



Enabling 3D Technology

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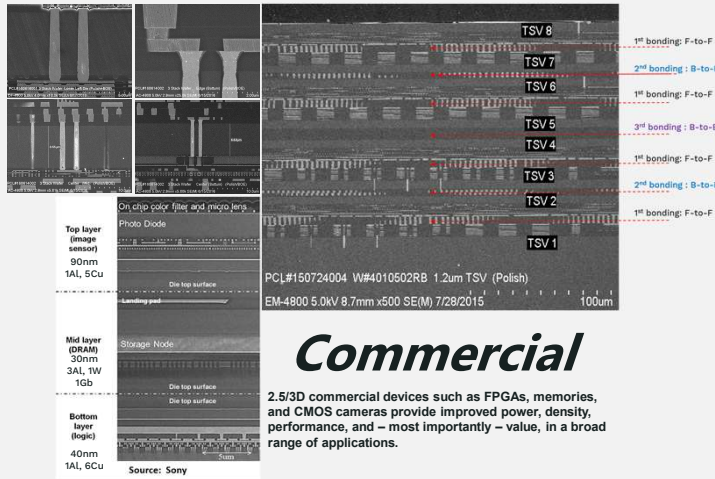


Driving Applications: Reconfigurable Imaging (Relmagine)

This research was developed with funding from the Defense Advanced Research Projects Agency (DARPA).

2.5/3D Technology to Support Relmagine Imaging Stack

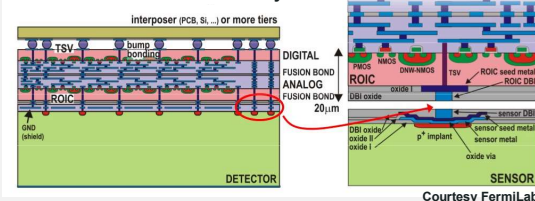
Existing Capabilities provide basis for anticipated Relmagine impact



Commercial

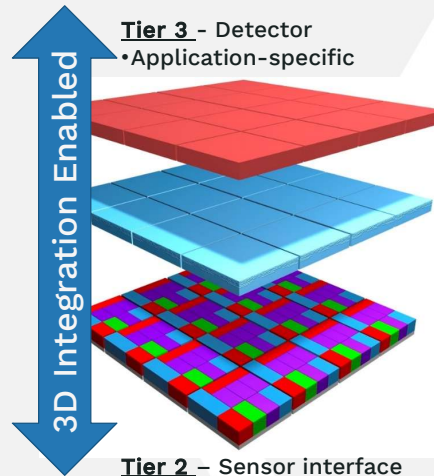
Fermilab demonstrated vast improvement in silicon sensor performance with 3D integration. Work continues to extend this technology broader applications.

First 4-Side Abutable Detector System



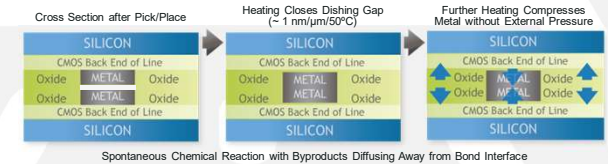
Relmagine

Tier 3 - Detector
•Application-specific

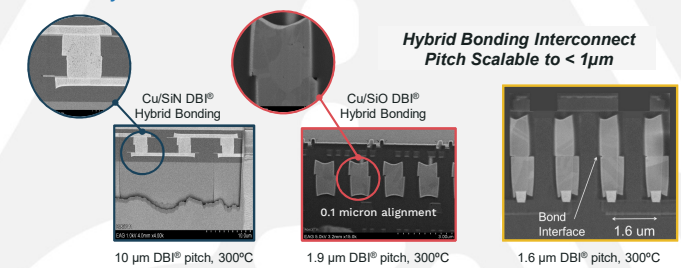


Tier 2 - Sensor interface
•Custom design
•Supports multi-function
Tier 1 - Processing fabric
•Software programmable digital processing
•Common reconfigurable fabric
•14 nm fabrication and performance

The Process



Scalability



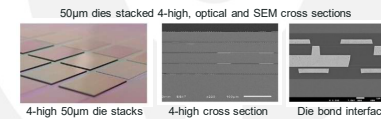
Options

Wafer-to-Wafer

- Implementable in foundry back end of line (BEOL) with low cost of ownership
 - Particle control requirement easily met
 - Proven in many applications
- CMOS BSI Image Sensors, RF switches
- Requires wafer and die sizes to be matched

Die-to-Wafer

- Accommodates die tiling, stacking, and mismatched die/wafer sizes
- Additional process steps required for die singulation and handling
 - Additional particulate/handling challenges



Die Stack with DBI® Hybrid Bonding

- Improved performance, cost, and yield/reliability potential
- Throughput – no reflow/alloy, throughput improved x2
- Thermals – no underfill, ΔT improved x5/10 for 4/8 high stack
- Electrical parasitics – DBI® replaces bumps, RC improved ~ x20
- Reduced stress – eliminate reflow/alloy and underfill
- Reduced pitch – pick/place tool limited, throughput dependent

Relmagine

3D integration process supports Relmagine 3D integrated sensors development, providing flexibility and functionality far beyond the capabilities of standard 2D semiconductor constructions.

