Sub-10µm Pitch 3D Integration Technology for Adaptive Focal Plane Array Imagers

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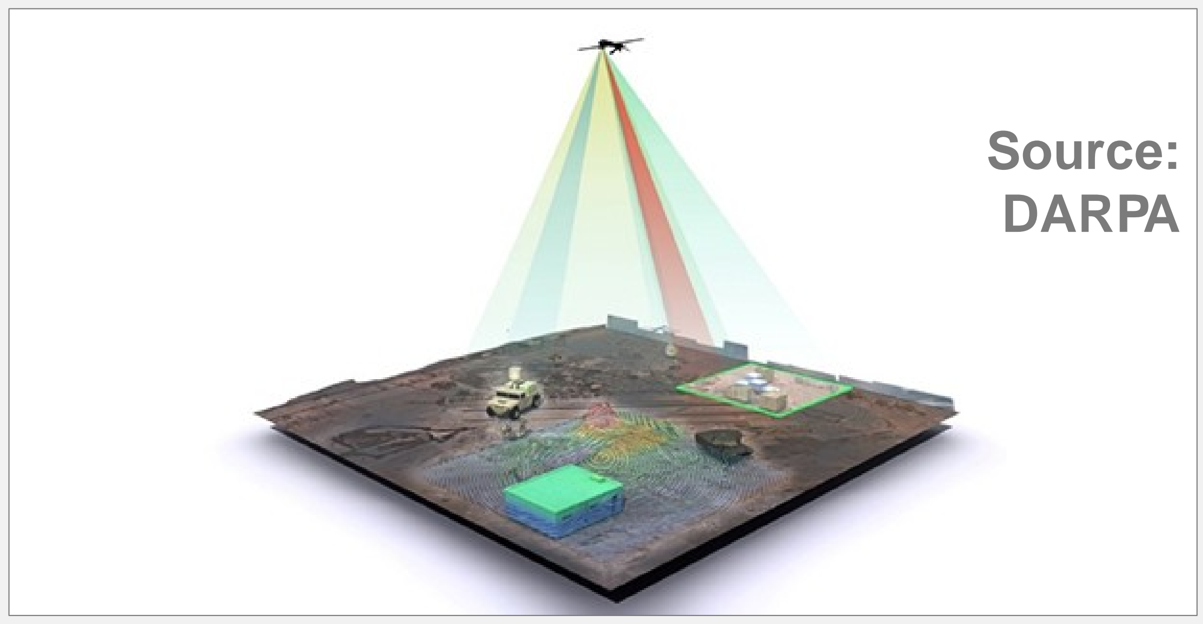
Micross Components

Driving Applications: Reconfigurable Imaging (ReImagine)

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

ReImagine Program Focus:

Smart, reconfigurable imagers which can adapt to collect the ideal type of sensor data for a given situation.



Source: DARPA

3D-Enabled Smart Pixels:

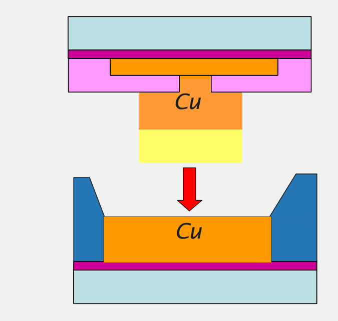
- Advanced 2-layer 3D readout IC (ROIC): Analog layer with integrated digital processing at pixel level

Unique 3D Integration Requirements:

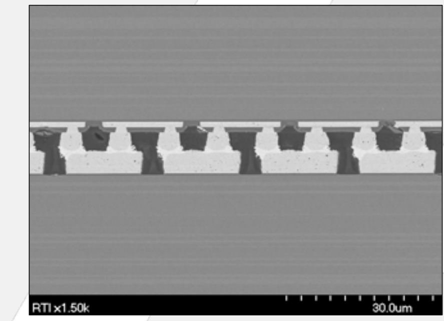
- **Fine pitch 3D** interconnects:
  - 12 µm pixel size
  - Sub-10 µm pitch bumps & TSVs
- **High I/O**: >1M pixel interconnects
- **Large die**: up to 20 mm / side
- **Advanced CMOS**: to 14 nm node
- **Vacuum package** compatibility
- **Temperature extremes**:
  - Cryo (cooled) operation
  - Thermal gradients in stack (due to ROIC power dissipation)
- **3-layer, heterogeneous integration**
  - Digital ROIC, Analog ROIC, detector layer

3D approach: Cu/Sn SLID bonding

- Plated Cu/Sn & Cu micro-bumps
- Thermocompression (TC) bonding
- ~1 µm alignment accuracy
- Solid-liquid interdiffusion (SLID), Cu_3Sn intermetallic bond interface
- High-strength, stable to >600°C

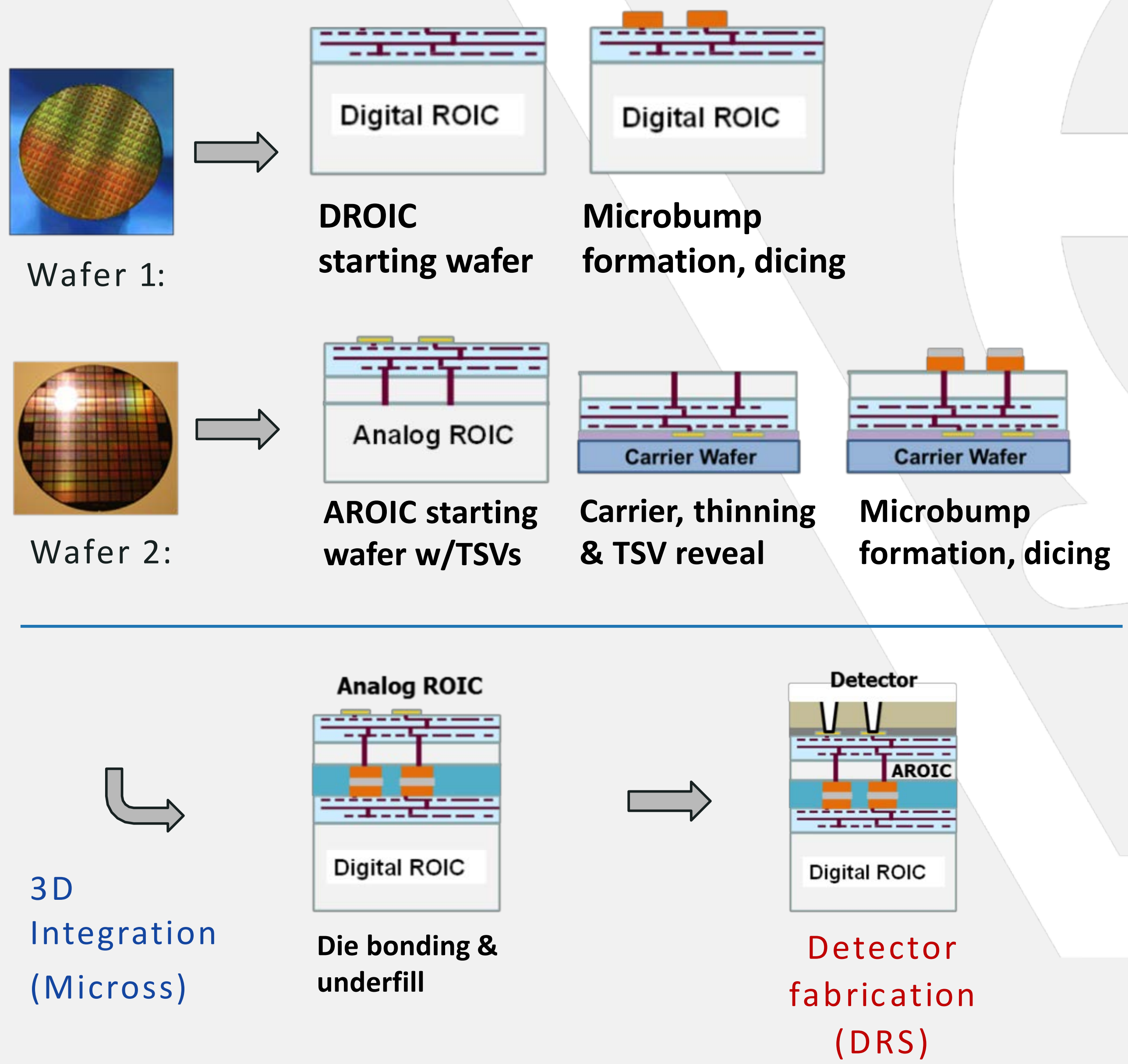


Cu/Sn-Cu Bonding Concept Diagram

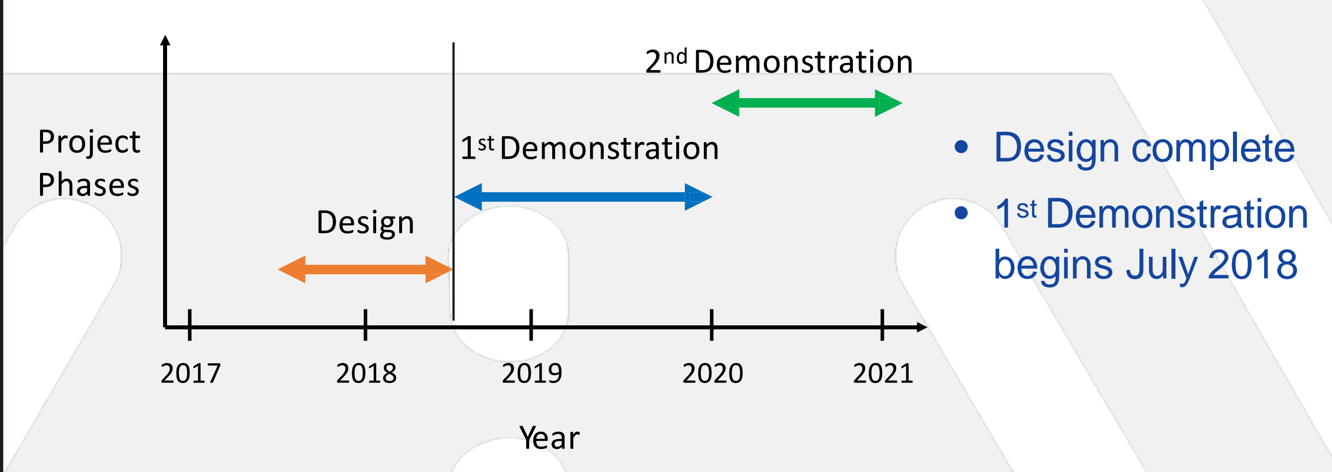


10 um pitch Cu/Sn-Cu SLID bonds (daisy chains)

3D Integration Process flow:

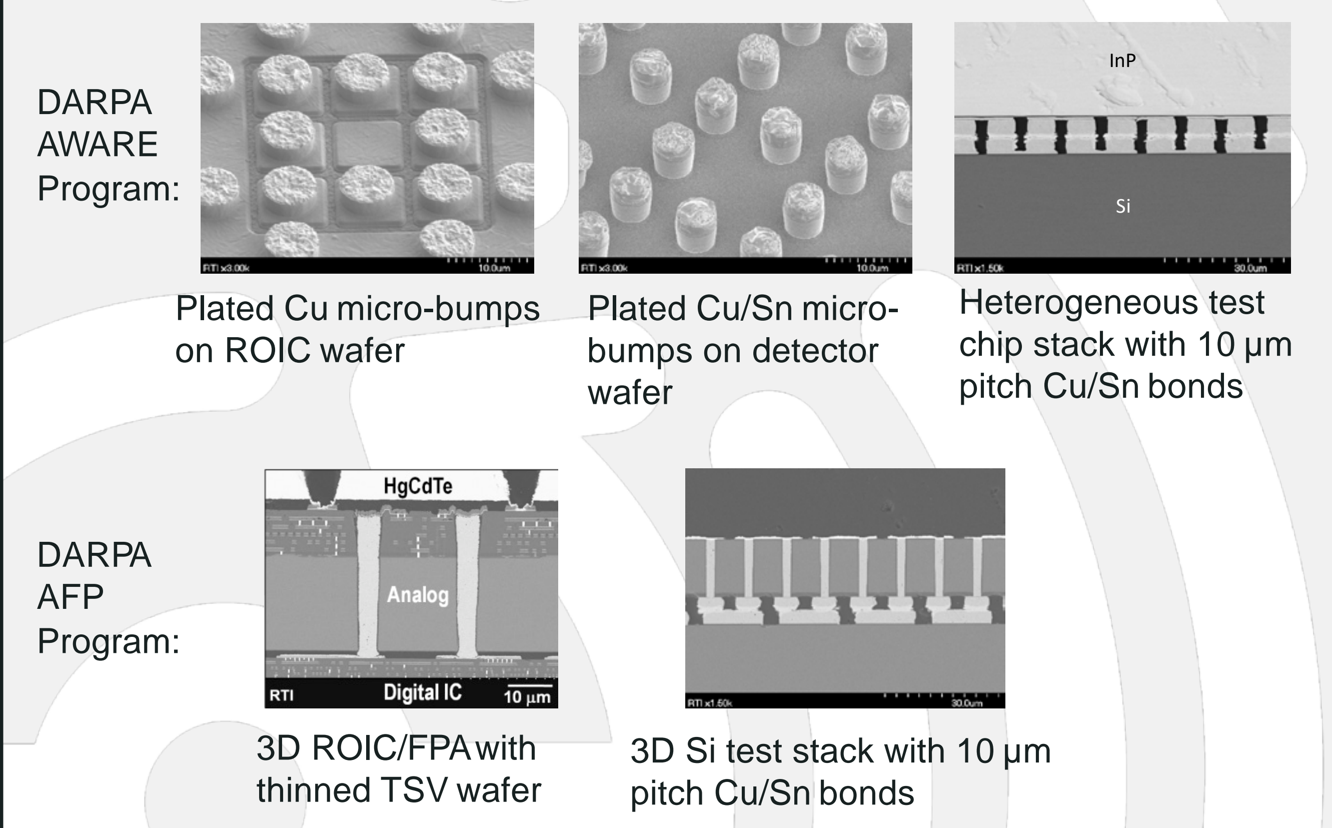


Program Timeline / Status:



- Design complete
- 1st Demonstration begins July 2018

Prior Related Demonstrations:

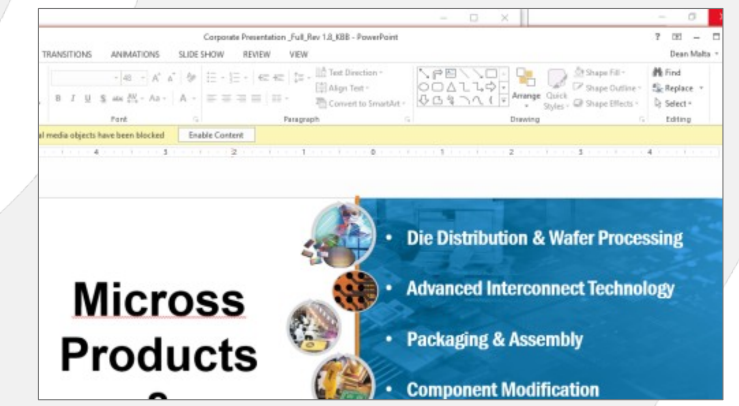


DARPA AWARE Program: Plated Cu micro-bumps on ROIC wafer; Plated Cu/Sn micro-bumps on detector wafer; Heterogeneous test chip stack with 10 µm pitch Cu/Sn bonds

DARPA AFP Program: 3D ROIC/FPA with thinned TSV wafer; 3D Si test stack with 10 µm pitch Cu/Sn bonds

Micross Capabilities:

Advanced Packaging & High-Rel electronic solutions for aerospace & defense, medical, and industrial markets



Micross cleanroom facility in Research Triangle Park, NC

Micross Advanced Interconnect Technology- NC, USA

- Wafer-level Packaging
- Through Silicon Vias
- 3D & Heterogeneous Integration

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