MICRO 3D SYSTEMS™

3D Printed Flexible Interconnects for the Packaging of Large and Segmented Nuclear Physics Detectors

DUJUD

3D PRINTING MICRODEVICES

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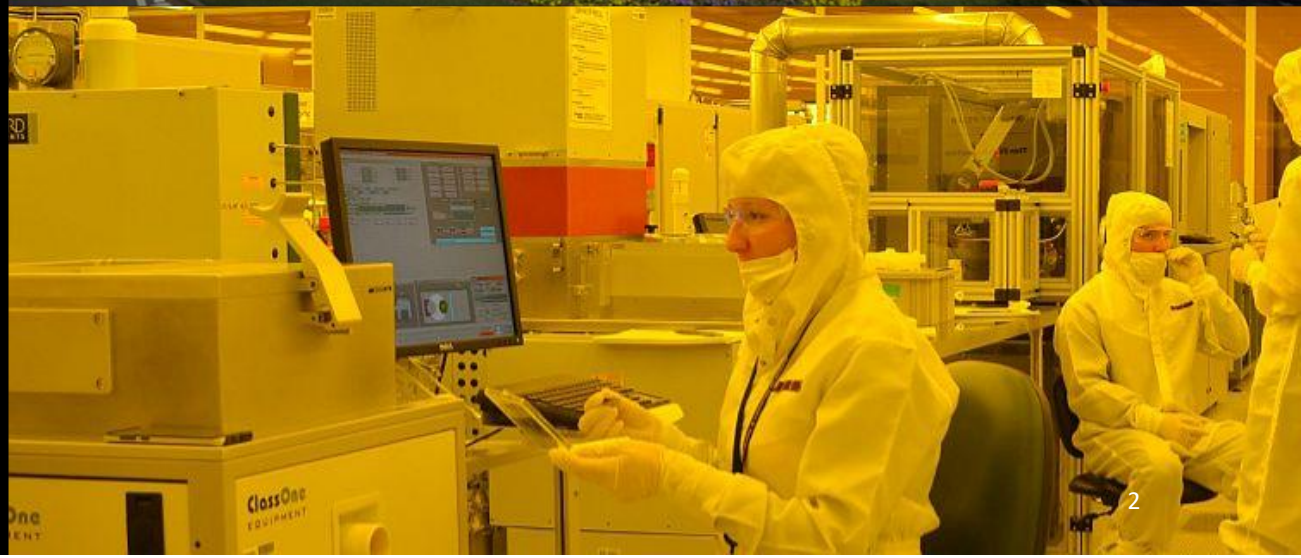
WHO WE ARE

- Founded in 2019
- Headquartered in Atlanta
- Microelectronics Technology Developer
- 12,000 sqft in-house R&D Facility

Just in the first three years of our operation, we joined the club of 500 fastest growing companies (based on revenue) in the United State.



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3D Printing Microdevices

WHO WE ARE

Forbes
NEXT 1000
List

Reza Abbaspour, CEO

Ph.D. from Georgia Tech on
3D Integration of Electronics

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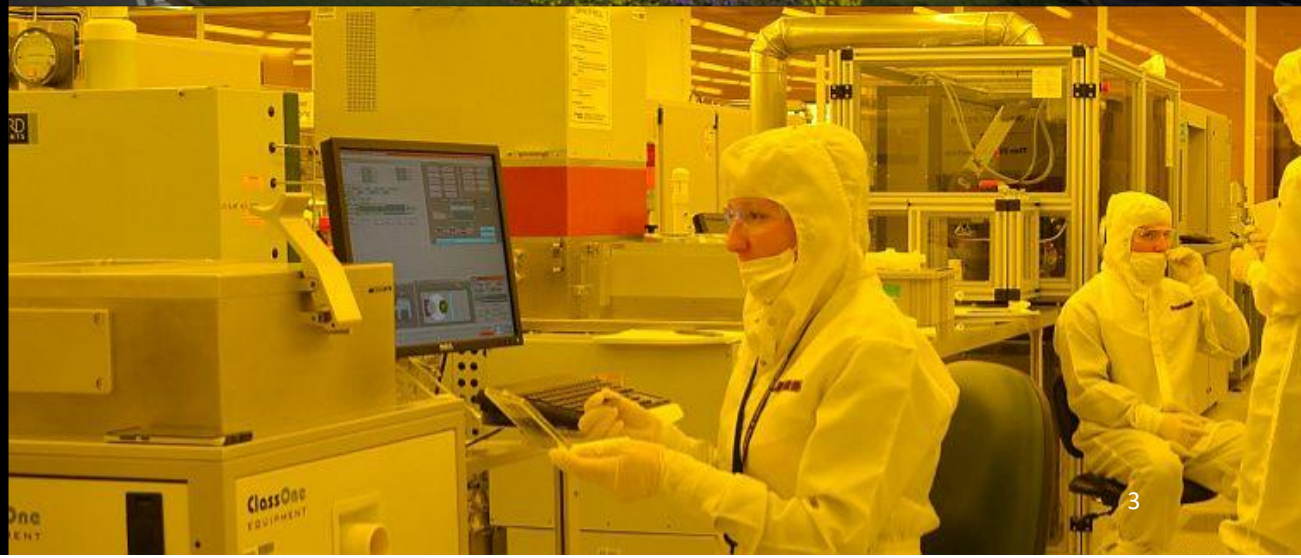
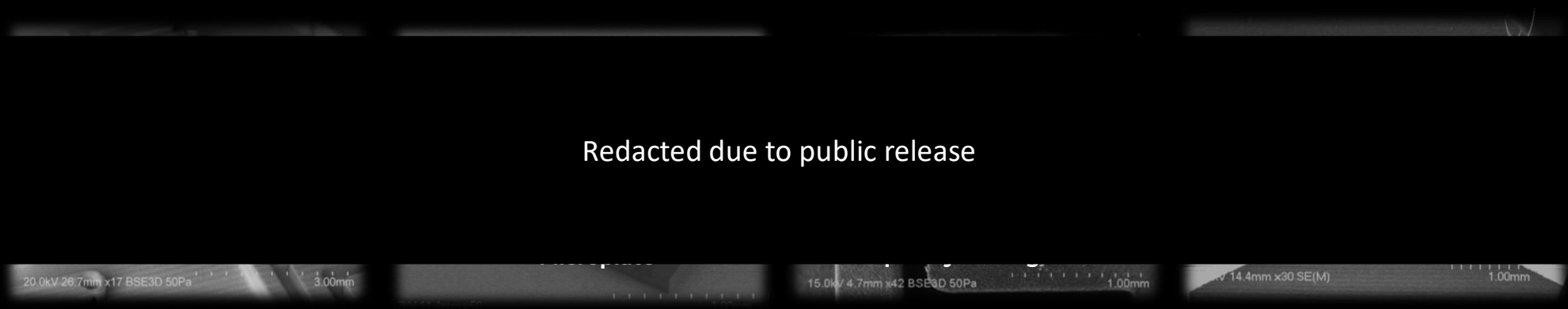


FIRST AND ONLY

MICRO 3D SYSTEMS

- THE **FIRST** COMPANY THAT MANUFACTURES **FUNCTIONAL** **3D PRINTED** ELECTRONIC MICRO-DEVICES
- THE **ONLY** COMPANY THAT DEVELOPS **3D** PHASED-ARRAY ANTENNAS FOR THE **mmWAVE** SPECTRUM

IMAGES FROM DUJUD'S MANUFACTURED DEVICES



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PROBLEM

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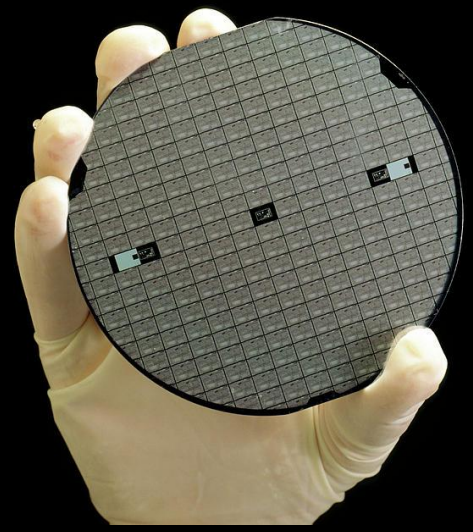
Microelectronic Industry Shortcomings

We are solving these problems



- **Slow and Costly** manufacturing process that is seen today in the national **chip shortage**
- **Complex Supply Chain** susceptible to any fluctuation increases **national security** vulnerability
- **Performance Limited** due to 70 years old 2D architecture **losing its edge** to global competitors

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TRAIL OF INNOVATIONS

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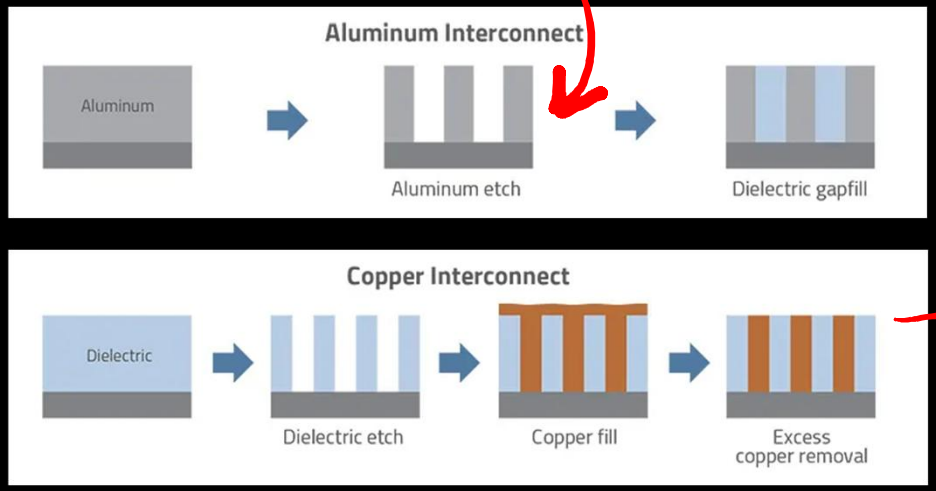
The conventional etching techniques cannot be used to pattern copper



Mechanical polishing is the key for copper patterning

- ✗ Not compatible with cleanroom → separate facilities to avoid contamination
- ✗ Extremely expensive
- ✗ Each layer needs polishing → time consuming for 30 layers

White vs Orange suits

OUR DISRUPTIVE MICROELECTRONIC TECHNOLOGY

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The solution is simple and specialize

- Migrating from 2D to 3D
- Moving from Subtractive to Additive Scheme

DUJUD's 3D Microelectronics	Conventional Microelectronics
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COMPETITIVE ADVANTAGE

MICRO 3D SYSTEMS

Reduced Manufacturing	Smaller Feature sizes	Metal Adhesion Quality	Electrical Resistivity

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✓ Room Temperature Process	✓ Thin Film Formation	✓ No Post-assembly	✓ No Re-tooling Cost
• No thermal shock • Compatible with temperatur sensitive materials such as polymers and semiconductor	Redacted due to public release	Monolithic integration of electronic components No pick-and-place operation Digital alignment vs. physical positioning of components	• No mask manufacturing • Rapid on-demand manufacturing → no retooling cost • Low cost process revisioning

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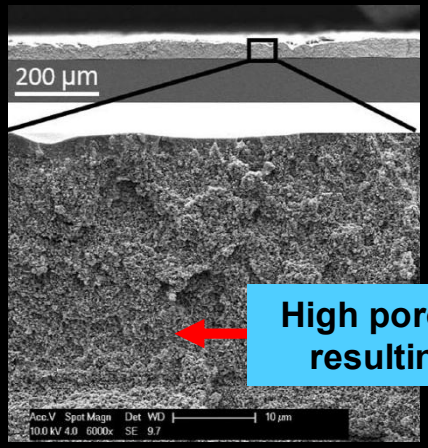
COMPETITION

MICRO 3D SYSTEMS

INK/AEROSOL-JET DEPOSITION PRINTING vs DUJUD FLASH 3D PRINTING

- ✖ 2D process by nature → challenging to employ on 3D surfaces
- ✖ High porosity → poor electrical conductivity
- ✖ Low adhesion to substrate → low mechanical reliability
- ✖ Sequential process → time consuming and difficult to scale
- ✖ Material limited → requires fluid bonding agents



High porosity profile (low quality) resulting from ink-jet printing ✖

- ✔ A True 3D process → virtually any 3D geometry can be manufactured
- ✔ [redacted]
- ✔ [redacted]
- ✔ Instantaneous process → The reason that its FLASH. It enables mass manufacturing because of high speed printing
- ✔ Virtually all dielectrics and metals are available

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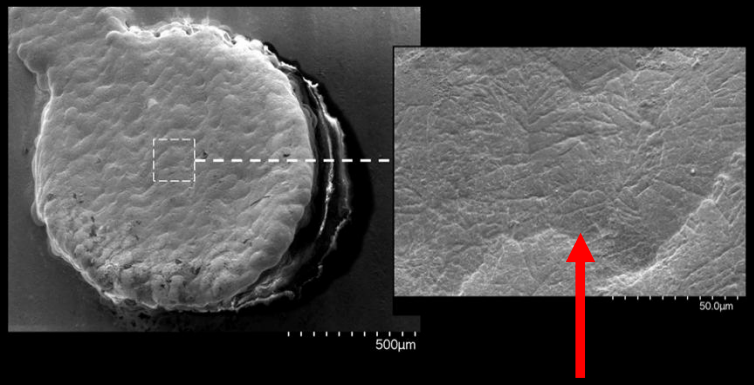

Smooth and dense metal profile resulting from our FLASH 3D PRINTING Technology ✔

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Particle Accelerators

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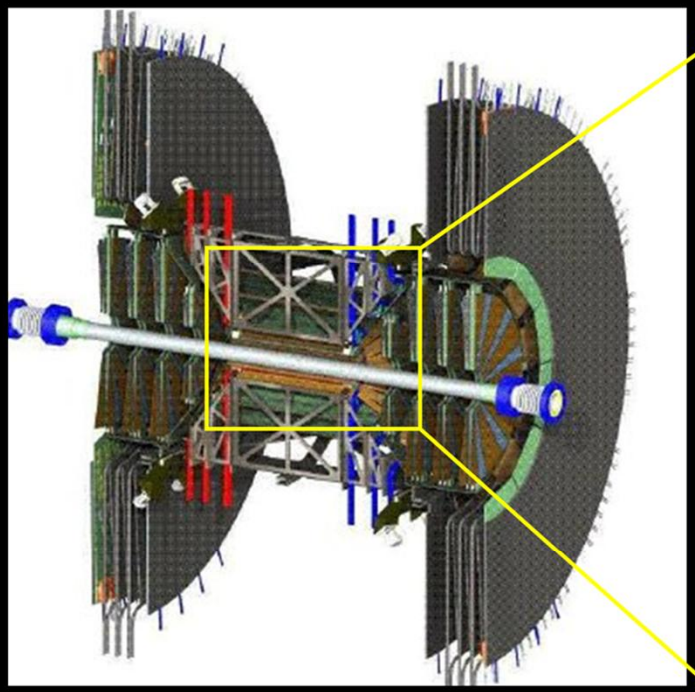

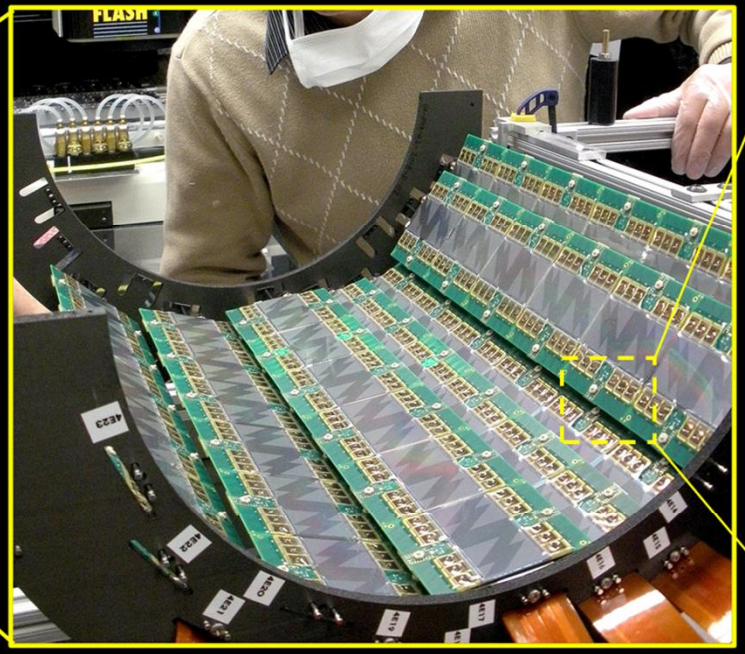

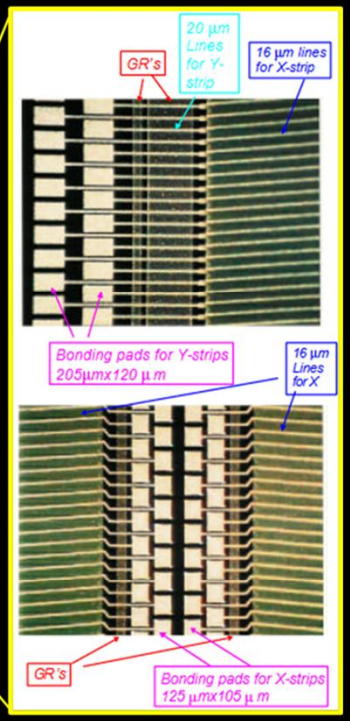

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Problem: Permanent Bonds

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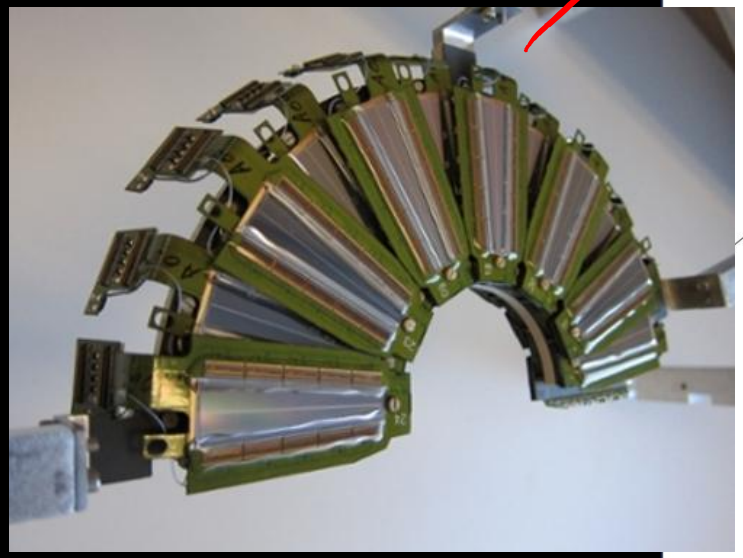

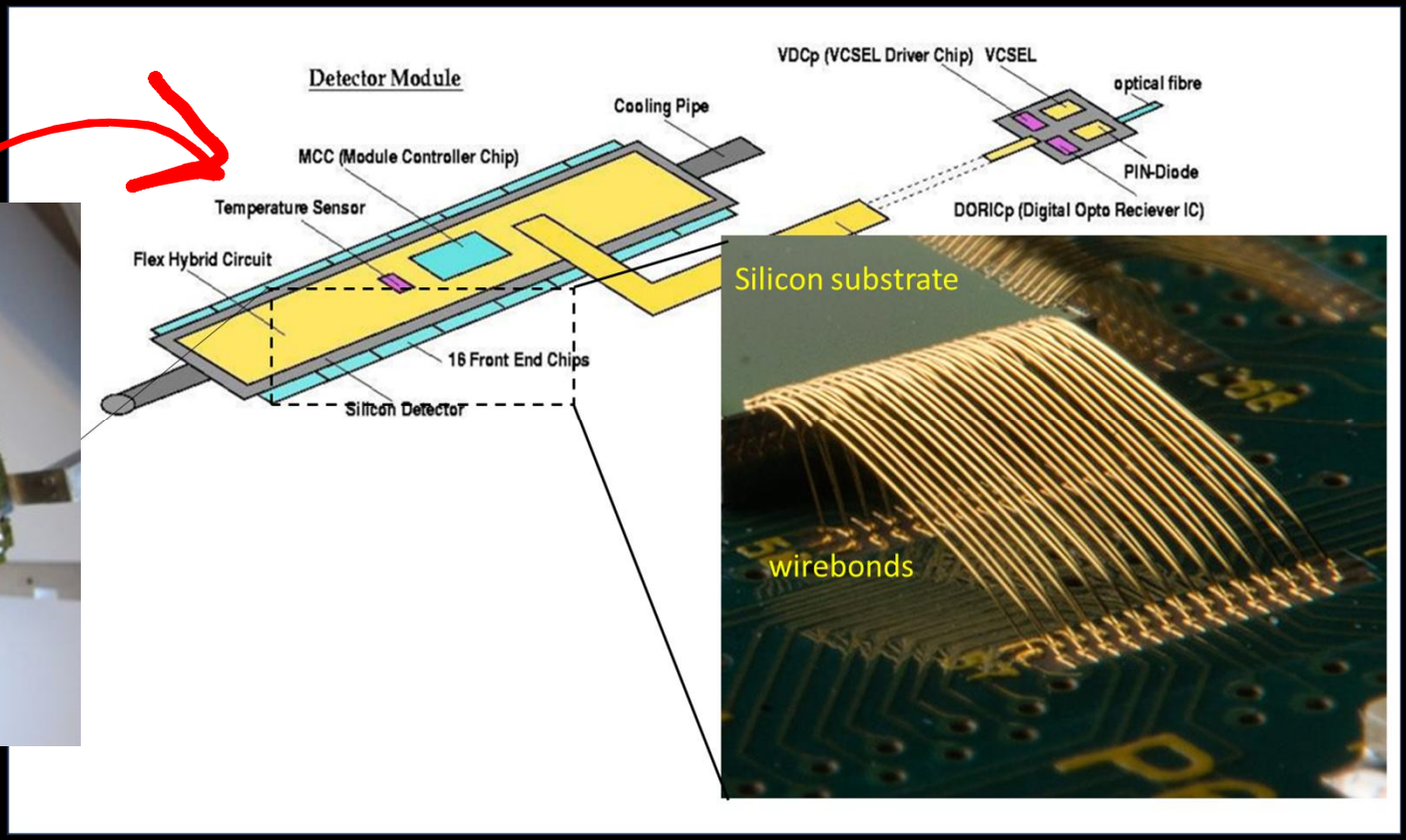

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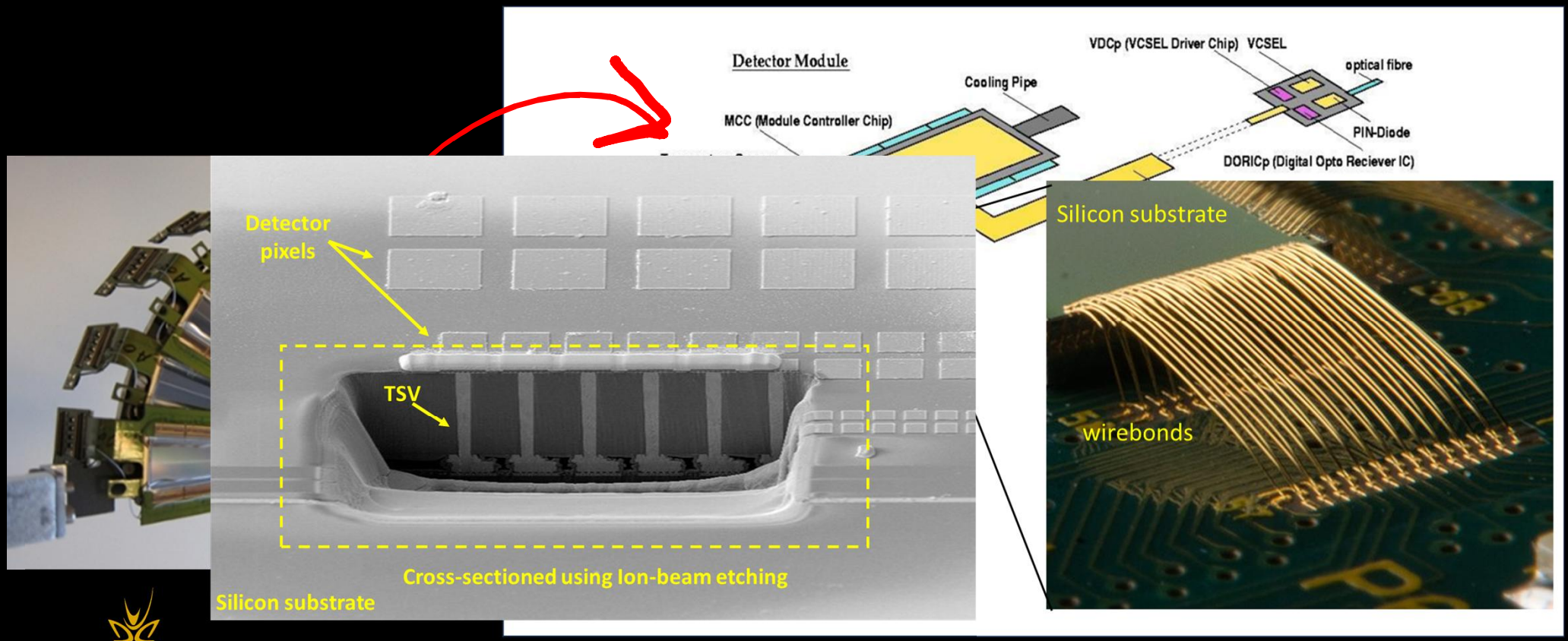
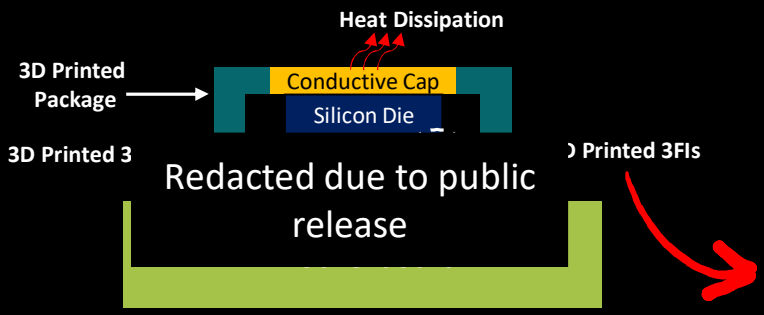
Problem: Permanent Bonds

MICRO 3D SYSTEMS

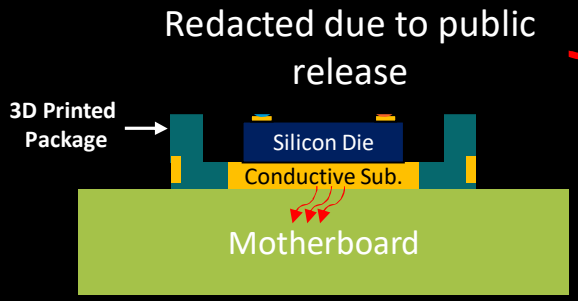


3D PRINTED SiP

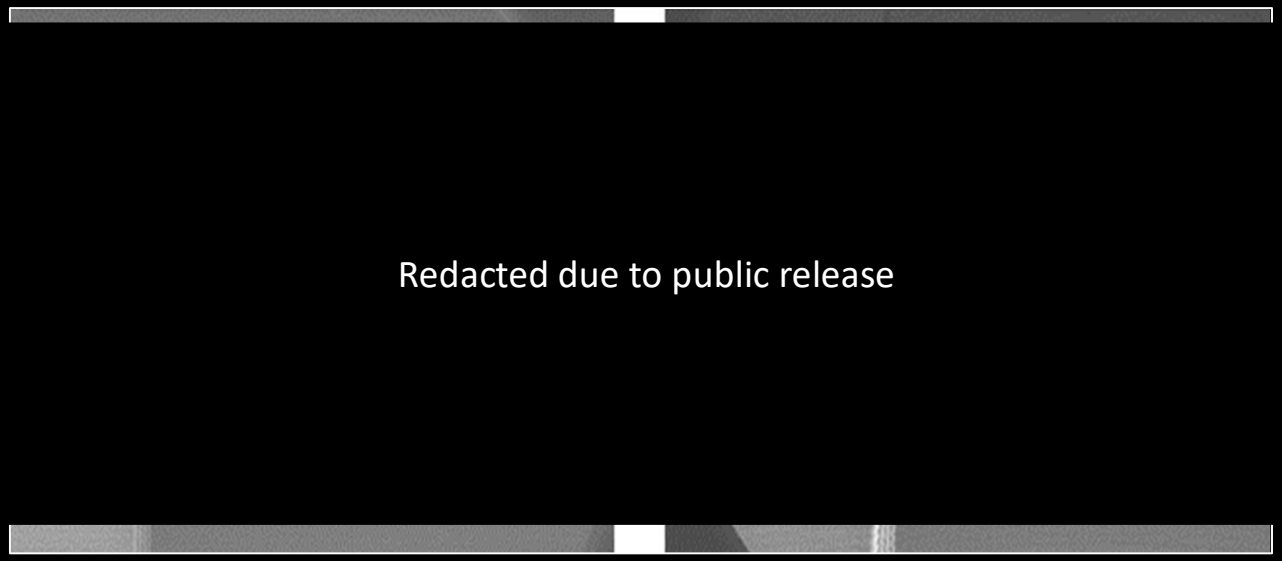
MICRO 3D SYSTEMS



Face-down silicon chip integration



Face-up silicon chip integration



3D PRINTED SiP

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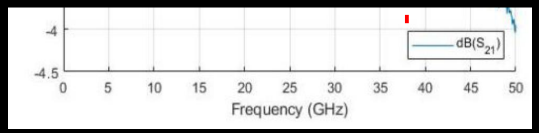
sion line

Redacted due to public release

Schematic of 3D printed SiP package substrate



Low loss 3D printed RF transmission line measurement

DISRUPTIVE ADVANTAGE

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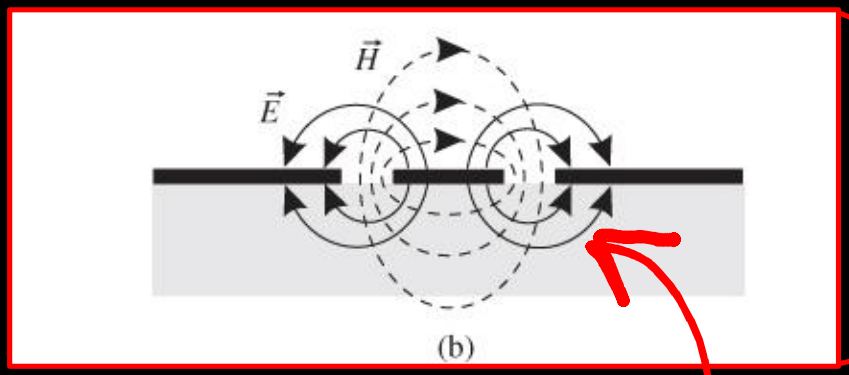
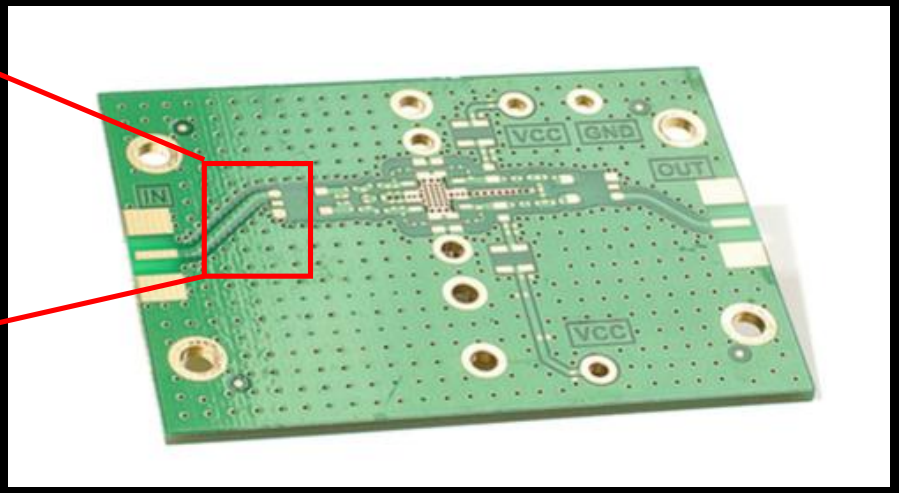
Schematic of the cross-sectional view of a CPW transmission line with a backside ground plane



A conventional PCB for RF systems



Dielectric **loss** via substrate

Significantly impacts power consumption

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DISRUPTIVE ADVANTAGE

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- Reduced dielectric loss
- Reduced Power consumption

Combination of low loss 3D printed RF transmission lines and 3D printed
= Previously unattainable performance metrics

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3D PRINTED RF ELEMENTS

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and matching elements

band antenna arrays

rigid circuit boards

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PRODUCTS

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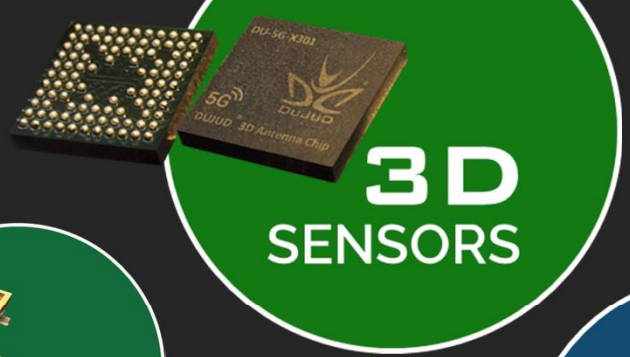
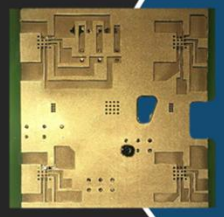


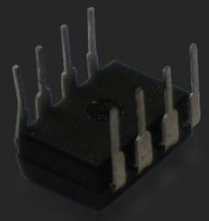
3D SENSORS

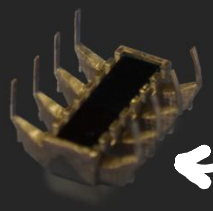
3D PASSIVE ELECTRONICS



3D CIRCUIT BOARDS

LEGACY DIP ELECTRONIC CHIP





3D PRINTED DIP ELECTRONIC CHIP

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NEW R&D CENTER

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FOLLOW-UP QUESTIONS

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Thank you!

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