

**Thermocompression Bonding in Large Multichip Modules:** As AI and high-performance computing applications grow in sophistication, the demands for higher bandwidth and faster data transfer rates will only continue to increase. Various semiconductor packaging solutions are being pursued to help meet these demands in multichip module architectures. One of them makes use of small pieces of silicon (Si) containing lines of interconnect, known as silicon bridges, which are used to span physical gaps and to interconnect the chips in multichip modules. ASE researchers will describe a version of this technology called Fan-Out-Chip-on-Substrate-Bridge (FOCoS-Bridge), and how they used it to build and test for the first time a large chip module (>3X Si reticle size) containing 10 chiplets and 10 Si bridge dies. Two versions of this module were built and tested. One had a fan-out size of 31 x 47 mm2 (overall package size = 70 x 78 mm2), and the other, with more complex backside metallization, had a fan-out size of 50 x 50 mm2 (package size = 76.5 x 80 mm2).

An issue with such large sizes is the potential for warpage, caused by differing coefficients of thermal expansion among the Si dies, redistribution layer (RDL), molding layers, copper pillars, Si bridges, microbumps, and organic substrate. The researchers used a thermocompression bonding process to reduce warpage during fabrication, and a variety of inspection methods afterward to evaluate the resulting modules. These included optical microscopy, shadow moiré, x-rays, focused ion beam and scanning electron microscopy. They say the results show that thermocompression bonding is appropriate for large-scale chiplet integration with embedded Si bridges, and is suitable for high-density advanced packaging for high volume manufacturing.

* The image at left above is a scanning electron microscope (SEM) cross-sectional view of the smaller module, showing no cold joint or necking issues resulting from thermocompression bonding (TCB).
* The image on the right is a cross-sectional schematic view of the FOCoS-Bridge structure on the larger module, showing its backside metallization.

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