Acoustic Emission & Printed Electronics

by

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Outline

- Acoustic Emission
  - Visual vs AE & X-ray vs AE
  - AE and X-ray of LGA and flip-chip CGAs
  - Microsection verification
  - Summary-AE
- Printed Electronics Technologies
  - PET definition, Mix of Technologies
  - PET vs Conventional
  - OE-A and iNEMI Roadmaps
  - Summary - PET

Visual Vs C-SAM

Visual Inspection

Excellent for exposed solder joints inspection including de-wetting, cold solder, contamination, stress marks

No inspection of hidden features, flip chip solder, underfill voids, delamination, FCGA/CGA

C-SAM Inspection

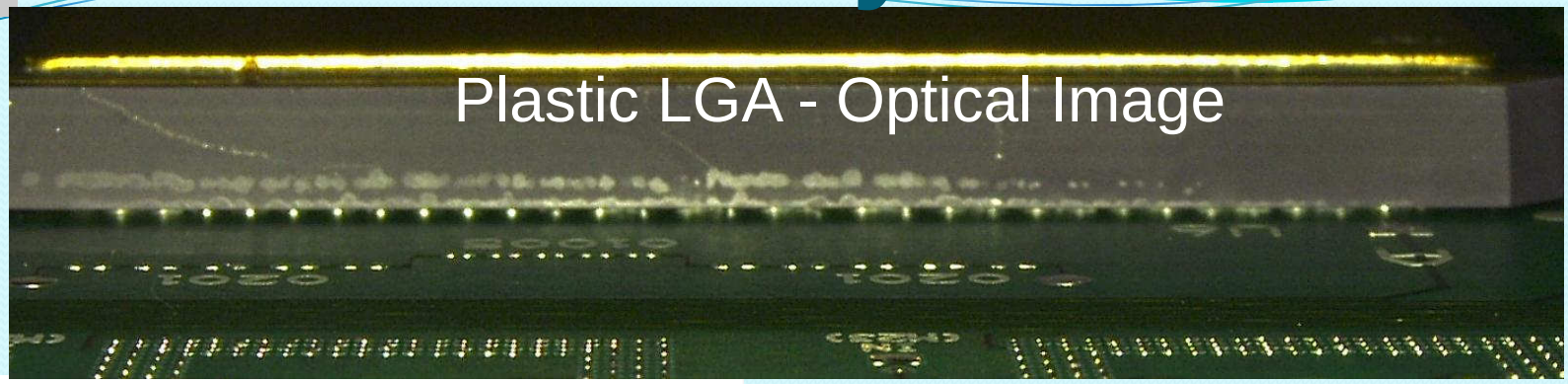
Excellent for hidden defects

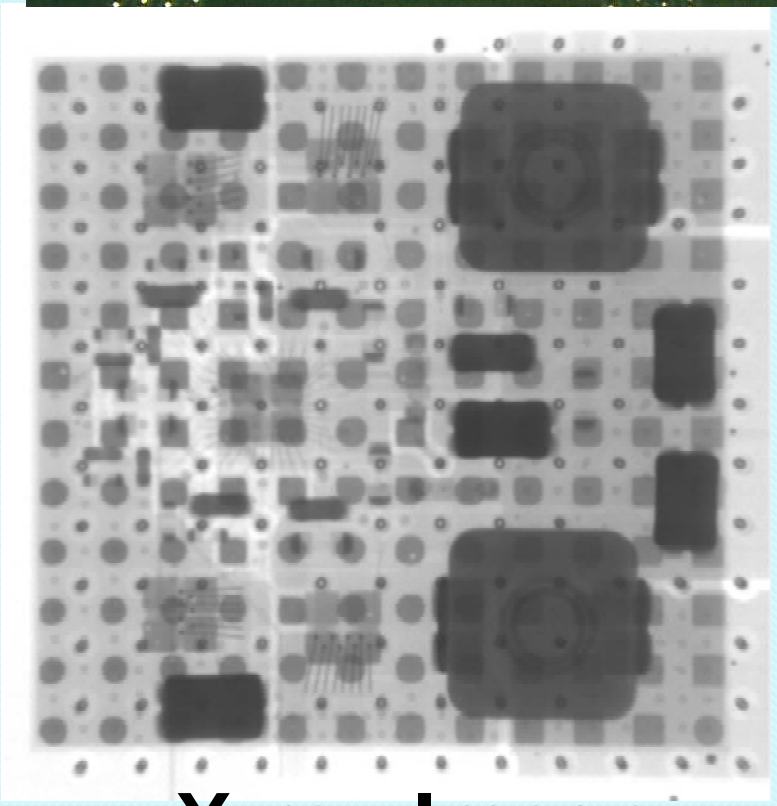
Delamination/voids /crack

Cannot detect features when interference with AE signal

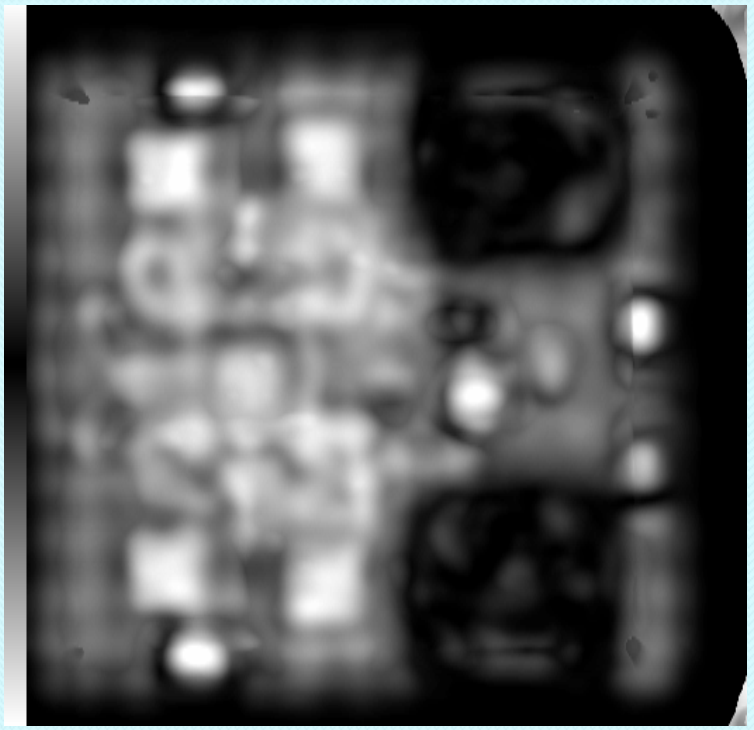
C-SAM needs to be inserted into water

P-LGA X-ray/C-SAM



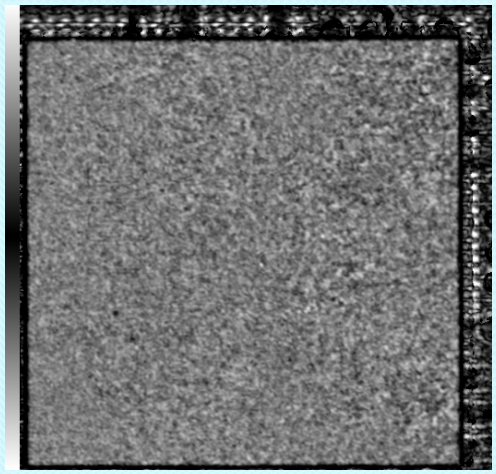


X-ray Image

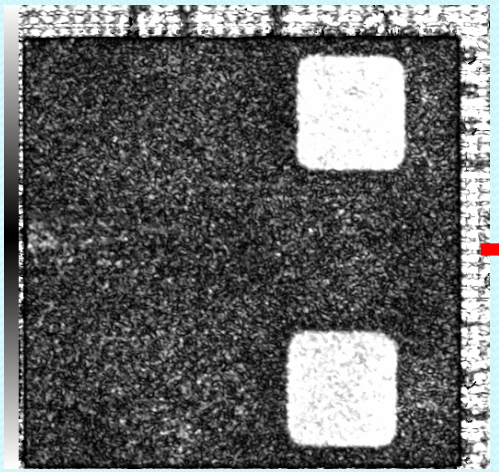


C-SAM Image- 5 MHZ

Layering C-SAM P-LGA



25 MHZ –A TOP



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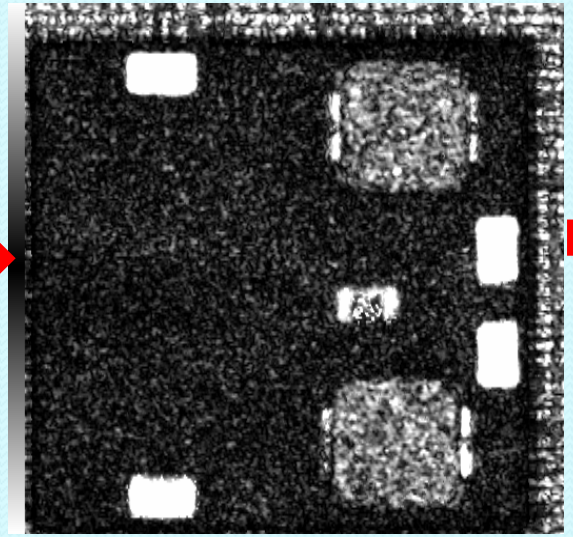
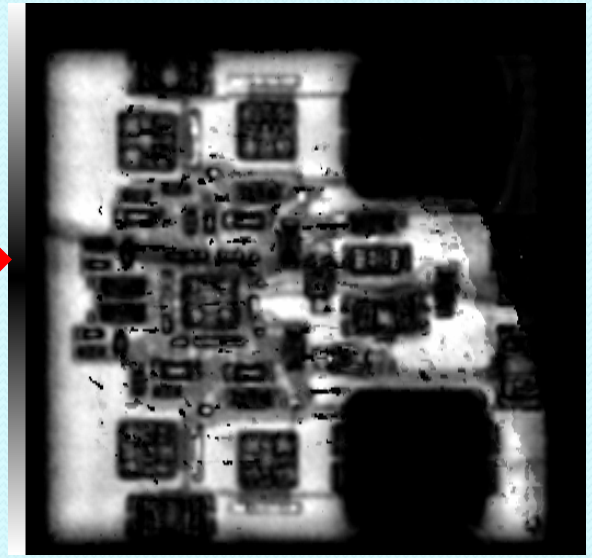


25 MHZ -C



25 MHZ -D

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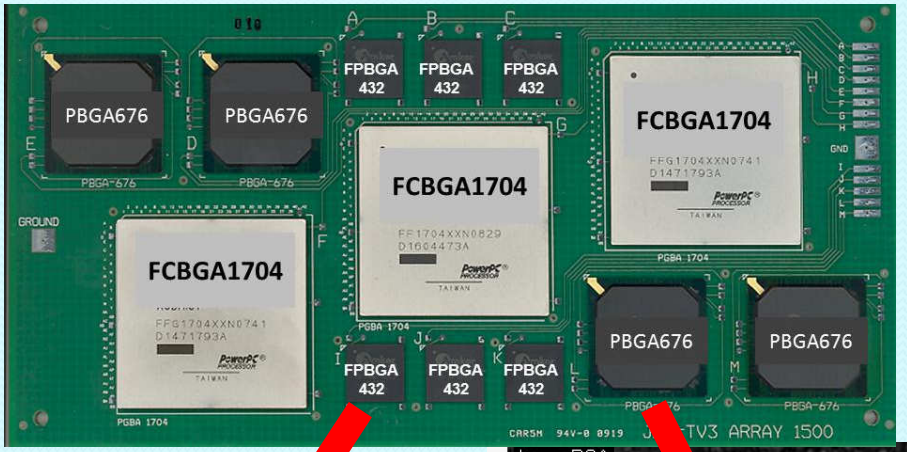
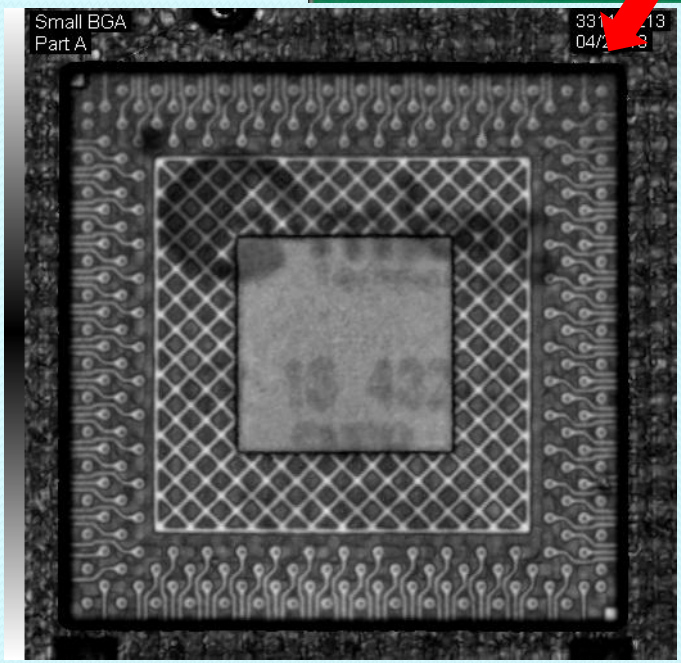
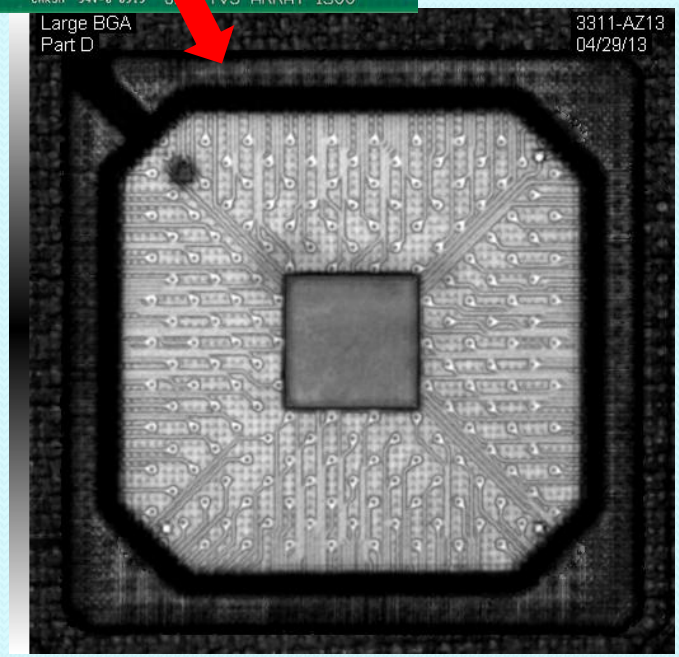
C-SAM PBGA Samples



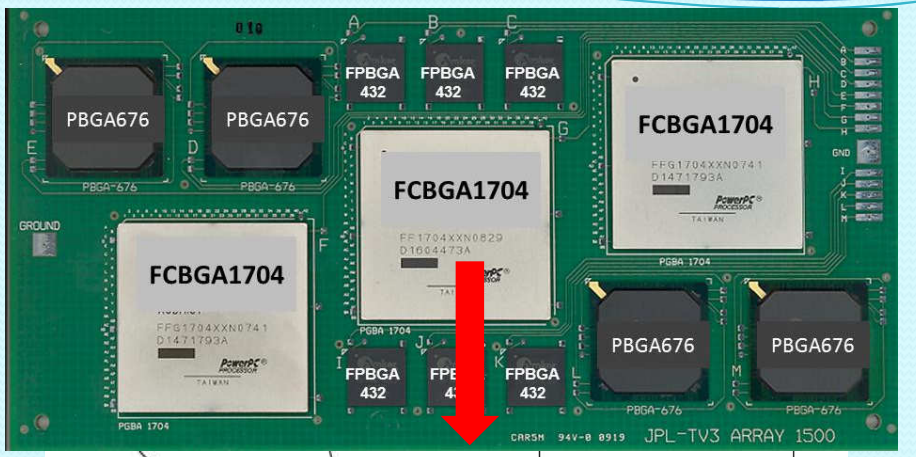


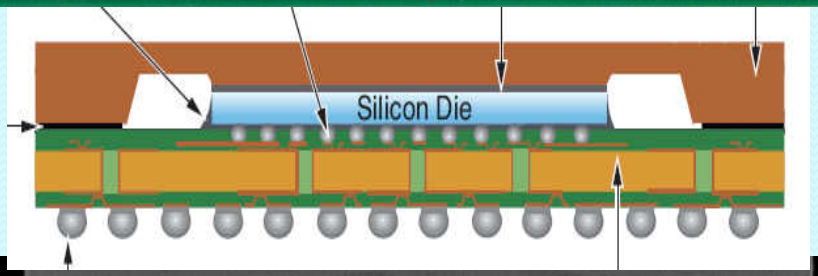
SN11 Part A- PBGA 432

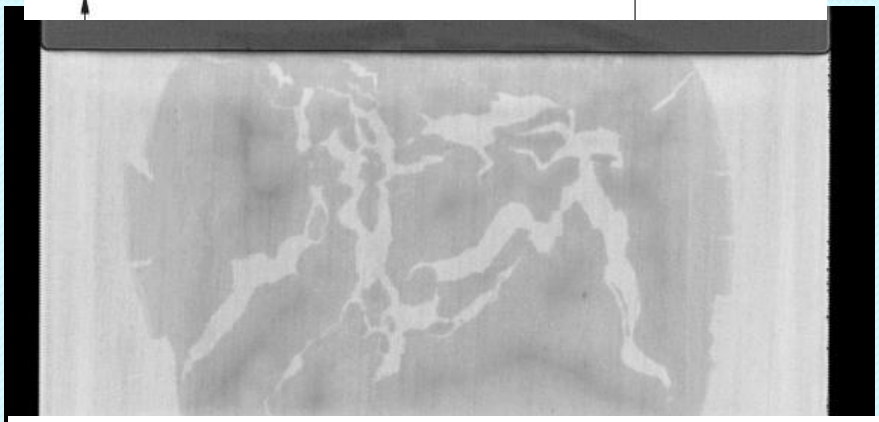


SN11 Part D- PBGA 676

C-SAM FC-BGA



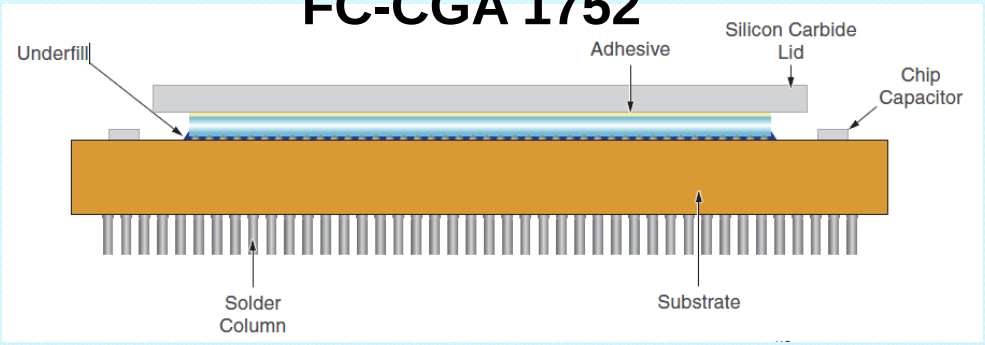


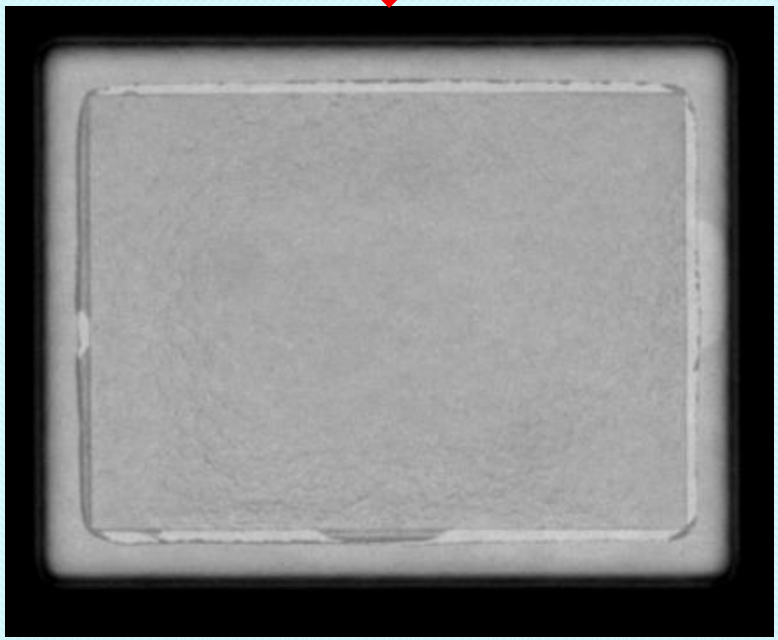


C-SAM Image-Heat Sink Interface

C-SAM FC-CGA

FC-CGA 1752





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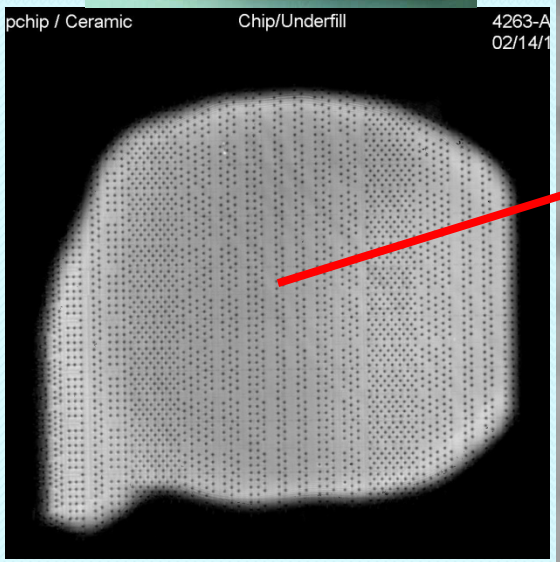
C-SAM FC-CGA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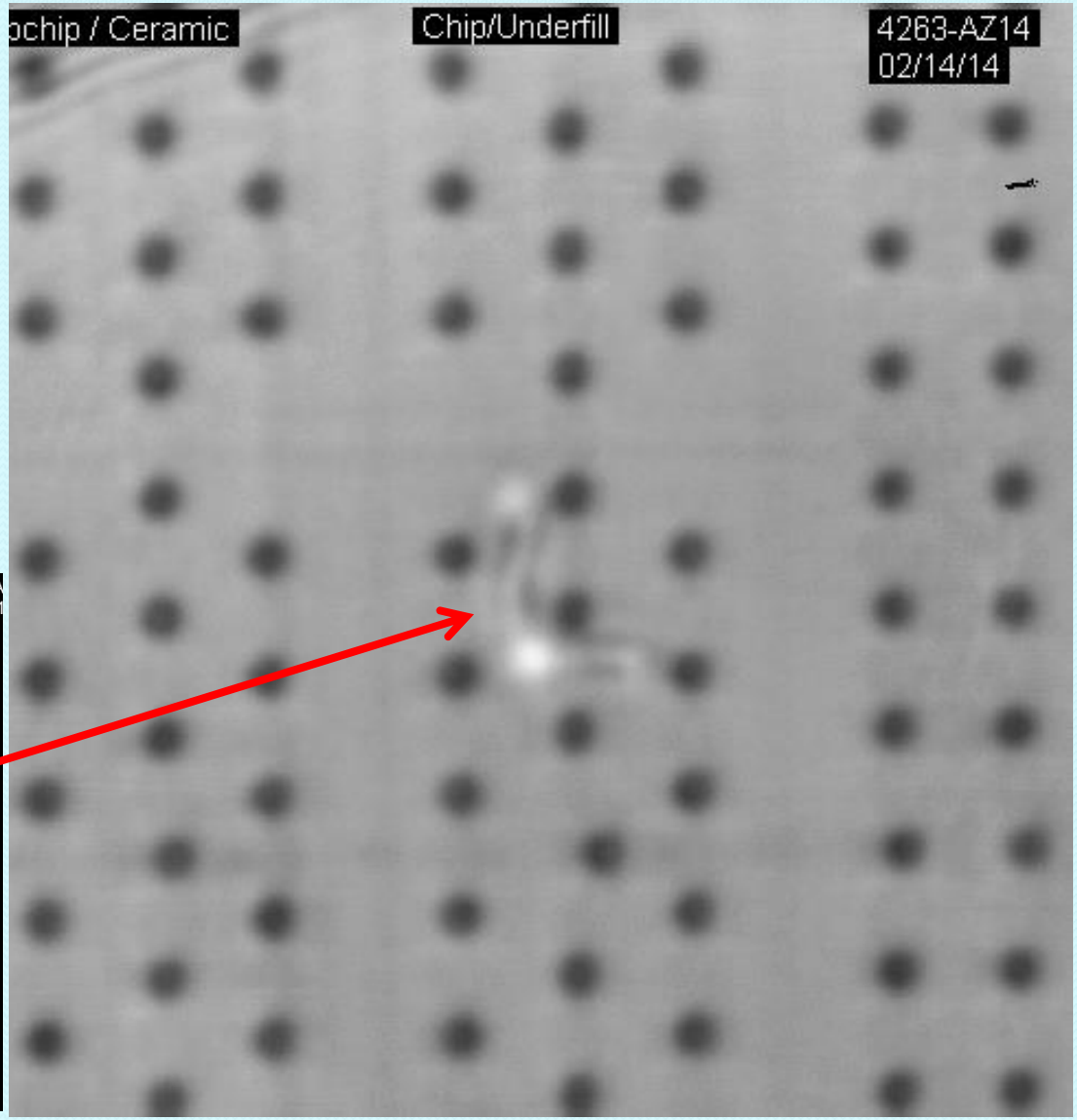
Chip/Underfill
4263-A
02/14/1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Chip/Underfill
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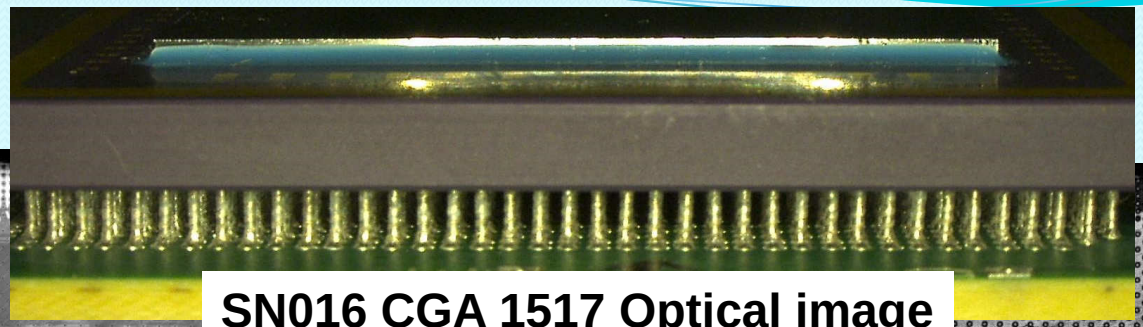
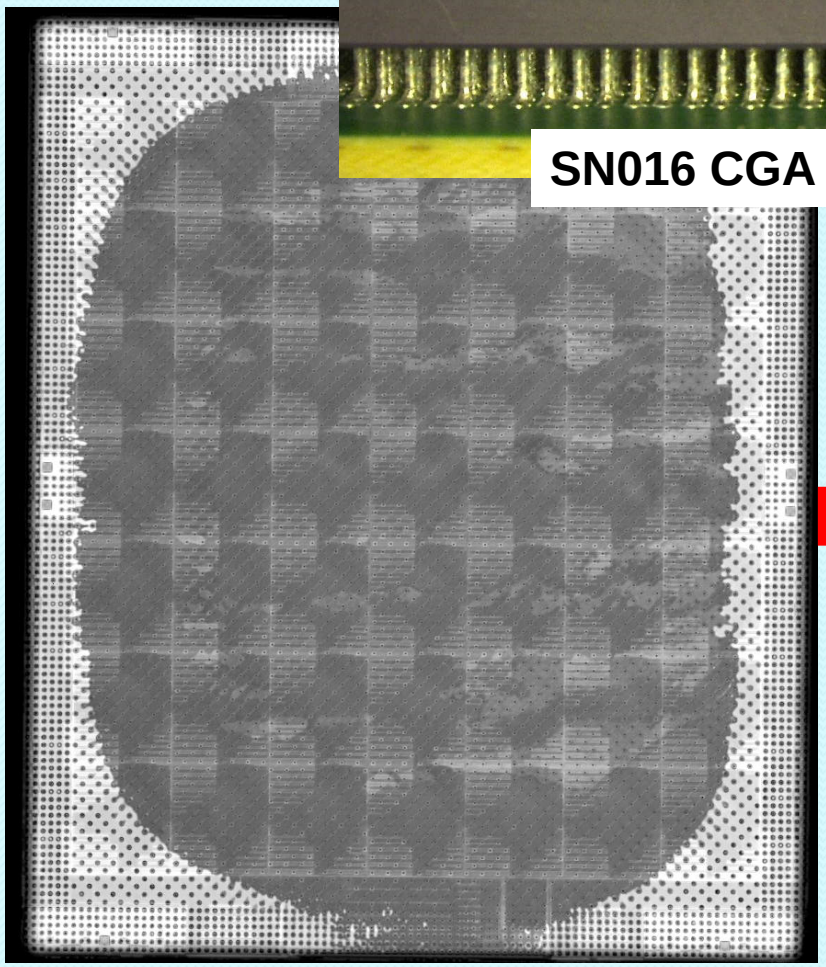
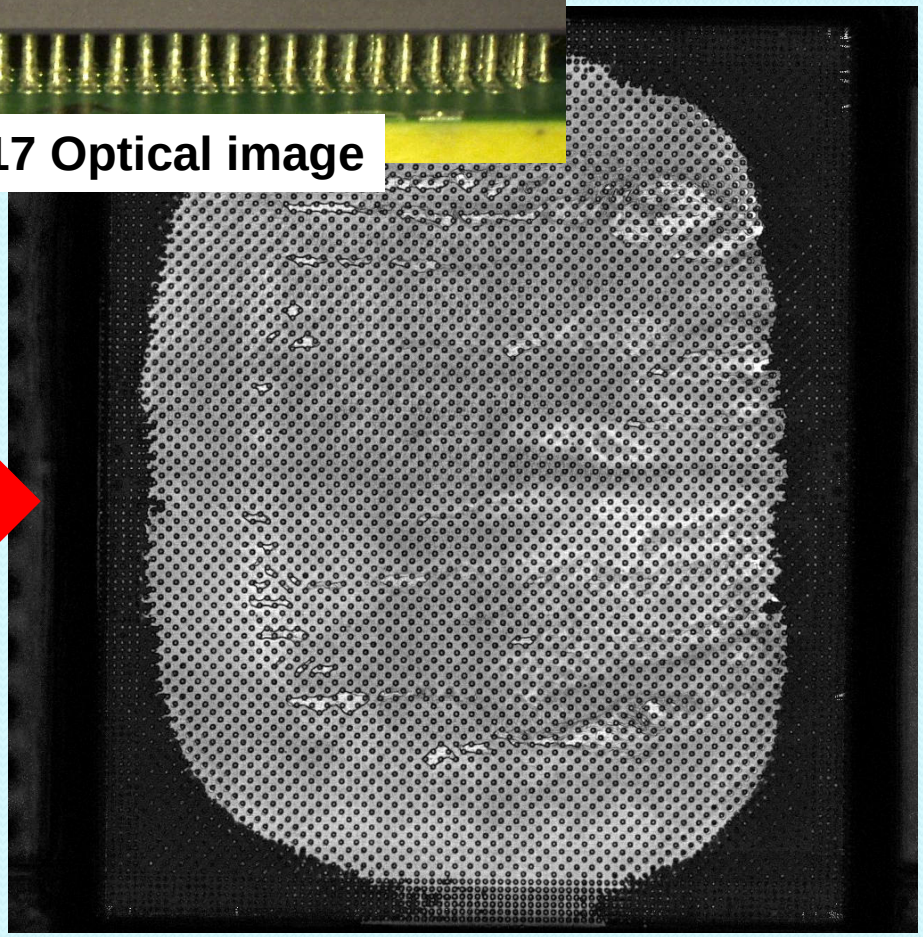
02/14/14

C-SAM FC-CGA



SN016 CGA 1517 Optical image





Flip-chip die interface
230 MHz

Substrate interface
230 MHz

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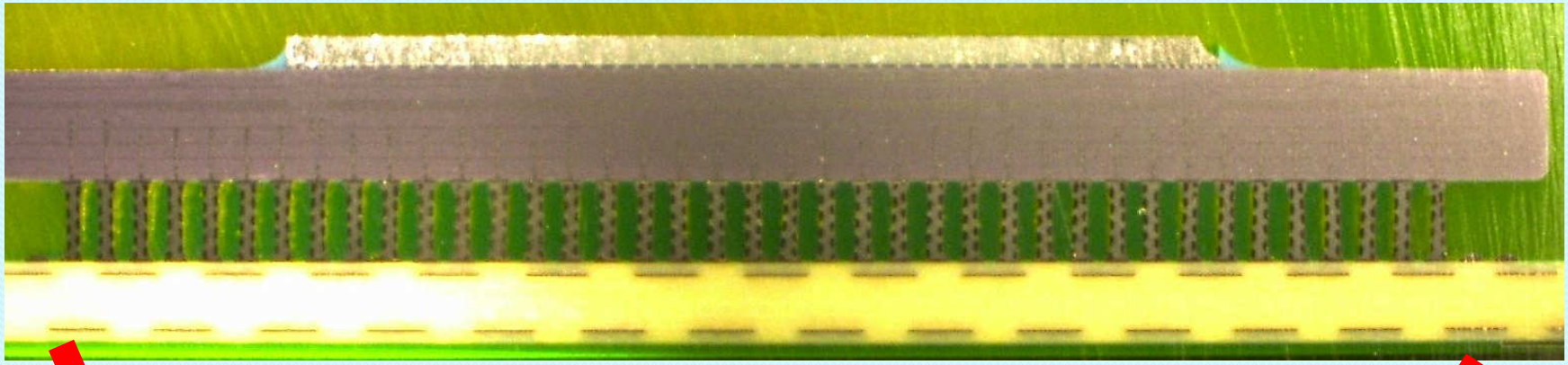
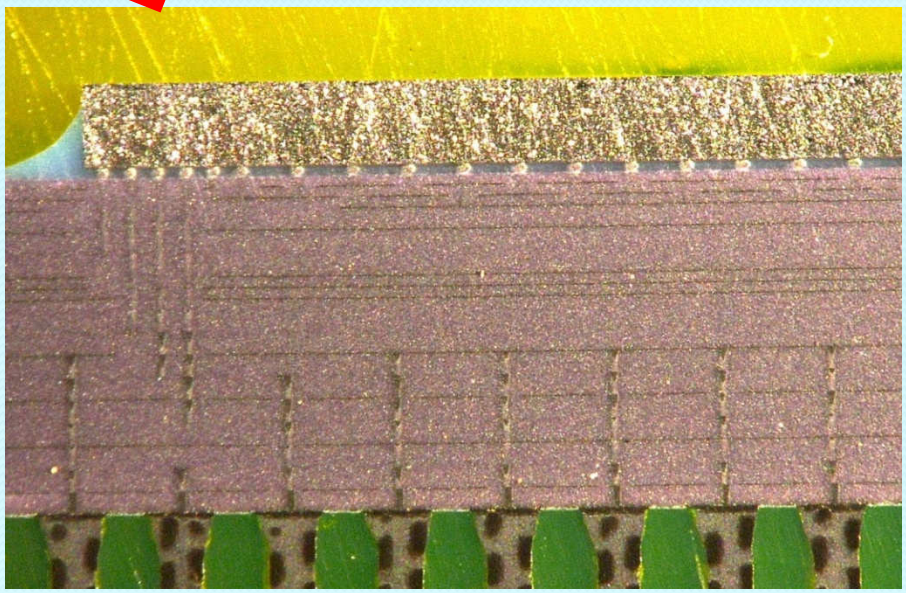
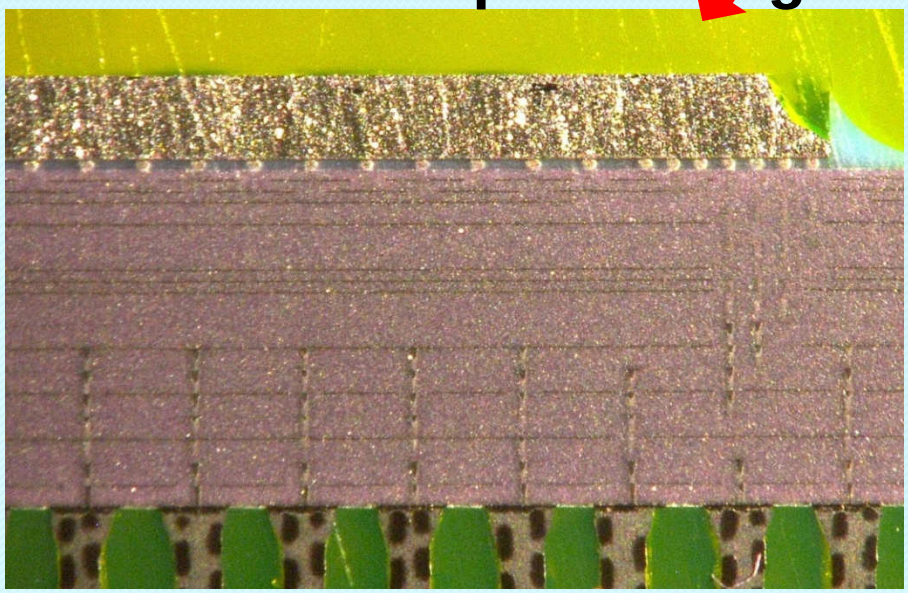
X-Section FC-CGA



SN016 CGA 1517 I/O X-sectional Optical images





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Summary - AE

- AE report is released: See http://NEPP.nasa.gov
- C-SAM for PEM
- C-SAM/X-ray of P-LGA assembly
- CGA/FC-CGA/FCBGA with heat sink
- FC-CGA, after heat sink sheared off
  - No C-SAM defect detection, 20 repeated with solder iron touches, a tip temp at 700°F
- FC-CGA with no heat sink
- Microsection to verify delamination
- C-SAM of fine pitch PBGAs
- **Recom:** Repeat with known defects

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Printed Electronics

Printed electronics technologies and **2D/3D** conventional/**rapid** printing of **organic**/non-organic electronic devices on various small/**large** substrates are projected to **grow exponentially** in commercial industry, providing an **opportunity** for various applications.

Additive manufacturing **(AM)** or 3D printing is a process for building up a three-dimensional solid object, **layer-by-layer**, from a 3D digital model. It is an additive process, contrary to traditional machining, which is a subtractive process.

Printed Electronics

Printed electronics technologies (PET) are emerging technologies that add significant advantages compared to the use of costly and inflexible electronic systems. These technologies can also be edible, biocompatible, and conformable/stretchable. For example on edibility, NASA recently (May 2013) awarded a contract to a company to make food "on-demand" from the ingredients; this allows for storage of ingredients rather than prepared food **meeting** the **demand** for **food** for long-distance travel such as humans to **Mars** by 2030. Other projects currently being pursued by NASA include **nanotechnology ink** and identifying ways PE technologies can be effectively implemented into various aspects of spacecraft. NASA is heavily involved in advancing the PET forward.

iNEMI Roadmap

- Paradigm Shifts
  - All PE to “hybrid” products
  - Cost per area rather than cost per function
  - No-traditional integration- Ubiquitous electronics
  - Scalable and high volume production
  - Novel form factor and low-cost electronics
- Enablers
  - Establish best-in-class manufacturing
  - Develop low temp interconnect materials
  - Improve materials/processes
  - Develop high performance/stable organic/inorganic/hybrid
  - Advance design and layout products

iNEMI Roadmap

Near-term opportunities are

1) Non-hybrid - an application that is comprised of only the emerging technology, or

2) **Hybrid** - an application that is manufactured using traditional electronics and devices, circuits, or components based on the new technology, e.g. a product with a printed display module and a silicon IC RF front-end.

For non-hybrid applications, one technical **barrier** concerns the development of in-line manufacturing **quality control** equipment. To benefit from the economies of scale that R2R and printing offers, systems must be developed and qualified for testing of the fabricated devices, circuits, and components.

Summary – PET

- PET report is released: See http://NEPP.nasa.gov
- PE market outpace Silicon Chip soon!
- Reviewed OE-A, ITRS, iNEMI roadmaps
  - Roadmaps continuously updated
- Review industry specifications
  - IPC, IEEE
- Presented hierarchy of device/package/systems
  - Reliability implication for each level
- Discussed briefly additive manufacturing
- OE-A stated “killer application” yet to be found!
- **Recom:** Build PCB/assembly for reliability

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Reference

http://NEPP.nasa.gov