demand for ultra-thin wafer handling, optimizing the Temporary Bonding and Debonding (TBDB) process remains a critical industry challenge. This presentation introduces the latest advancements in TBDB tape solutions, exploring new possibilities for optimizing process compatibility and streamlining manufacturing workflows.