PBGA & QFN

FCBGA/3D Stack TC/TSC Evaluation

by

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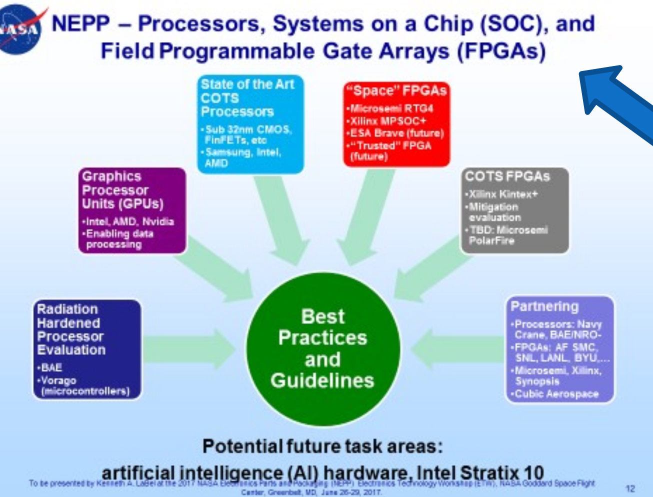
http://nepp.nasa.gov

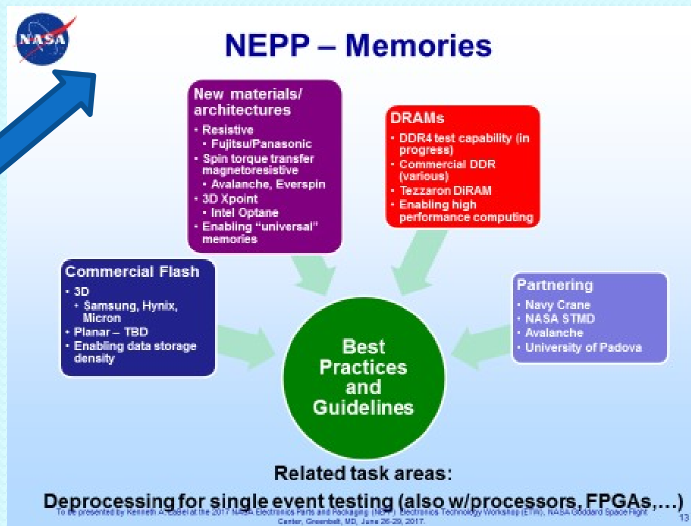
PBGA & QFN

- PBGA TC Evaluation
  - Numerous BGA packages
  - WLP assembly challenge
  - Standard 3D stack
  - High I/O flip chip BGA, 2.5D (passive interposer)
  - Accelerated testing/failure mechanisms
  - PCB finish effect
- QFN evaluation
  - Various QFN package sizes
  - Effect of conformal coating
  - Accelerated TSC/TC testing
- TMV/2.5D/TSV
  - TMV test vehicle and build
  - Interposer 2.5D test vehicle build
  - TSV daisy-chain test approach

FCBGA/3D TC Reliability

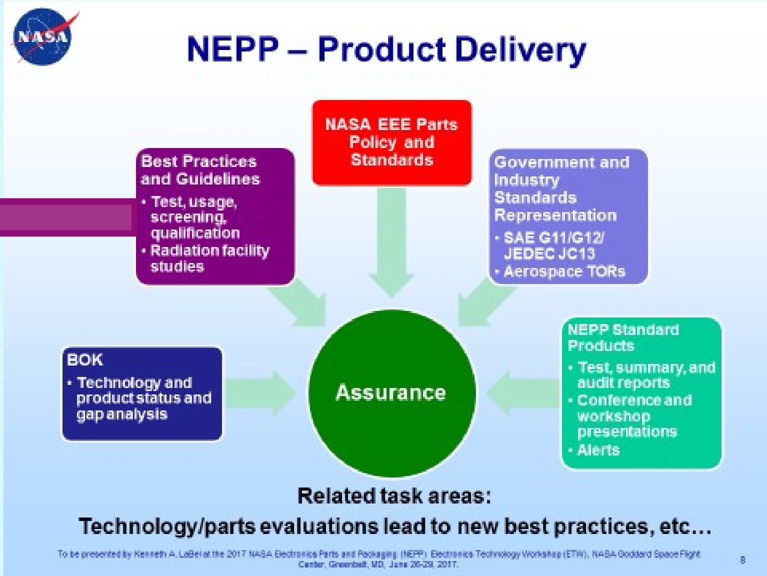


Guideline with Test Results NEPP Website



Best Practices and Guidelines

- Test, usage, screening, qualification
- Radiation facility studies



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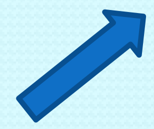
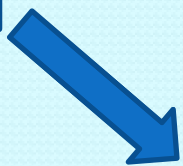
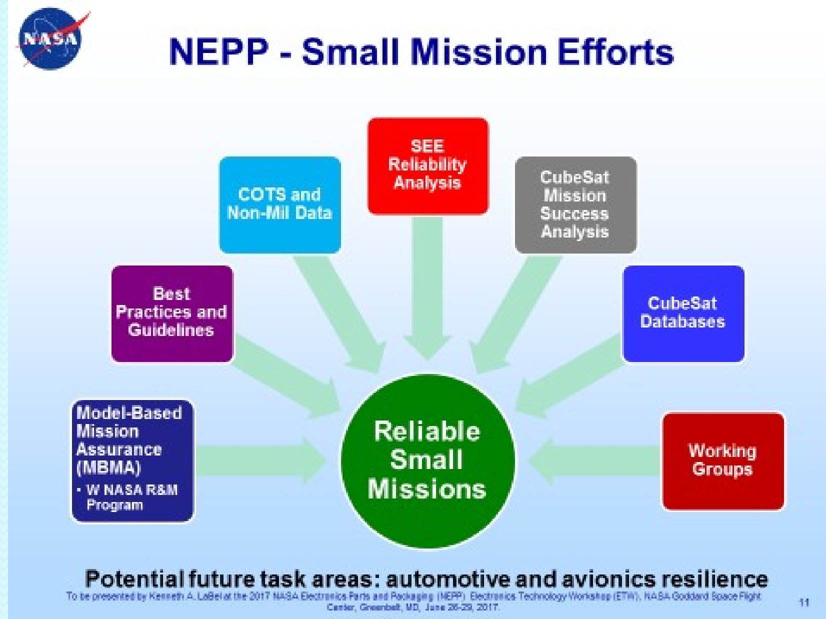
QFN TC Reliability

BOK
Guideline
Test Results
NEPP
Website







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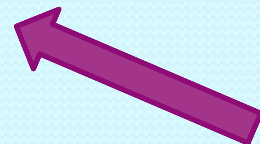
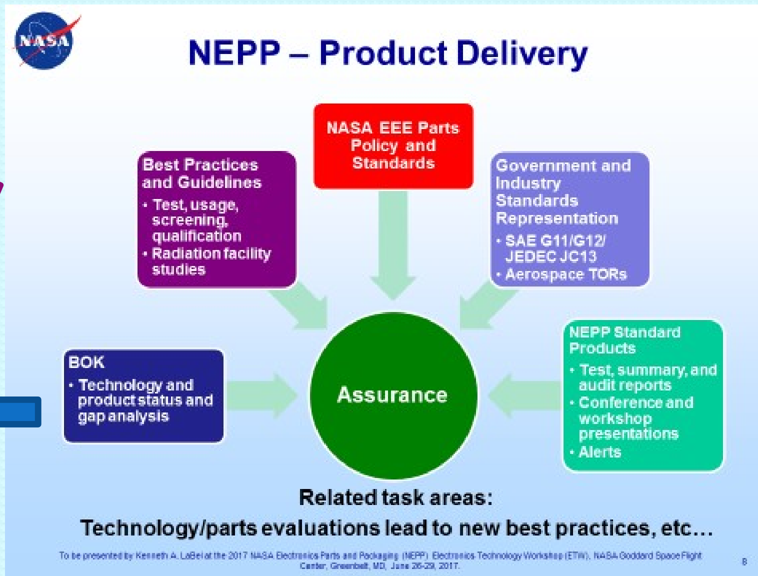
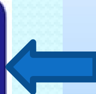


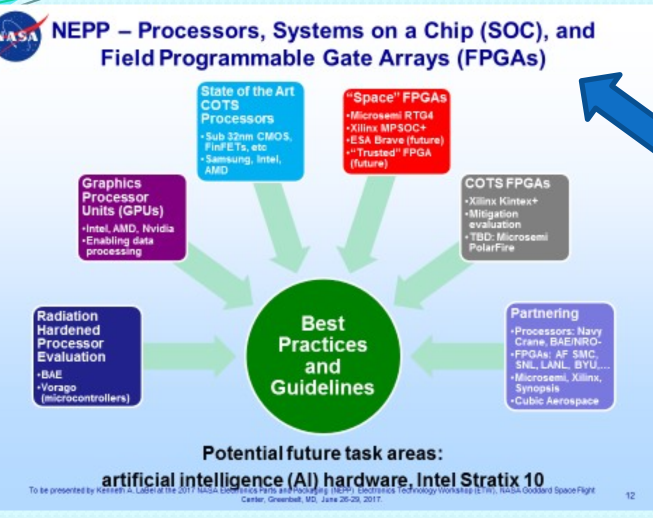


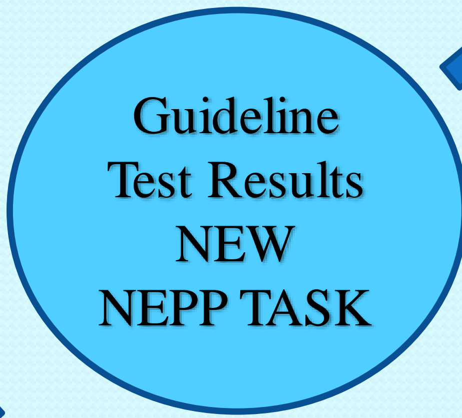


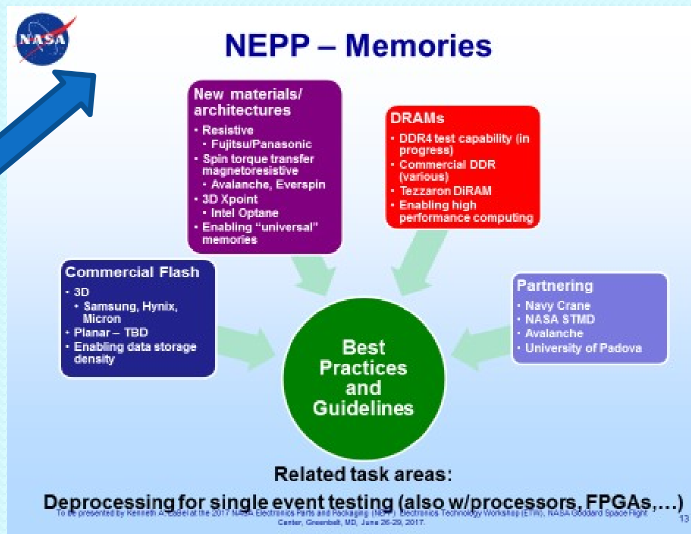
BOK

- Technology and product status and gap analysis

TMV/TSV TC Reliability







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- Test, usage, screening, qualification
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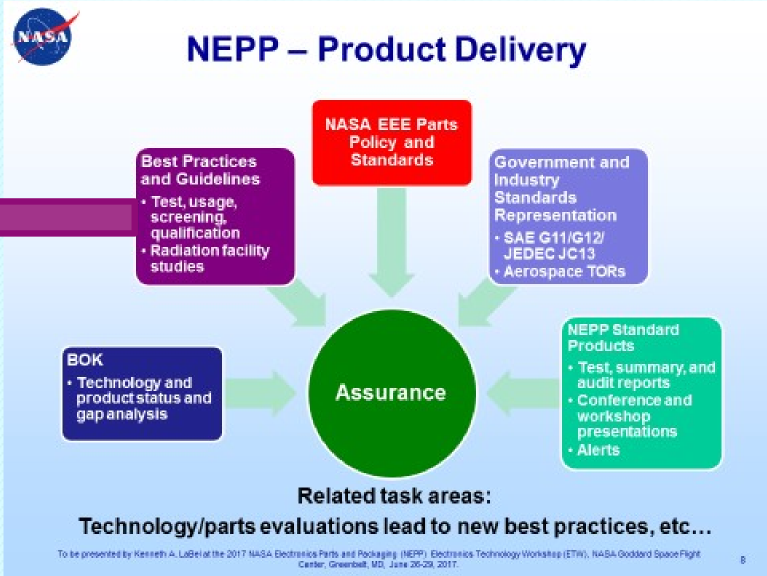
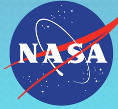
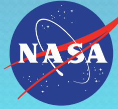




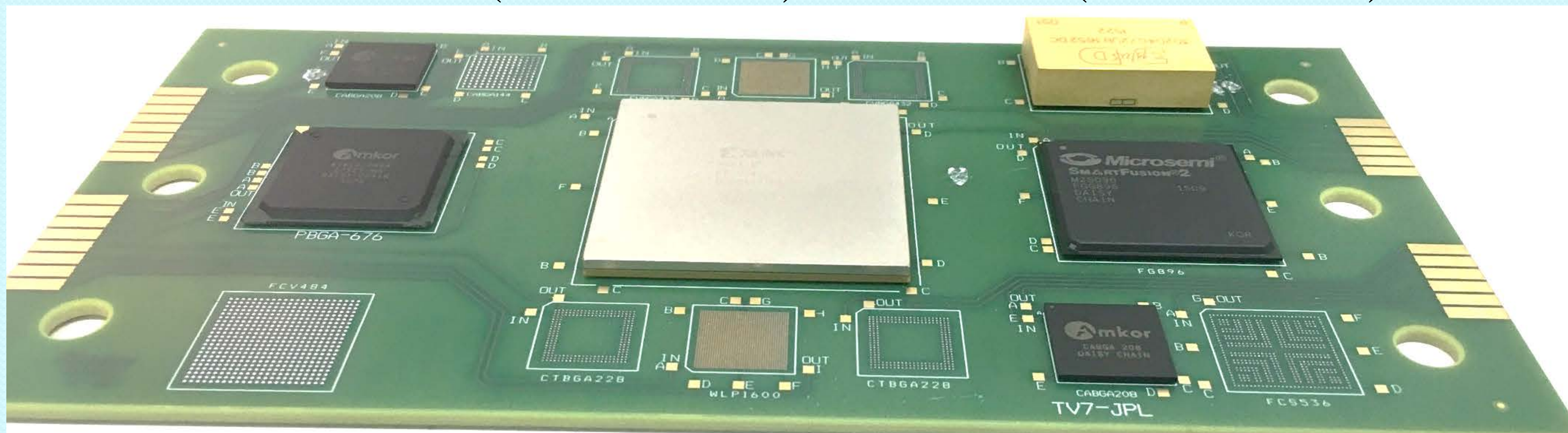
Outline

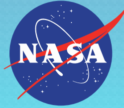
- Reliability
  - FCBGA/PBGA/WLP
  - 3D stack
- PCB Finish
  - HASL for SnPb
  - ENEPIG for WLP and FPGA
- Reliability Results
  - 200 Thermal cycles
  - 200 Thermal shock cycles
  - X-ray, optical & X-section/SEM images
- Summary



PBGA/3D Stack Packages

- Designed test matrix
- Select high I/O PBGA/FCBGAs and FPGA & 3D stack daisy-chain package for solder joint reliability and monitoring
- Selected two PCB finish (HASL/ENEPIG) with traces either on top or one layer under with microvia interconnections
- Successfully assembled TVs both single- and double- sided
- Performed QA evaluation followed by reliability testing
- Performed 200 TC (-55°C/100°C) or 200TSC (-65°C/150°C)





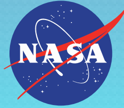
PBGAs/3D Stack

- PBGA pitch from 0.4 mm to 1.27 mm
- 3D stack, 1mm pitch
- WLP, 1600 balls, 0.3 mm pitch

191 Balls Stack 1.27 mm pitch

896 Balls 1 mm pitch

208 Balls, 0.8 mm pitch



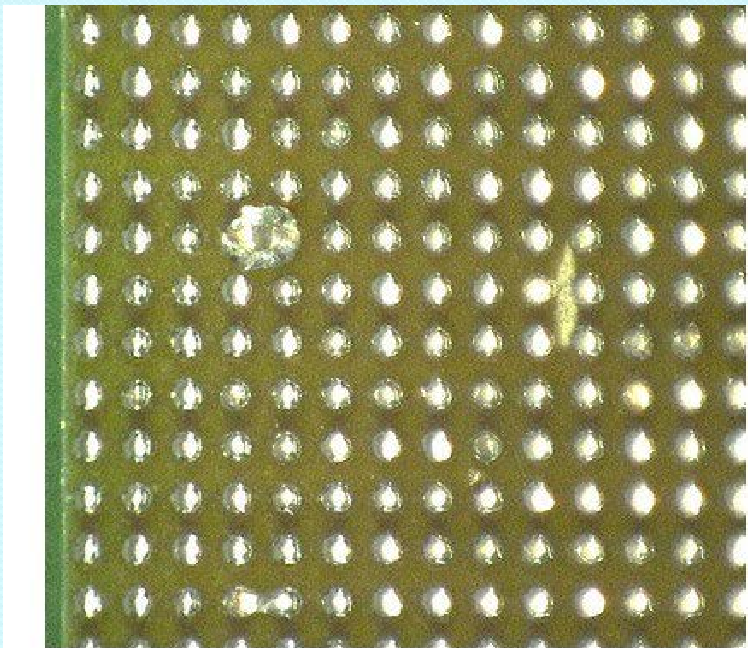
PCB Design

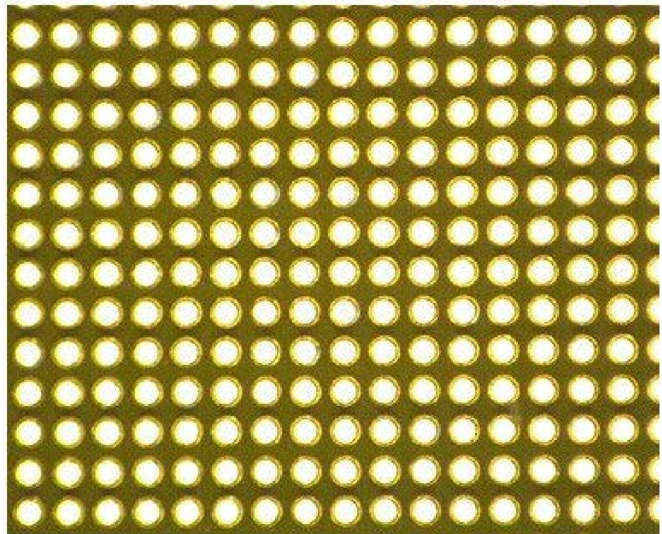
ViP

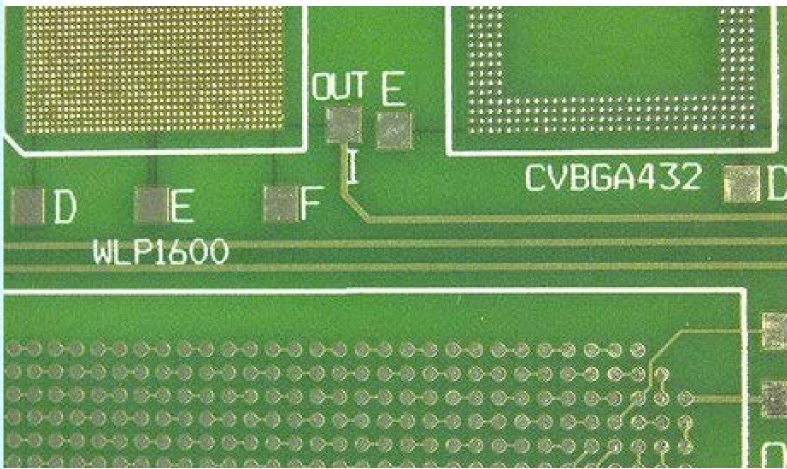
ViP

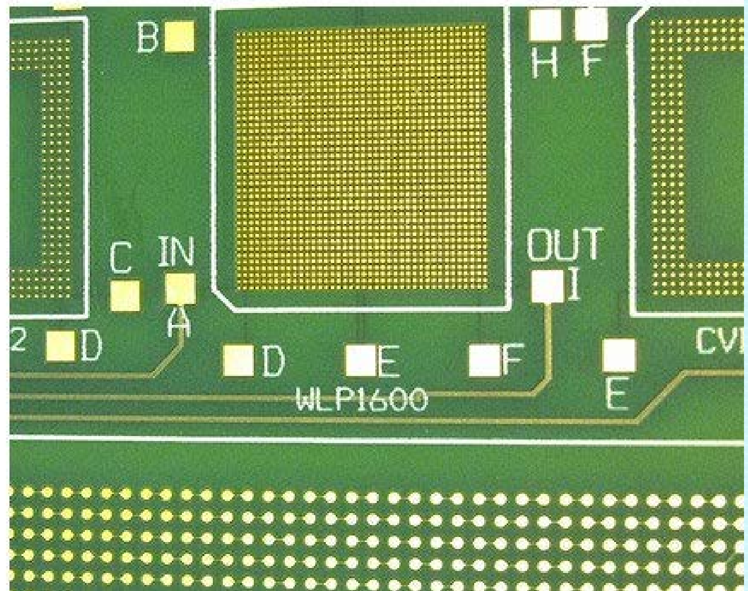
ViP

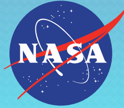
HASL vs ENEPIG



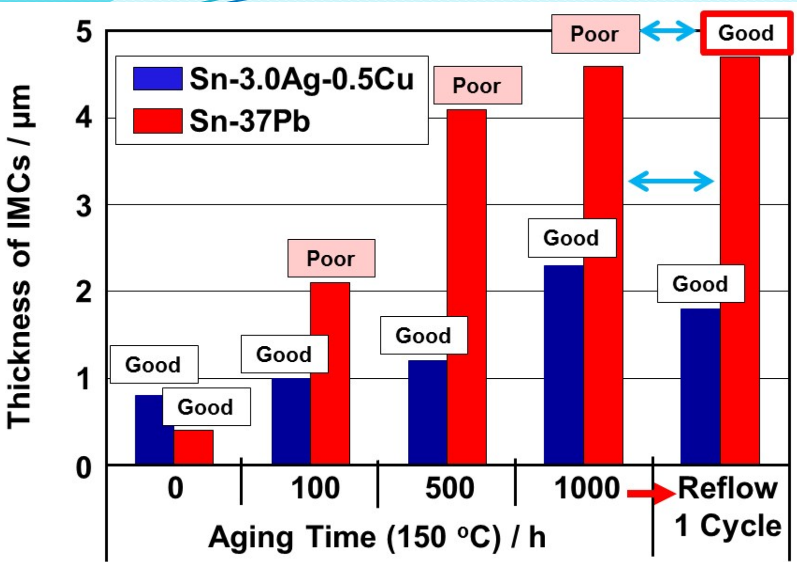




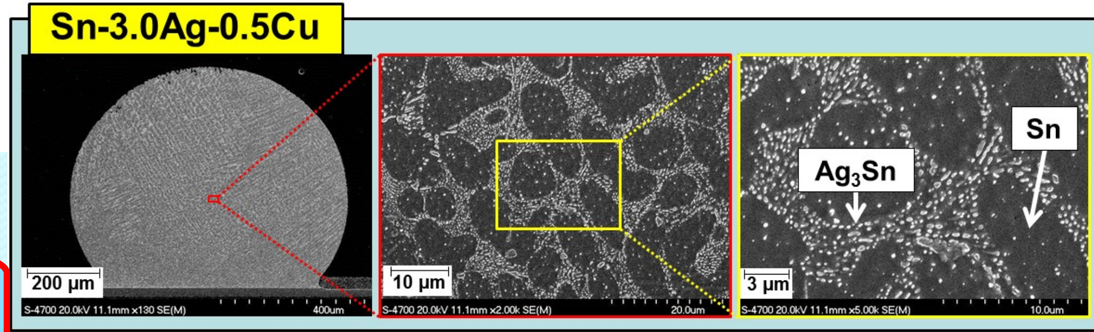


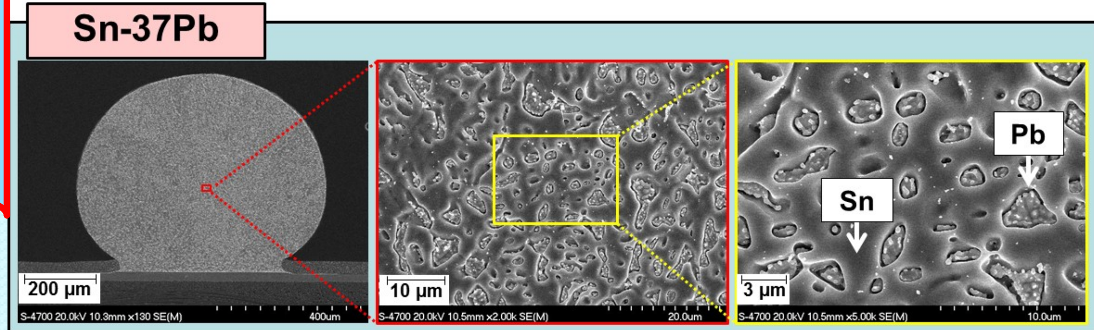


SnPb or SAC on ENEPIG

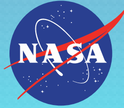


A PCB with "corrosion spikes" on Ni layer.
The IMC layer spalled off
Tegehall-ESA





ENEPIG/SnPb is NOT recommended for high T use
Milad-Uyemura

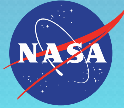


3D Stack

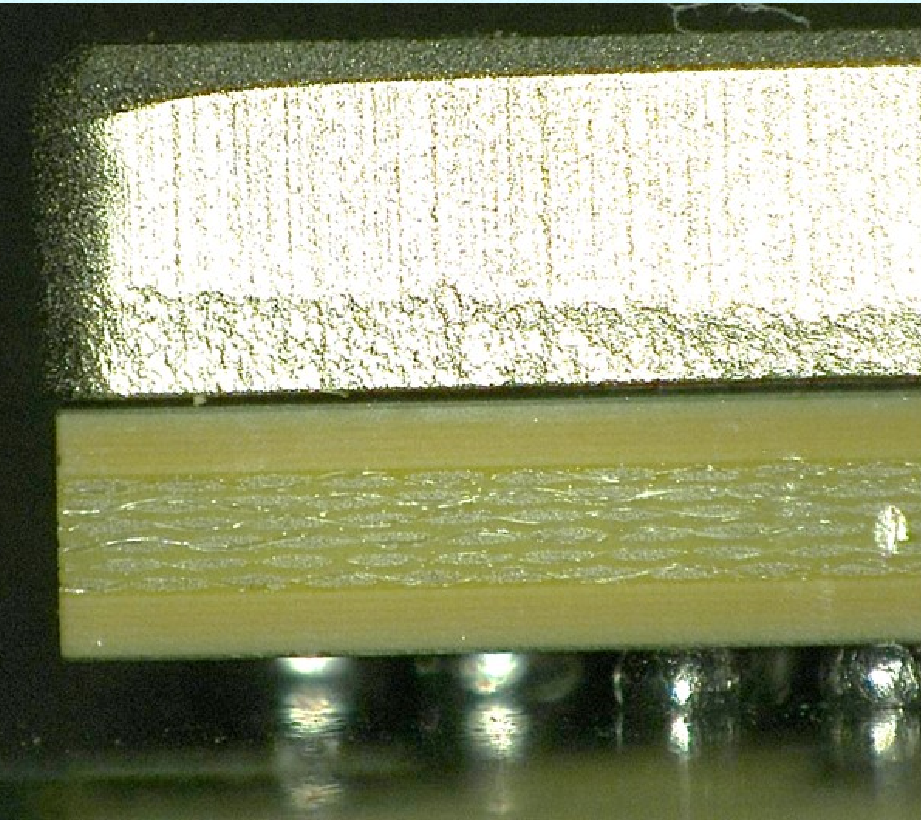
Single-sided

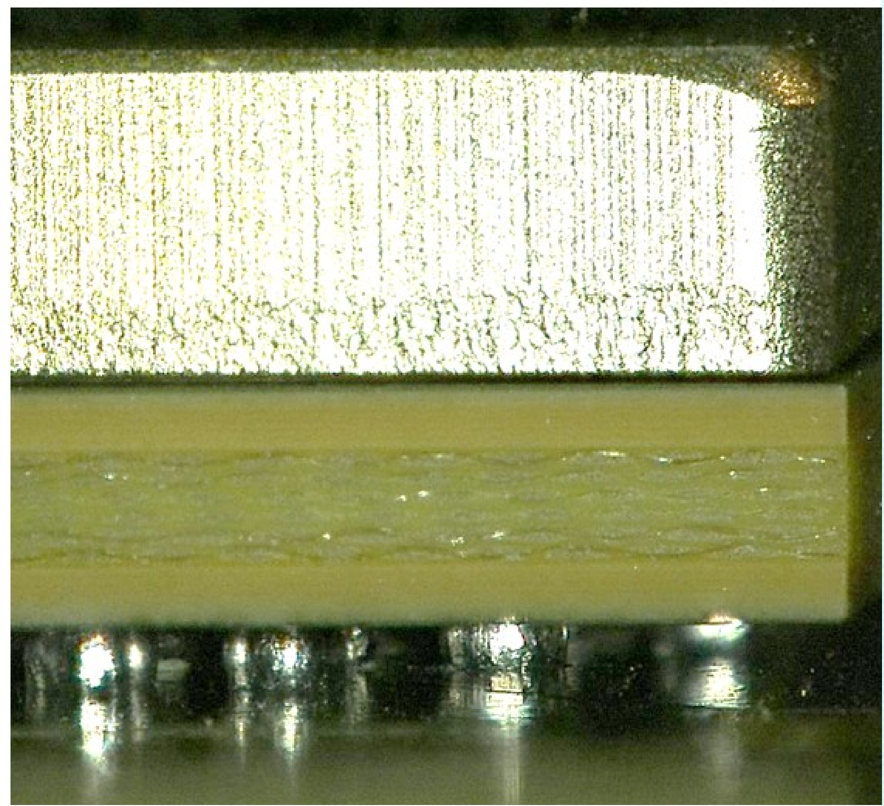
3D Stack

Double-sided



FCBGA 1924





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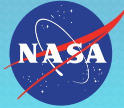
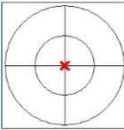


Jet Propulsion Laboratory
California Institute of Technology

X-ray 3D Stack

Single-sided

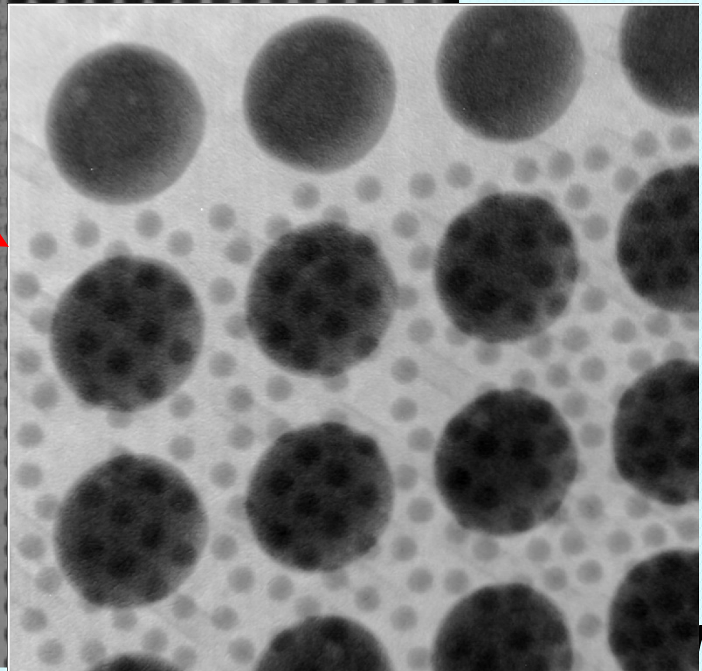
5.0mm

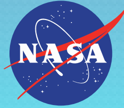


Tube voltage: 105 kV
Tube power: 1.98 W
Filter method used: None
Averaging: 64 frames

X-ray FCBGA 1924 I/O

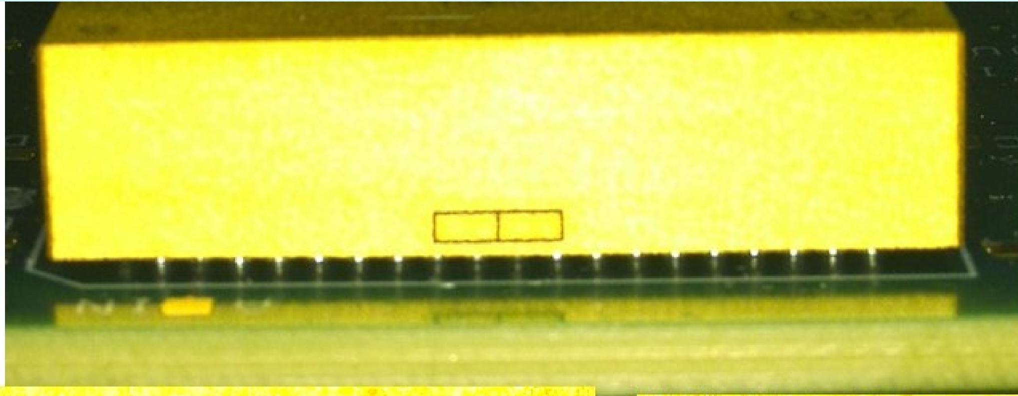
FCBGA 1924

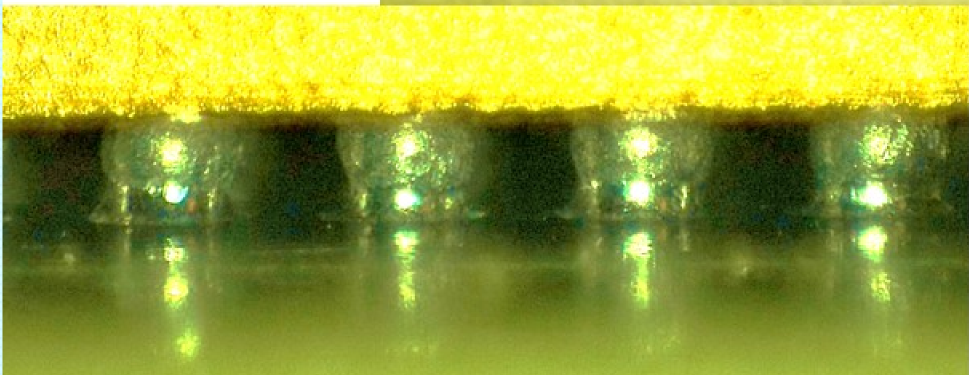


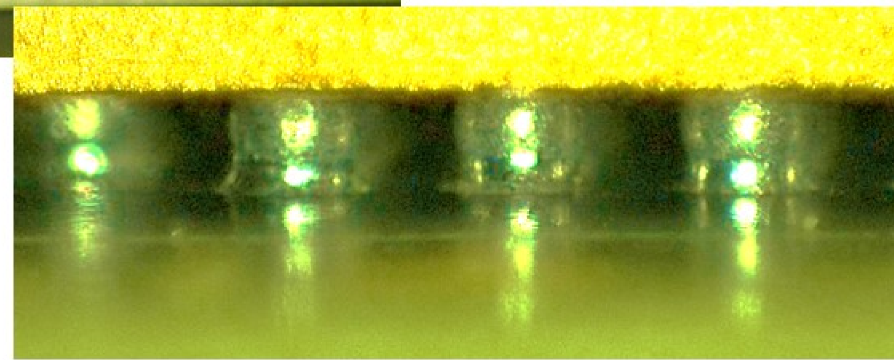


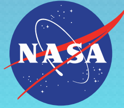
3D Stack

200TC (-55°C/100°C)



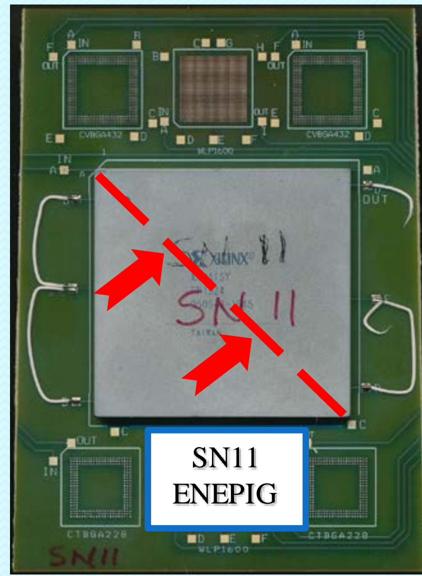


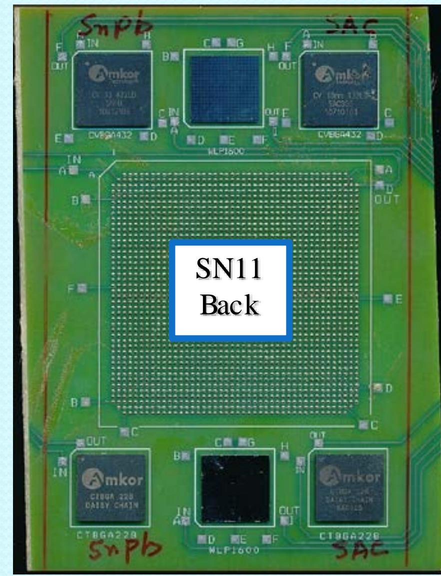


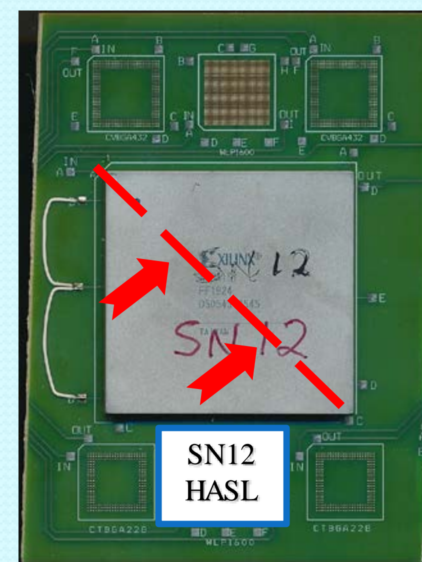


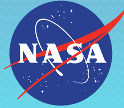
FCBGA 1924

200 TSC(-65°C/150°C)

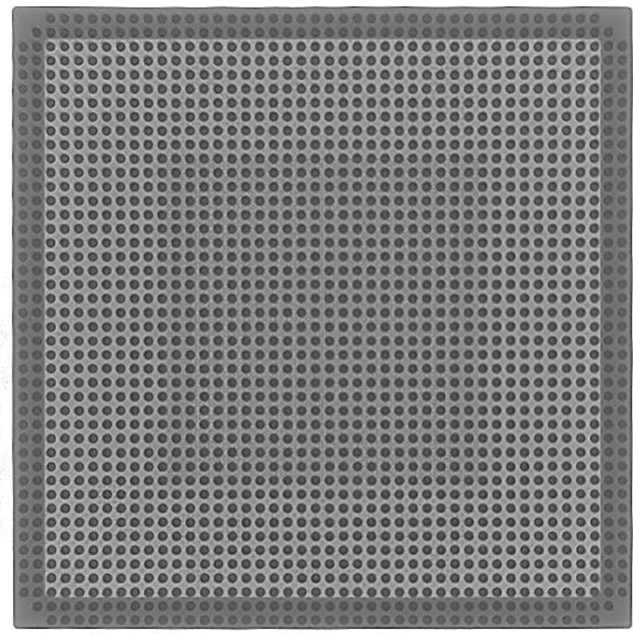


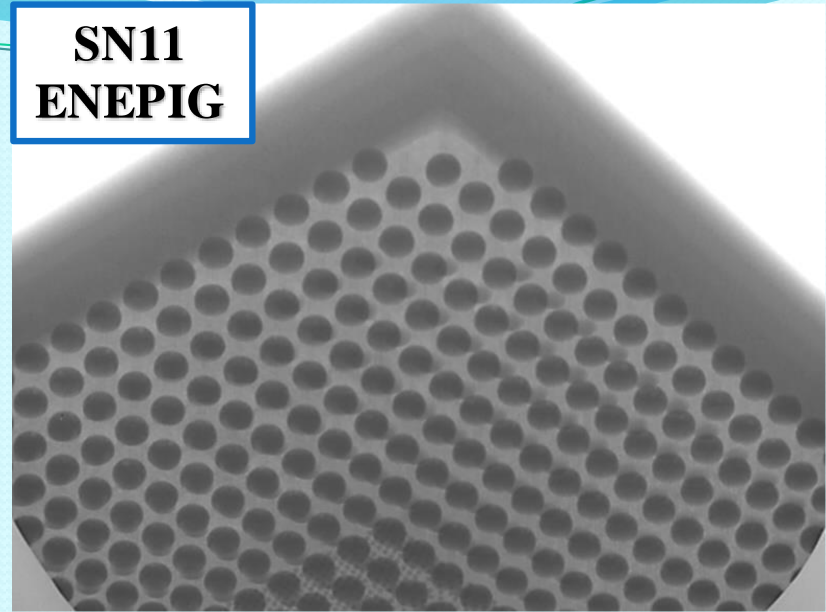


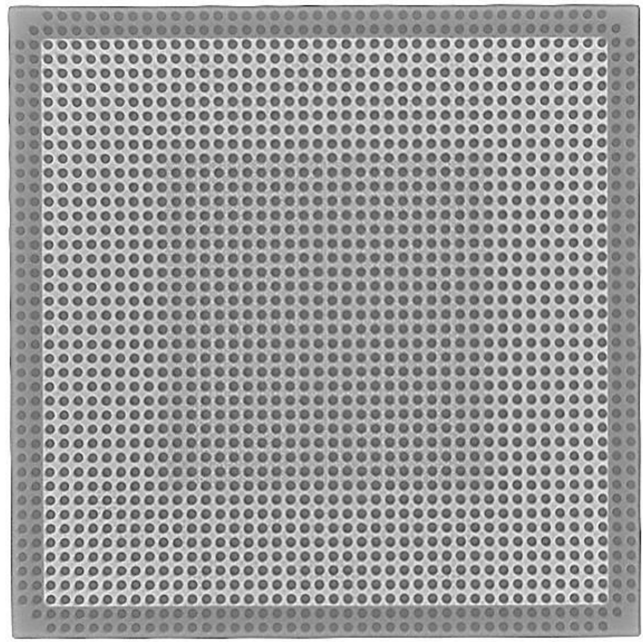


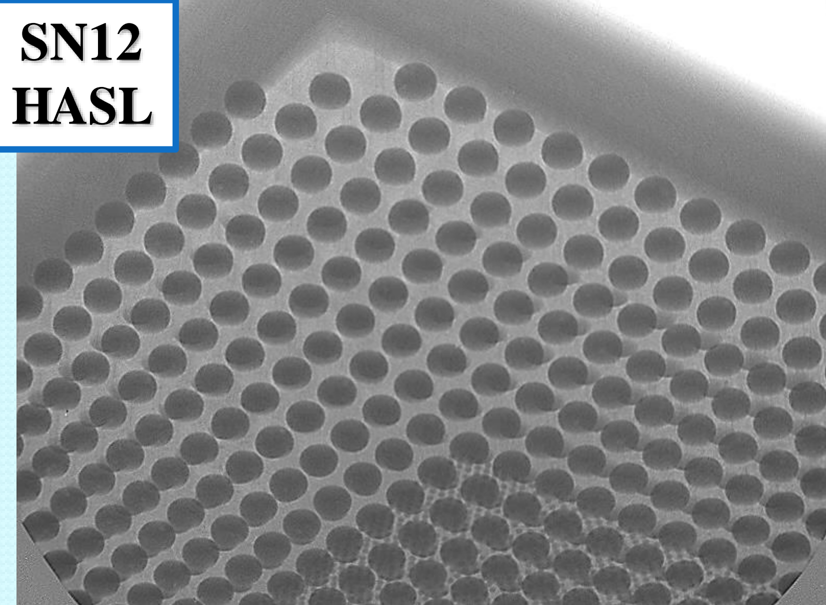


X-ray FCBGA 1924

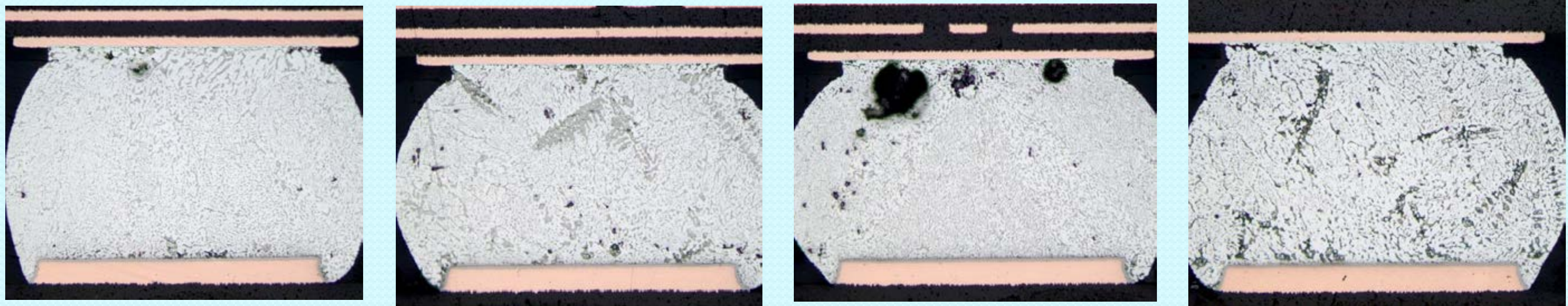




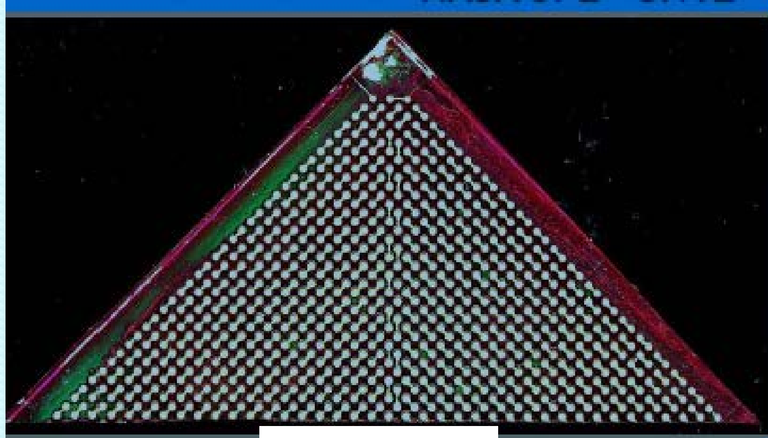


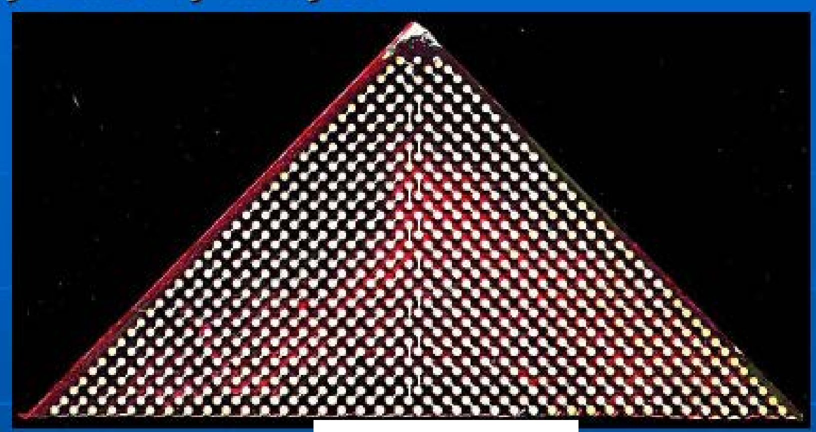


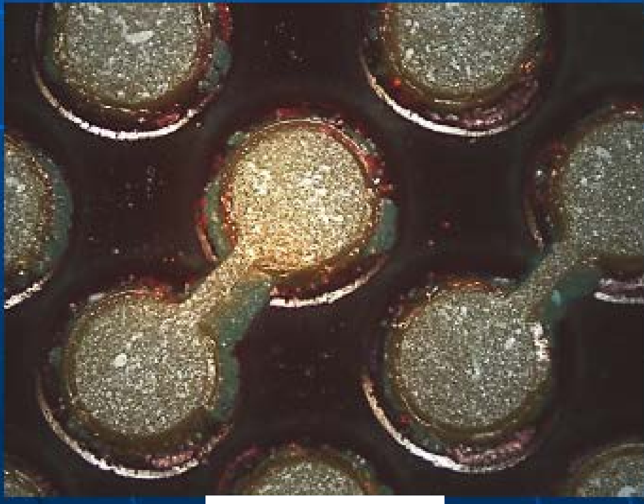
FCBGA 1924 on ENEPIG 200 TS (-65/150°C)

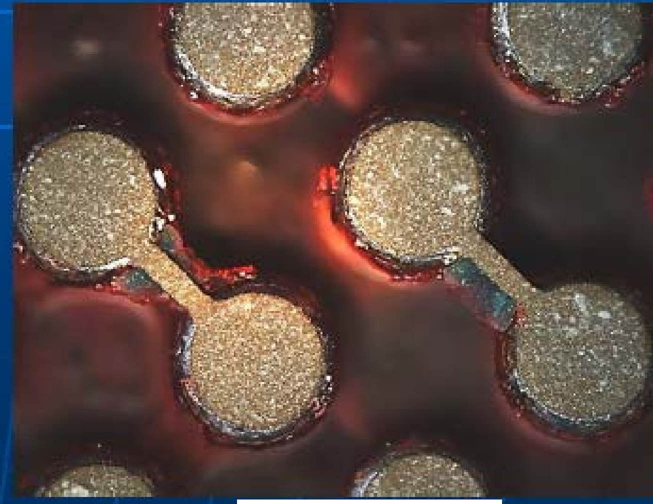


FCBGA 1924 on HASL
200 TSC (-65°C/150°C)


PCB Pads

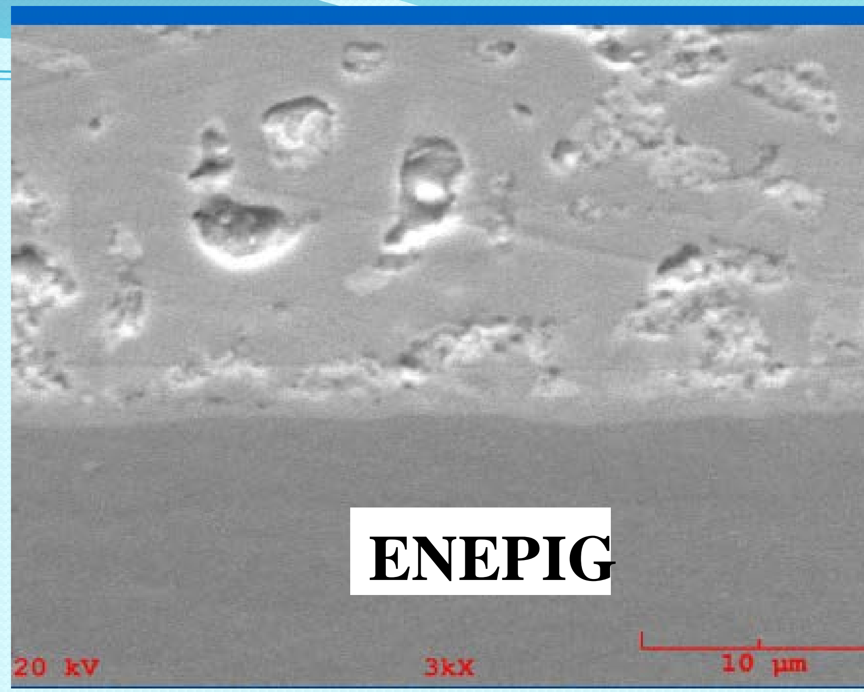

BGA Pads

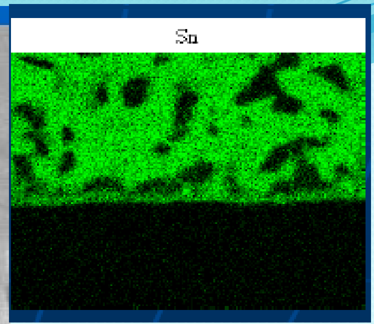

PCB Pads

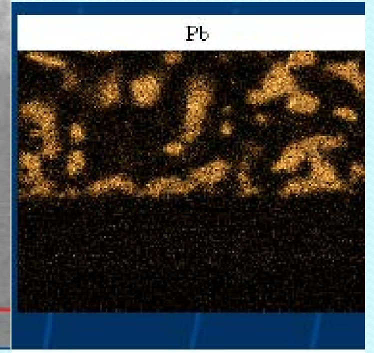

BGA Pads

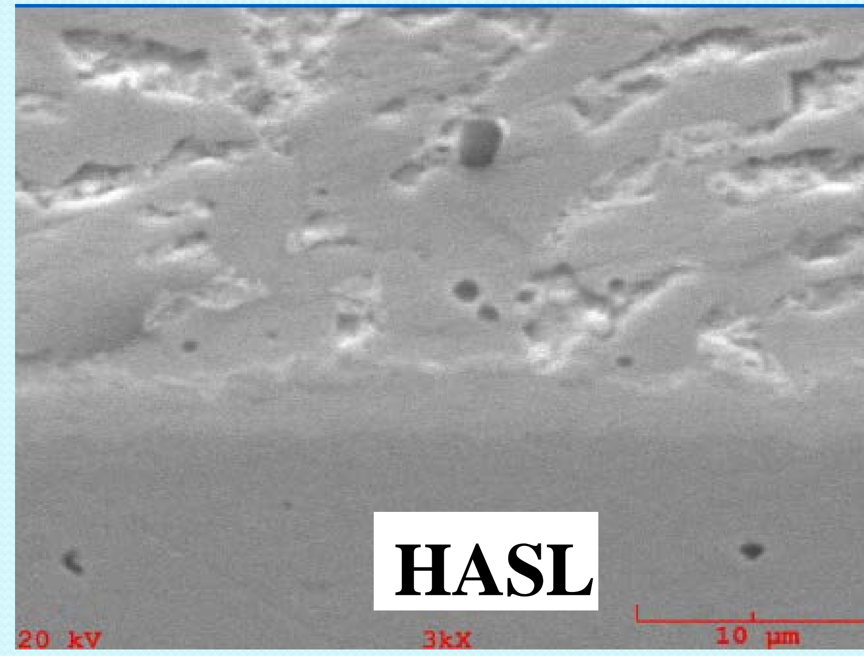
No defective solder connections were found.

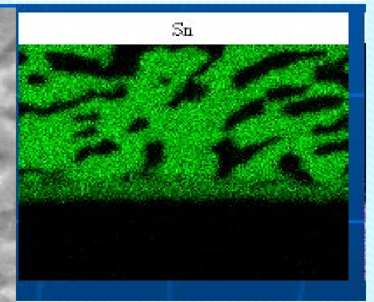
SEM/EDS FCBGA 1924 ENEPIG HASL

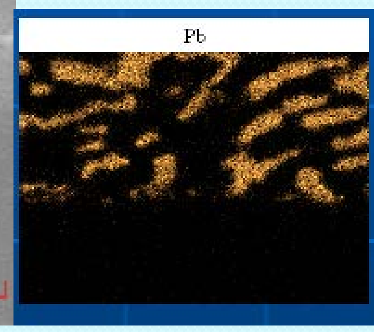












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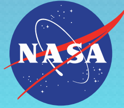
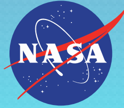


Summary

- Released NEPP report
  - **https://nepp.nasa.gov/**
  - Evaluated FCBGA, FPBGA, 3D Stack, and more
  - PCB finish
    - HASL/ENEPIG
- 3D Stack/FPBGA1924
  - 200 TC (-55°C/125°C) on ENEPIG
    - No failures of 3D stack/FCBGA
  - 200 TSC (- 65°C/150°C)
    - No failure of FCBGA 1924
    - Failure of FPBGA from package sites
- Evaluate further when funded



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Thank You!