

Through Silicon Via (TSV)

Through Silicon Via (TSV) interconnects serve a wide range of 2.5D packaging applications and architectures. TSV technology allows state of the art packages to meet high performance, low-energy demands.

Through Silicon Via (TSV) Wafer Finishing & Flip Chip Placement

Through Silicon Via (TSV) interconnects have emerged to serve a wide range of 2.5D TSV packaging applications and architectures that demand very high performance and functionality at the lowest energy/performance metric. To enable the use of TSVs in these 2.5D TSV architectures, Amkor has developed a number of backend technology platforms for high volume processing of TSV-bearing wafers and assembly. It is important to distinguish that Amkor does not provide TSV formation in foundry wafers.

Amkor's TSV wafer process begins with 300 mm wafers in which "blind" TSVs have already been formed. Amkor's wafer process includes thinning the wafers to expose the TSVs and creating backside (BS) metallization to complete the TSV interconnect structure.

The TSV reveal and BS metallization process flow is commonly referred to as Middle-End-Of-Line (MEOL). Amkor's MEOL production tooling and processes include:

- ▶ Temporary wafer support bonding and de-bonding
- ▶ TSV wafer thinning
- ▶ TSV "soft" reveal, wafer backside passivation and chemo-mechanical planarization (CMP)
- ▶ Cu redistribution as required on the interposer wafer backside
- ▶ Lead-free plating of Cu micro-pillars or C4 backside interconnects

Amkor's Role in 2.5D TSV Packaging With TSV Interconnects

Amkor has enabled TSV technology solutions for the backend processing of TSV wafers (MEOL), bumping and 2.5D TSV assemblies. This requires advanced capability in the following key areas:

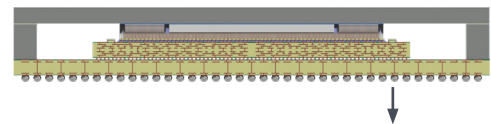
- ▶ Wafer support bonding and de-bonding of TSV-bearing wafers
 - ▷ Temporary Wafer Support System (WSS) for thin wafer management
- ▶ TSV MEOL processing
 - ▷ Bonding and de-bonding of TSV-bearing wafers
 - ▷ Wafer thinning to 100 μm (nominal) or thinner for 2.5D TSV products (per customer requirements)
 - ▷ Wafer backside passivation
 - ▷ TSV reveal process including CMP

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- ▶ Advanced assembly technology
 - ▷ Micro-Cu pillar bumping of functional die
 - ▷ Chip on Wafer (CoW) flip chip attach of functional die
 - ▷ 300 mm interposer wafer molding
 - ▷ Molded wafer backgrinding
 - ▷ Large, molded CoW module attach to organic substrate
 - ▷ 25-60 mm FCBGA body sizes for 2.5D TSV assembly integration
 - ▷ Bare die (with stiffener), lidded and overmolded final assembly options available
 - ▷ Intermediate electrical test for partially assembled modules (if customer design allows)
- ▶ Advanced TSV wafer finishing
 - ▷ Frontside and backside interposer wafer bumping
 - ▷ 40 μm pitch Cu pillar and landing pad micro-bumps
- ▶ Backside Cu redistribution qualified for the 2.5D TSV platform

2.5D TSV Platform

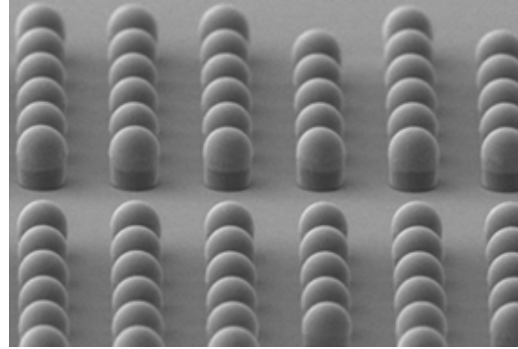
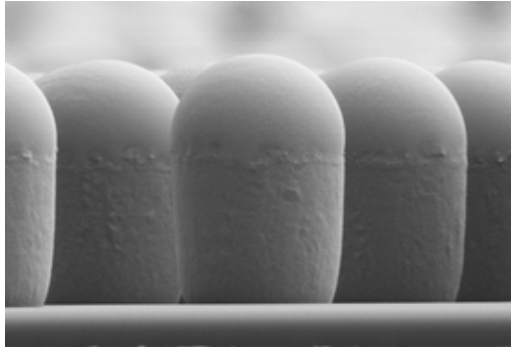
Examples of 2.5D TSV products are shown to demonstrate Amkor's production capabilities.



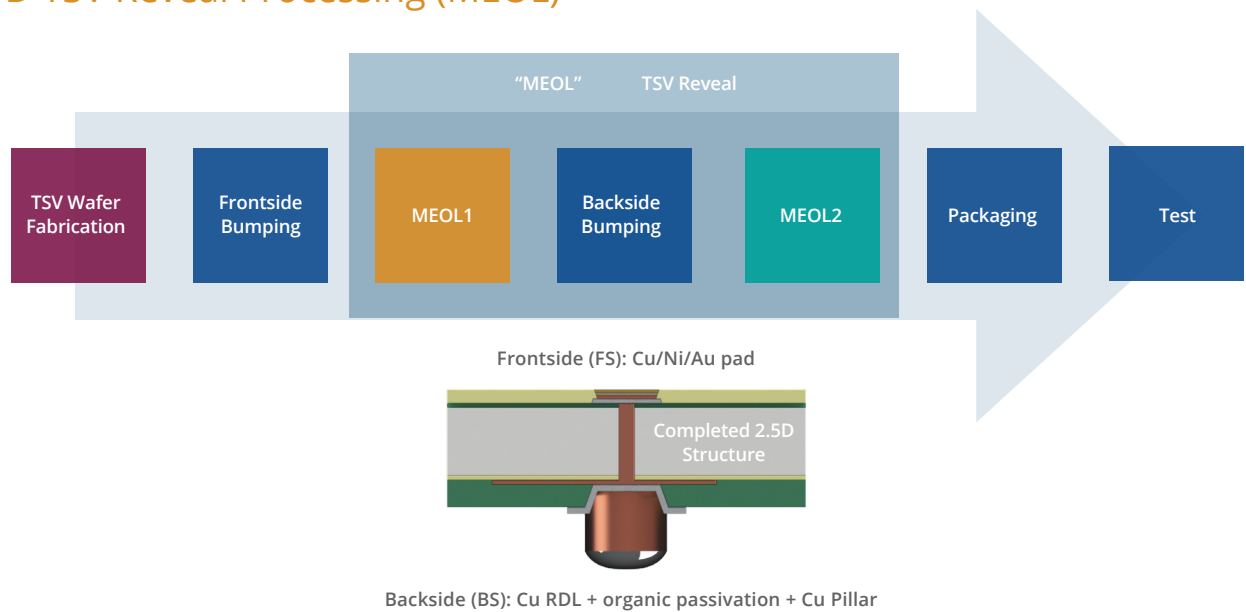
Application	GPU	GPU	AI	GPU	Large Interposer 2.5D	Stacked Substrate (Cost Effective 2.5D)
Configuration	ASIC + HBM	ASIC + 4HBM	ASIC + 6HBM	ASIC + 6HBM	2ASIC + 8HBM	ASIC + 6HBM
Pkg	41 x 31 mm	55 x 55 mm	55 x 55 mm	55 x 58 mm	85 x 85 mm	55 x 55 ABF 85 x 85 HDI
Interposer	27 x 15 mm	43 x 34 mm	43 x 37 mm	47 x 34 mm	54 x 46 mm	45 x 34 mm
ASIC	17 x 33 mm	32 x 26 mm	33 x 26 mm	33 x 26 mm	85 x 85 mm	32 x 24 mm
Si Node	14 nm	12 nm	7 nm	5 nm	TV	TV
Memory	HBM2	HBM2	HBM2	HBM2E/3	HBM2E TV	HBM2E TV
Status	LVM 2019	HVM 2019	HVM 2020	Undergoing Qualification (HVM Q2 2022)	Undergoing Internal Qualification (Q2 2022)	Customer Qualified
Floor Plan 						

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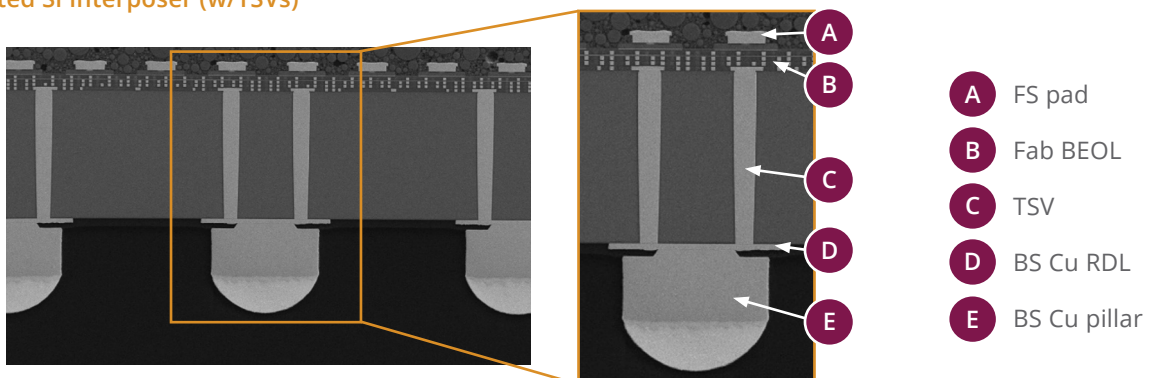
Fine Pitch Micro Copper Pillar Bumping – The Backbone of TSV Assemblies and Advanced Packaging



2.5D TSV Reveal Processing (MEOL)



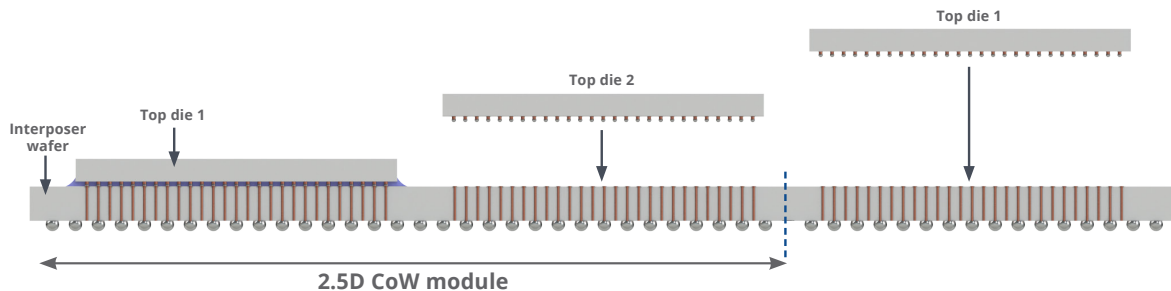
Completed Si Interposer (w/TSVs)



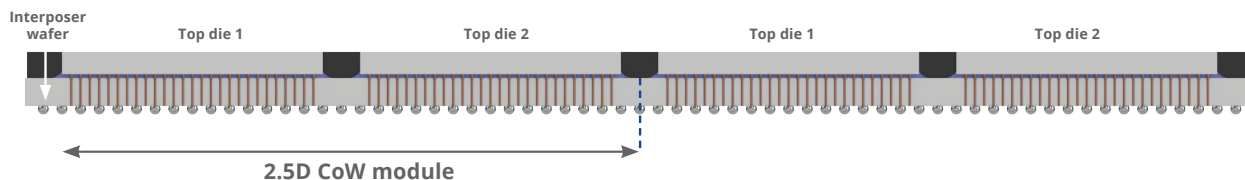
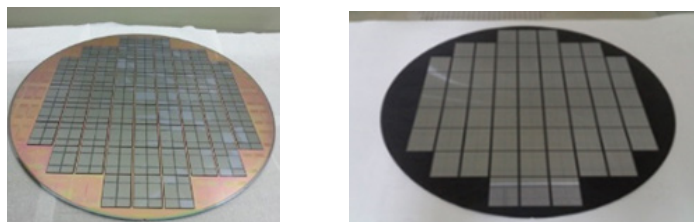
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Chip on Wafer (CoW) Assembly Flow

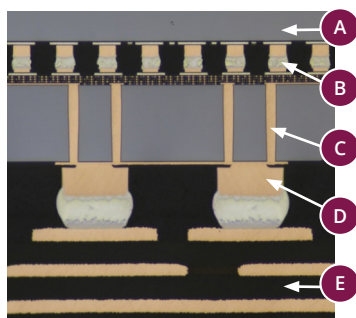
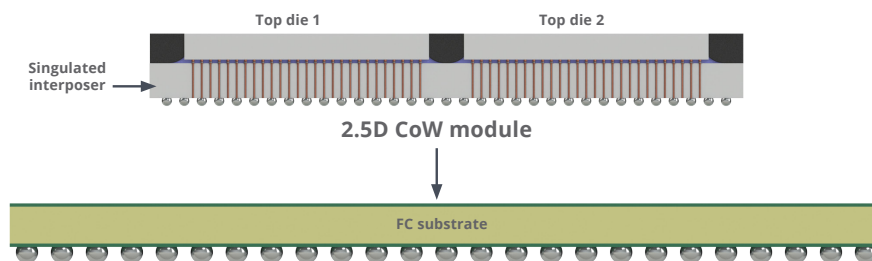
2.5D CoW Assembly: Die Site Population on Wafer & Die Underfill



2.5D CoW Assembly: Wafer Overmold, Mold Backgrind and Module Thinning



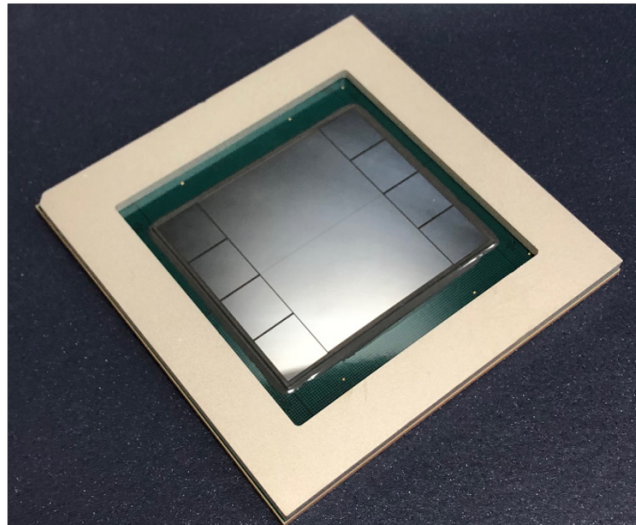
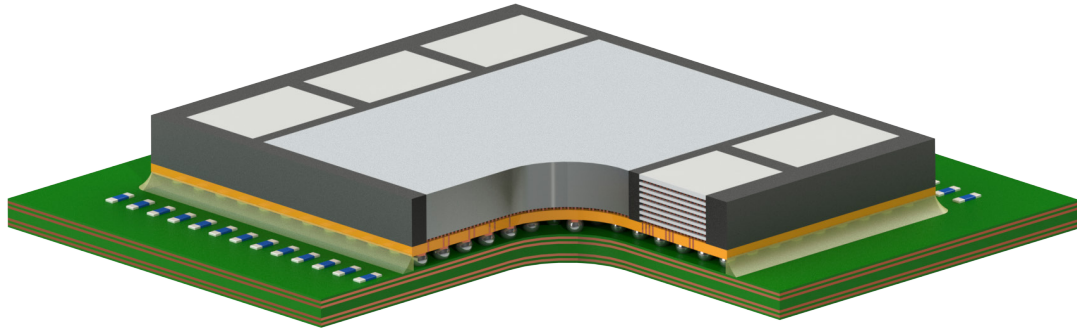
Final Stage of 2.5D CoW Assembly



- A Top die
- B CuP interconnect
- C TSV
- D BS Cu pillar
- E Substrate

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Amkor's 2.5D TSV Module Assembly Platform



Visit amkor.com or email sales@amkor.com for more information.

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