PURDUE UNIVERSITY

Birck Nanotechnology Center

From Backend 3D to Frontend 3D:3D IC, Advanced Packaging and Heterogeneous Integration

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Abstract:

3D IC, advanced packaging, and heterogeneous integration have become increasingly significant in current electronic products and applications due to their flexibility and ability to integrate various substrates, functions, devices, and products into small form factors with low power consumption. These approaches are not only considered candidates for extending "Moore's Law" but also for realizing the concept of "More than Moore". Moreover, given the current semiconductor development focus on the potential and demands of AI and IoT, these approaches provide solutions for fabricating various advanced electronic products. Ongoing technological development aims to achieve high-performance computing and compact dimensions by refining the pitch and size of vertical interconnections and exploring solutions to mitigate stress and warpage issues. Innovative platforms based on low-temperature bonding and ultra-thin device layer stacking show promising capabilities.

This presentation will begin with an introduction to the current status, including historical background and the current status of semiconductors, followed by discussions on 3D integration schemes such as 3D, 2.5D (interposer-based), and 2.1D (fanout-based). Key technologies will be described, including significant hybrid bonding technology. Finally, the presentation will delve into the challenges associated with the aforementioned goals and discuss possible solutions through industry efforts and research advances.

Bio:

Dr. Kuan-Neng Chen is a Chair Professor at the Institute of Electronics at the National Yang Ming Chiao Tung University (NYCU) in Taiwan. He received his Ph.D. degree in Electrical Engineering and Computer Science, as well as his M.S. degree in Materials Science and Engineering, both from the Massachusetts Institute of Technology (MIT). Dr. Chen has held several prominent positions including Vice President for International Affairs and Associate Dean of the International College of Semiconductor Technology at NYCU, Program Director of the Micro-Electronics Program at the National Science and Technology Council in Taiwan, and a Research Staff Member at the IBM Thomas J. Watson Research Center.

Dr. Chen has received numerous awards and honors throughout his career, including the IEEE EPS Exceptional Technical Achievement Award, the IMAPS William D. Ashmon – John A. Wagnon Technical Achievement Award, the National Industrial Innovation Award, the MOST/NSTC Outstanding Research Award (twice), the MOST/NSTC Futuristic Breakthrough Technology Award (twice), the Pan Wen Yuan Foundation Outstanding Research Award, the CIE Outstanding Professor Award, the CIEE Outstanding Professor Award, and the IBM Invention Achievement Awards (5 times). He is the author of over 300 publications, including 3 books and 6 book chapters, and holds 87 patents. Dr. Chen has also served as a Guest Editor for the MRS Bulletin and IEEE Transactions on Components, Packaging, and Manufacturing Technology, and has held leadership roles in various conferences and committees, such as IEEE IITC General Chair. Dr. Chen is a Fellow of National Academy of Inventors (NAI), IEEE, IET, and IMAPS, and a member of Phi Tau Phi Scholastic Honor Society.

Additionally, Dr. Chen holds the position of Specially Appointed Professor at the Tokyo Institute of Technology (Tokyo Tech) and serves as an Adjunct R&D Director at the Industrial Technology and Research Institute (ITRI). His current research interests focus on three-dimensional integrated circuits (3D IC), advanced packaging, and heterogeneous integration.

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