Limitation of standard analysis and verification methods on Non-Hermetic Flip-Chip components

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Introduction

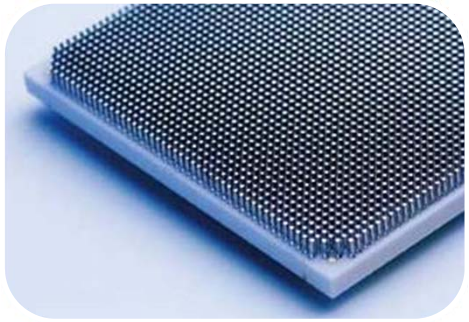
1. Non-Hermetic and/or Flip-Chip Components ➔ Best challenge ever for space components?

- Technologically : Yes
- Performance Vs Cost : Maybe
- Reliability : We'll see
- Testing methods : Not at all !!!

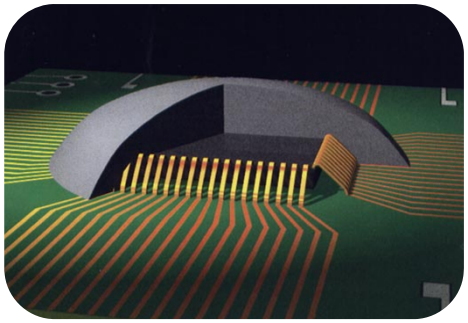
2. How can we guaranty the reliability of equipments for 17 years without a VALUABLE analysis and verification methods?

Overview of Non Hermetic packages

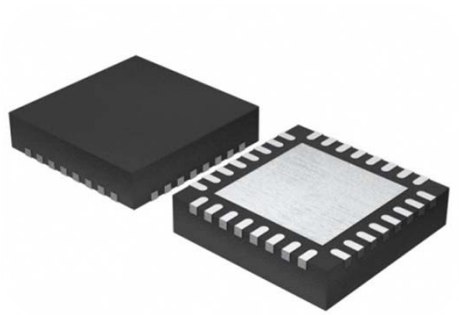
1. First, let's take a look of what we have as Non-Hermetic components?



Ceramic based

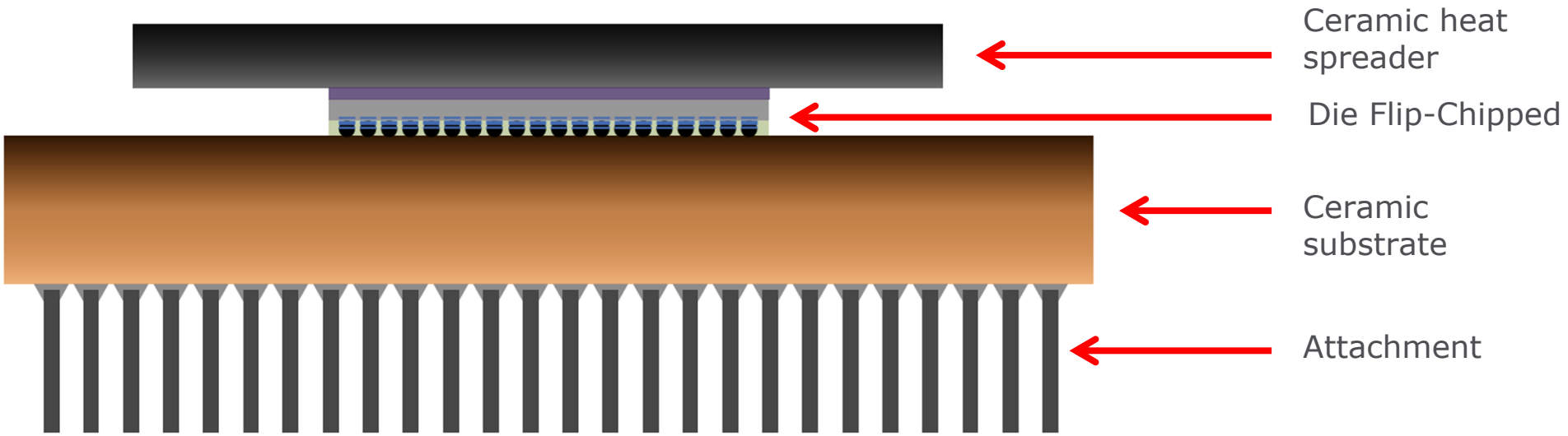


Resin encapsulation

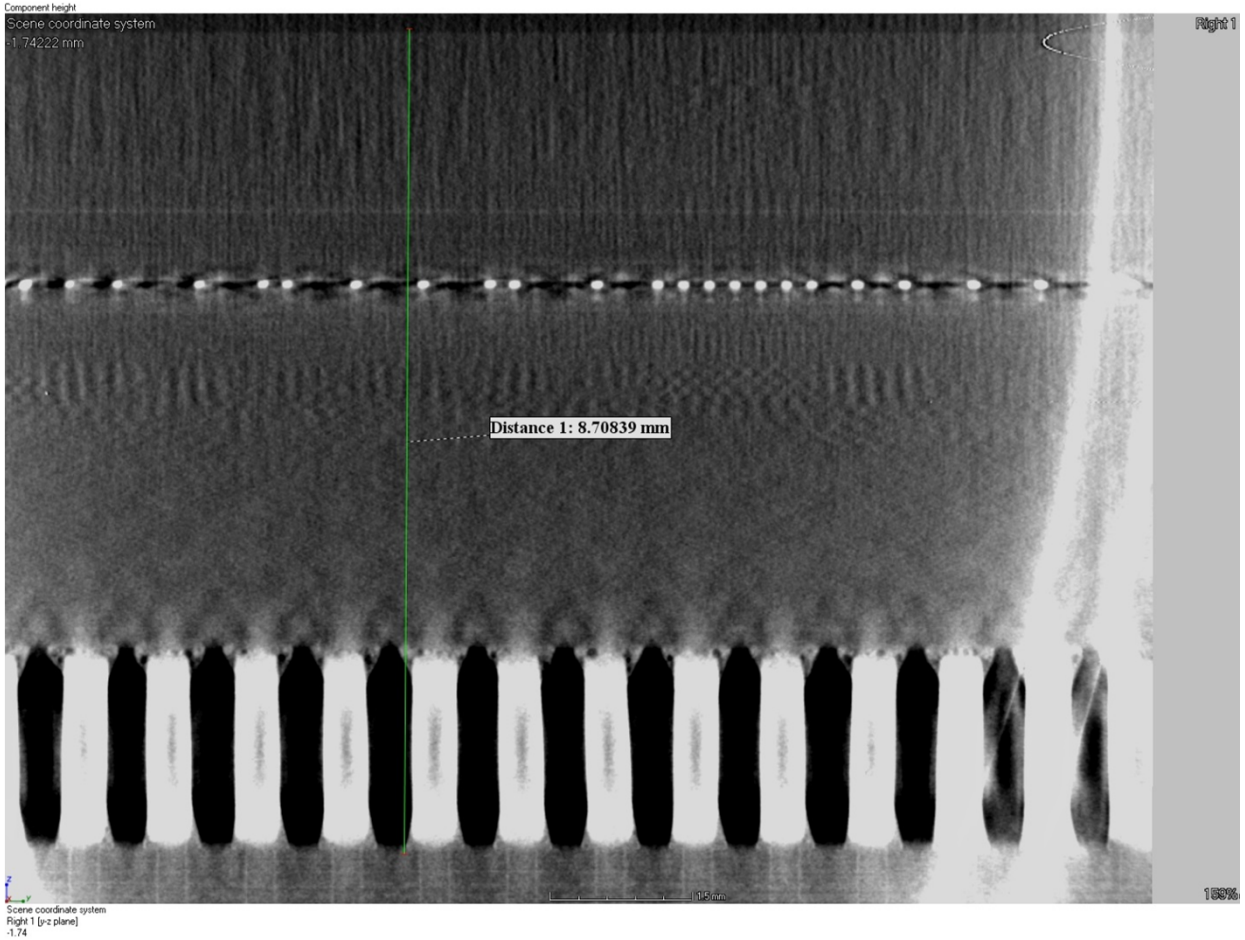


COTS

Ceramic based Non-Hermetic Flip-Chip component



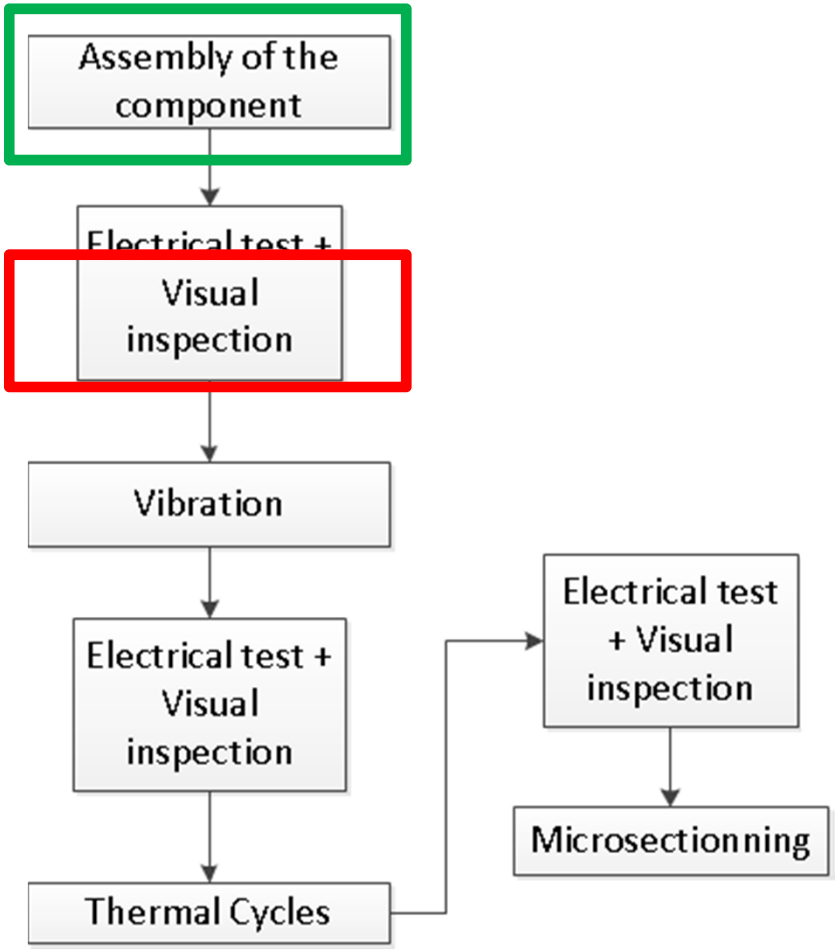
Parts Vs Methods

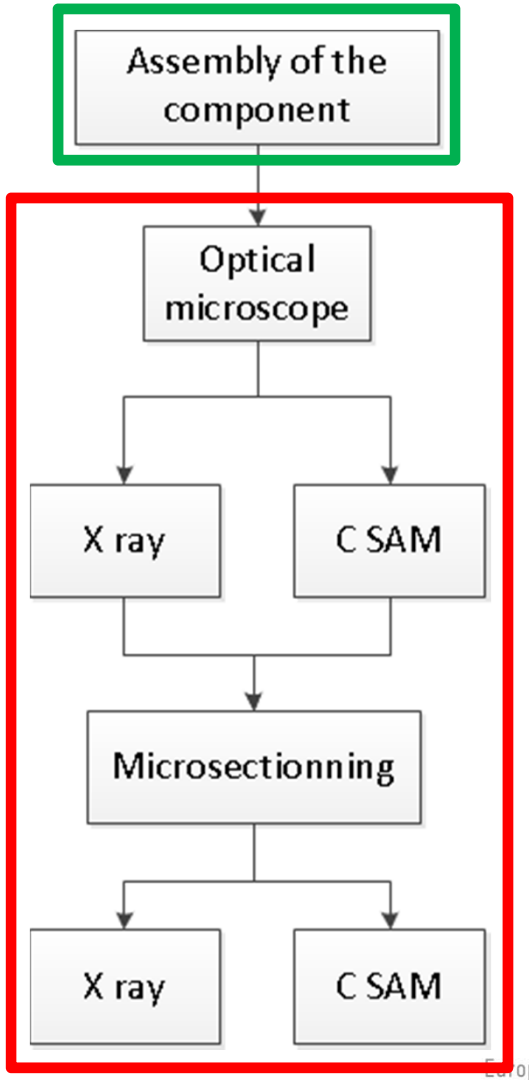


Component level

Assembly level

Verification programme for SMT





Assembly level

1. Different parts to be checked :

   a. Integrity of solder joints on the package side (presence of voids, cracks, delaminations ➔ CSAM, X-ray, µsec)

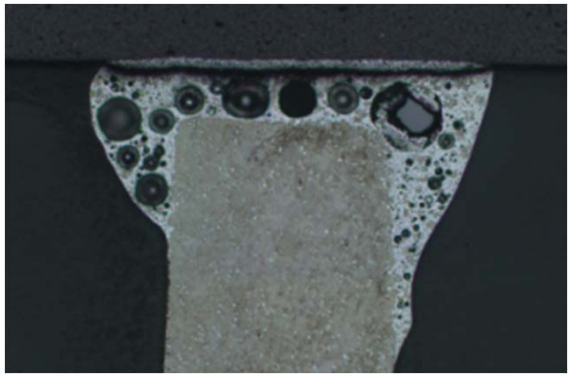
   b. Integrity of the balls, columns (presence of cracks ➔ CSAM, X-ray, µsec)

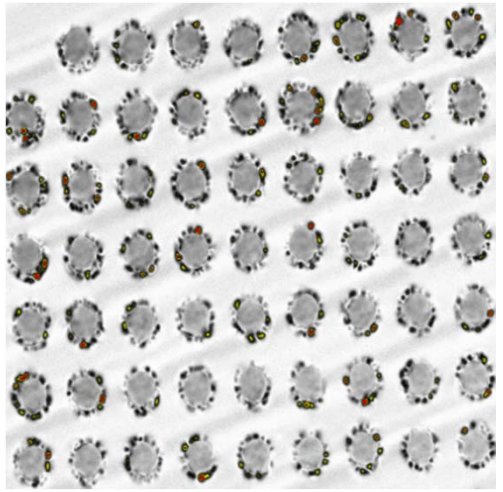
   c. Integrity of solder joints on the PCB side (presence of voids, cracks, delaminations ➔ CSAM, X-ray, µsec)

Assembly level

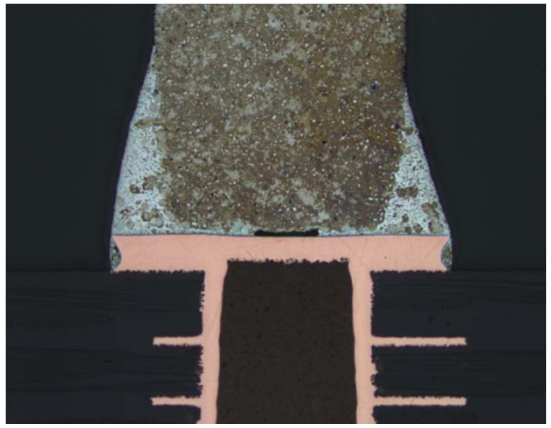
1. C-SAM

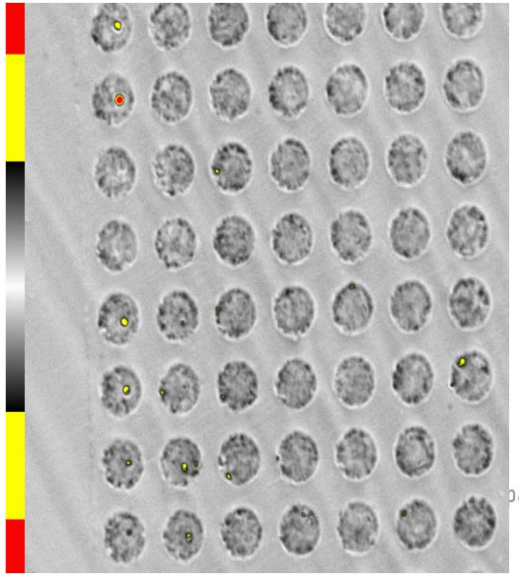
Package side





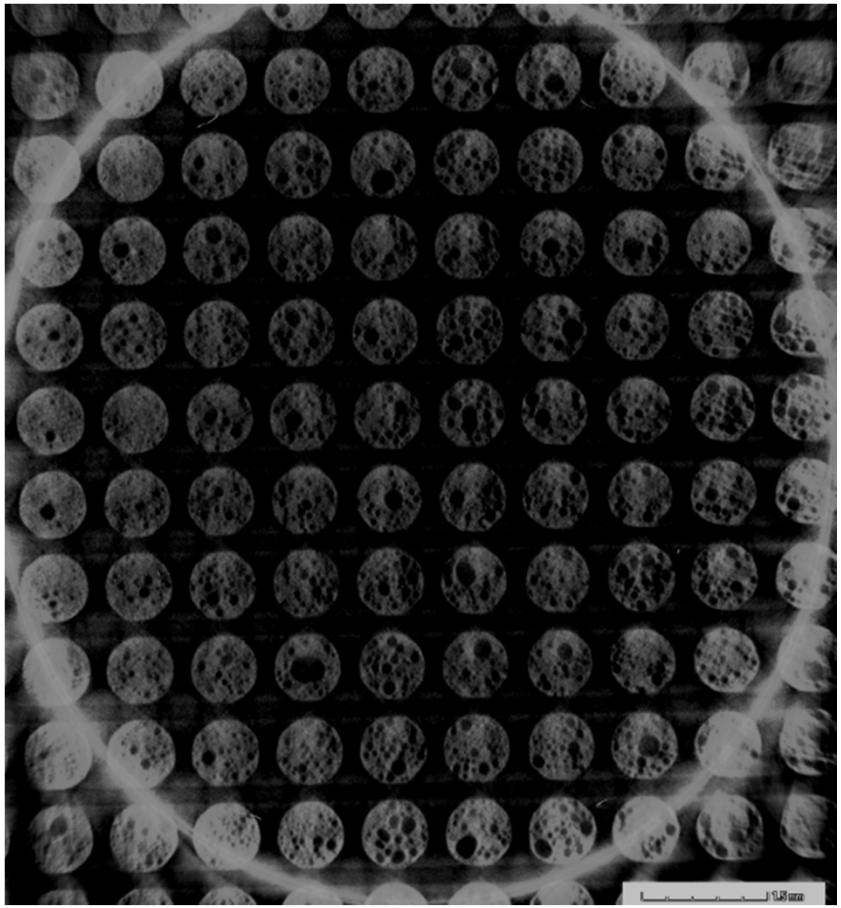
PCB side

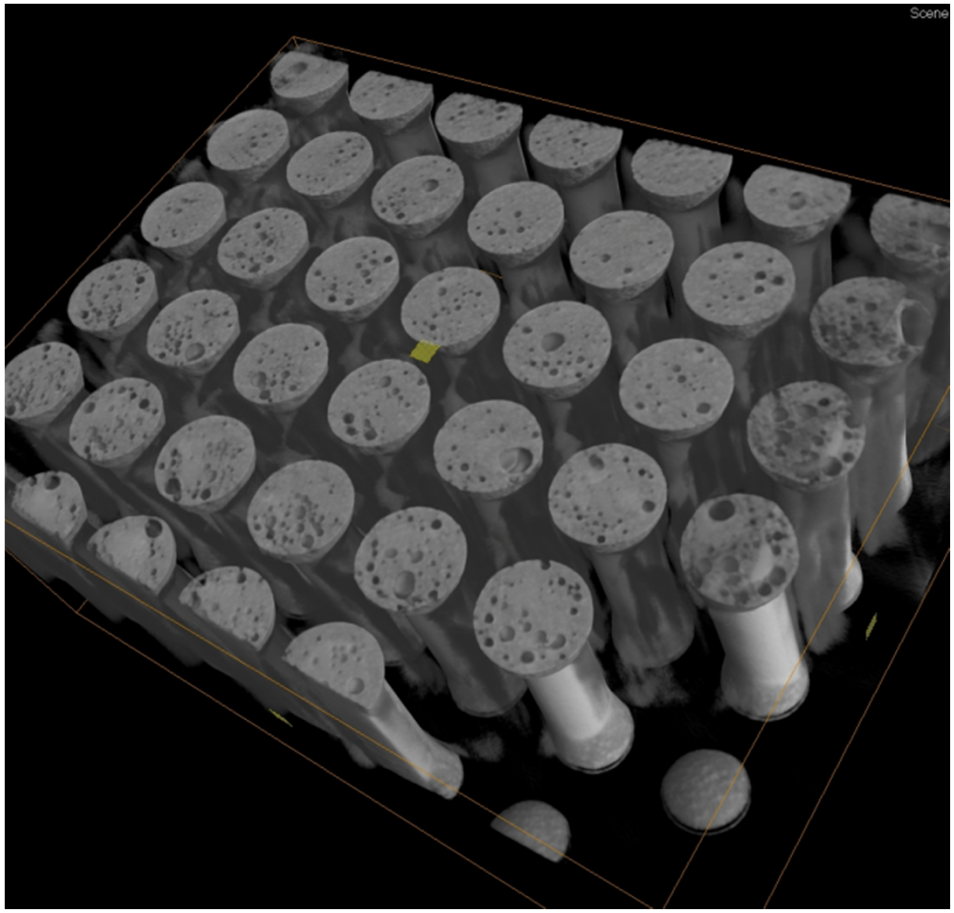




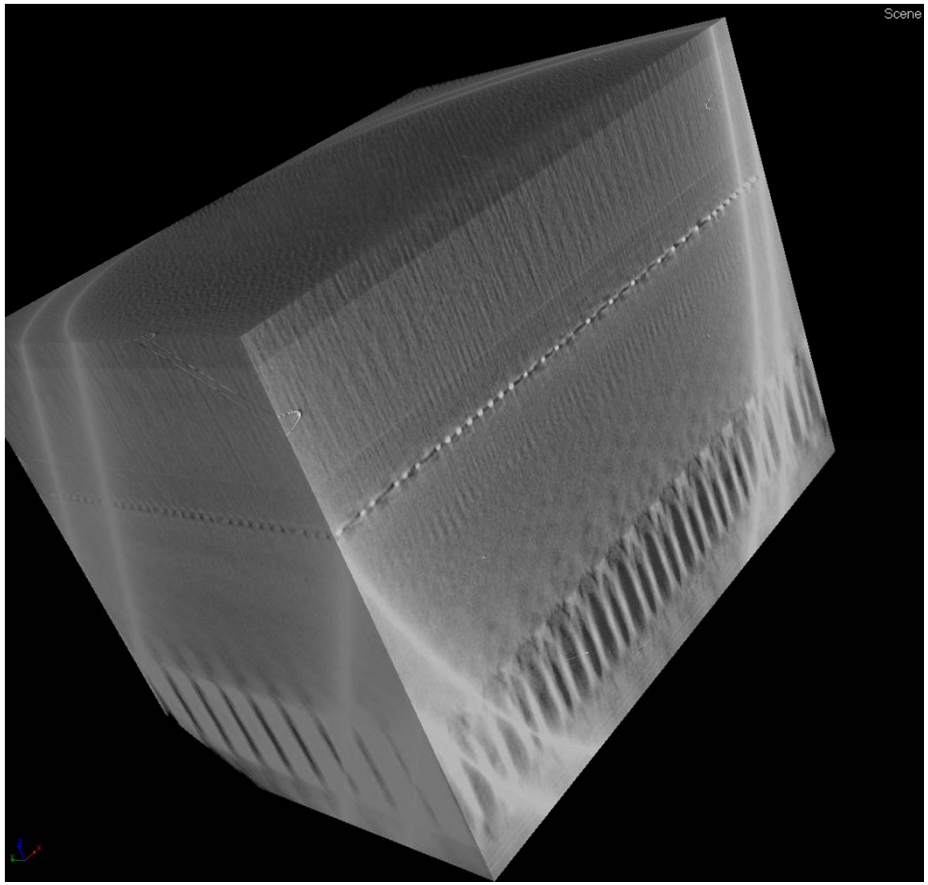
Assembly level

2. X-Ray



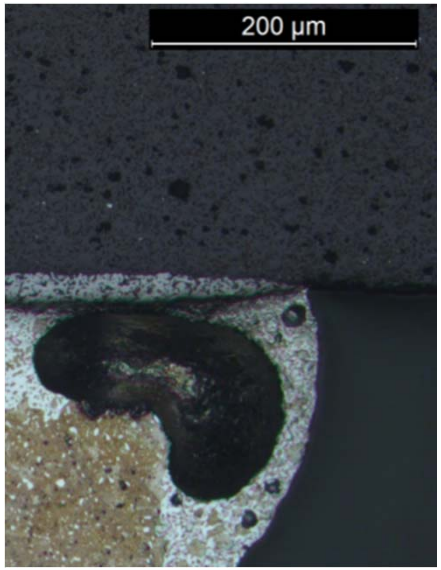


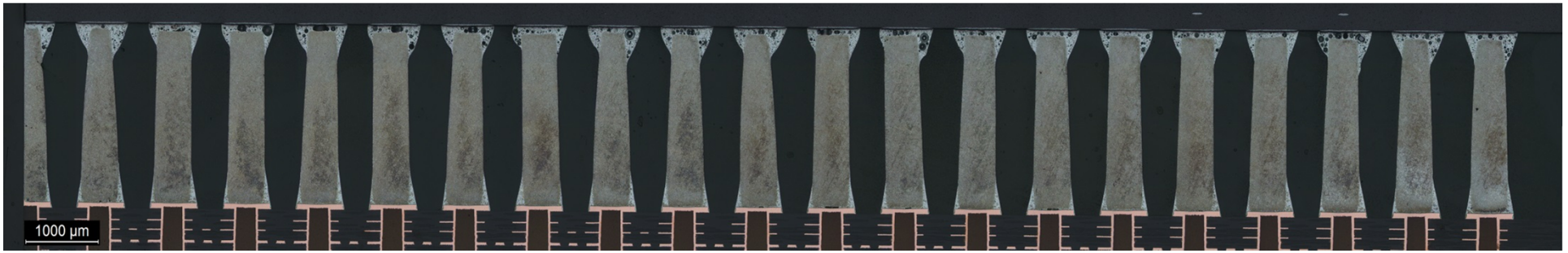
2. X-Ray



Assembly level

3. µsection





Conclusion Assembly Level

1. Methods to check the parts on the assembly level :

	Advantages	Limitations
C-SAM	Non destructive, Accurate to find porosities	**Resolution** Vs penetration
X Ray	Non destructive	**Resolution** Vs dimensions
Microsection	Very accurate, give a lot of information concerning the nature of the defaults	Destructive, **take a lot of time** to grind and polish

Conclusion Assembly Level

1. Three microsections of a large part (200 cm2) made of soft materials

   → **0.8 Day**

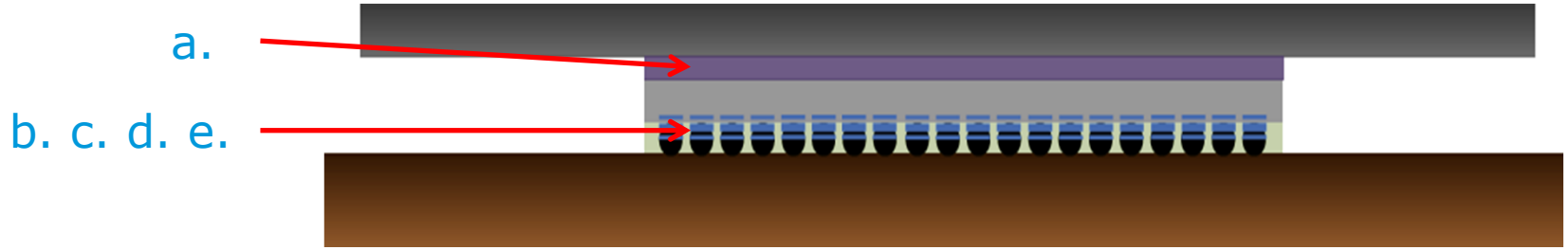
2. Three microsections of a large complex part (≈200 cm2) made of hard materials such as ceramic

   → **up to 4 Days (with the good parameters)**

5 times a regular microsection !!!!

Component level

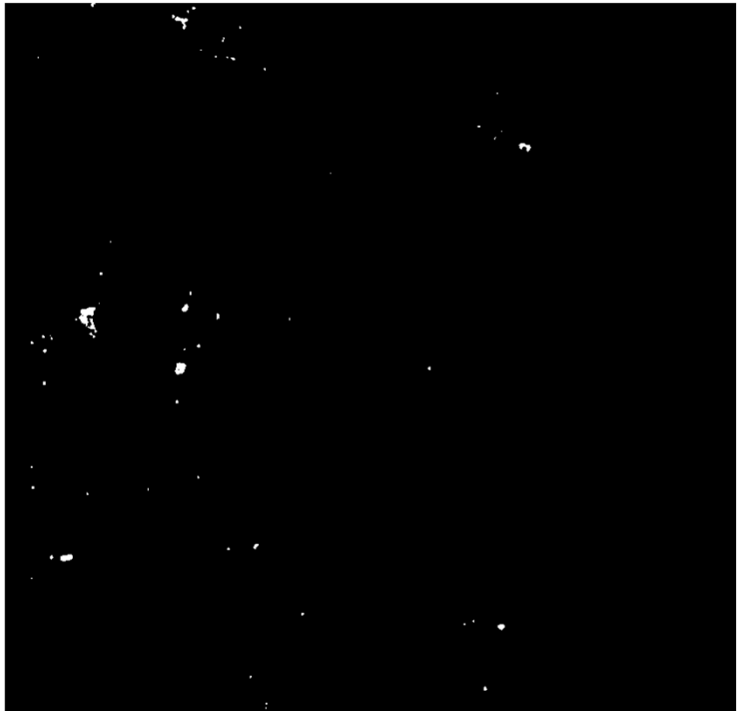
1. Different parts to be checked :
   a. Adhesion of the lid (presence of voids ➔ CSAM)
   b. Integrity of the underfill (presence of voids ➔ CSAM, µsec)
   c. Defaults at the die surface (?)
   d. Defaults at the UBM level (µsec)
   e. Defaults in the bumps (presence of porosities ➔ CSAM, µsec)



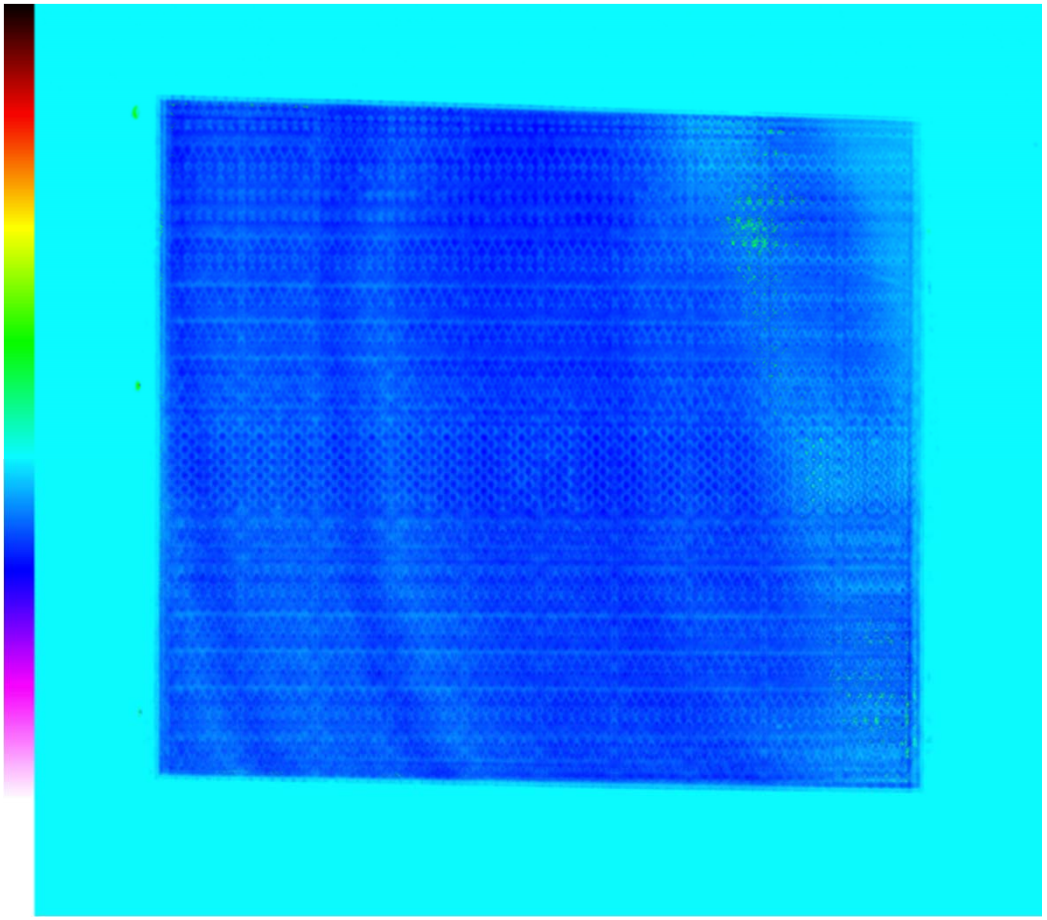
Component level

1. C-SAM

Adhesive (a.)

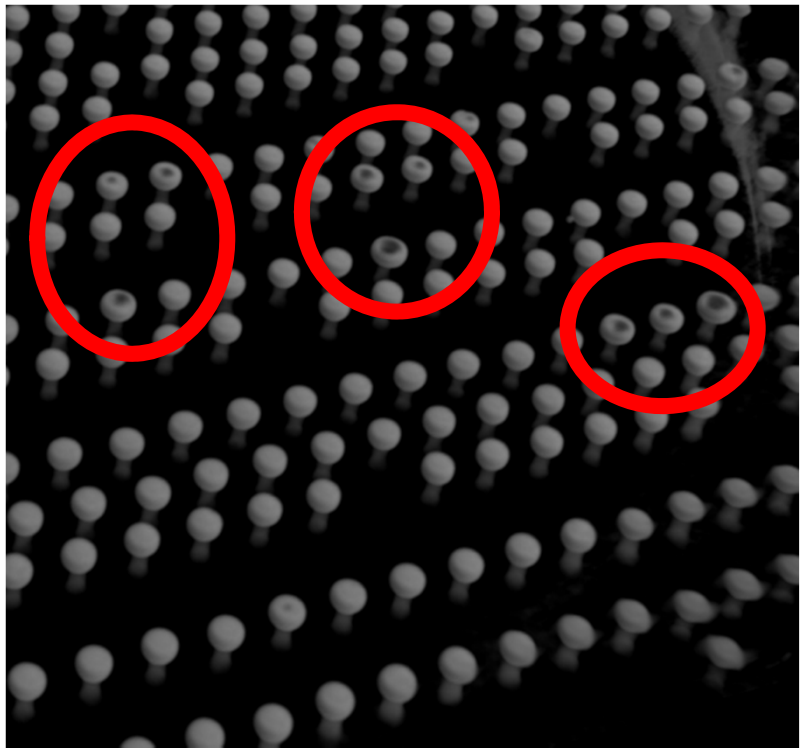


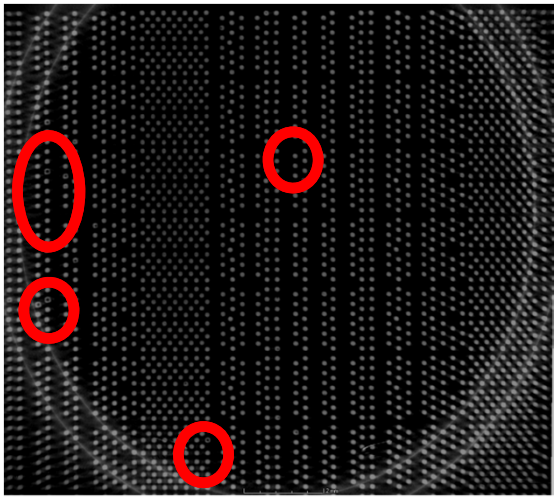
Bump Array, Underfill (b. e.)

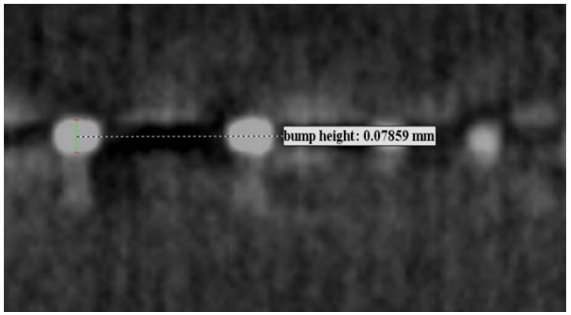


2. X-Ray

Bump Array (e.)

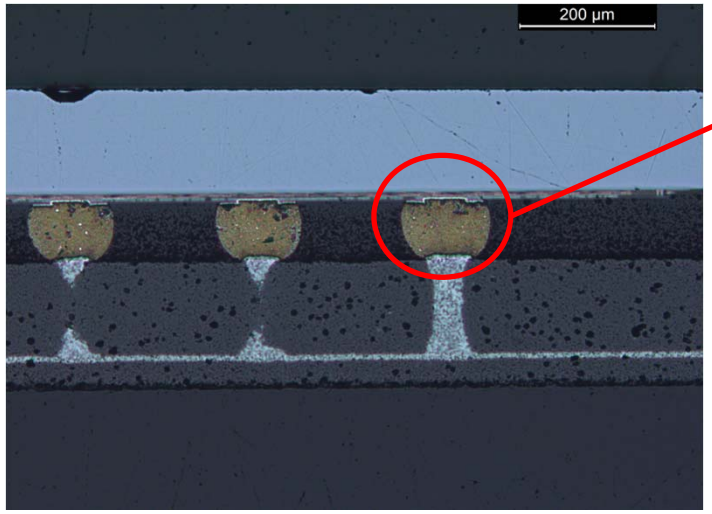


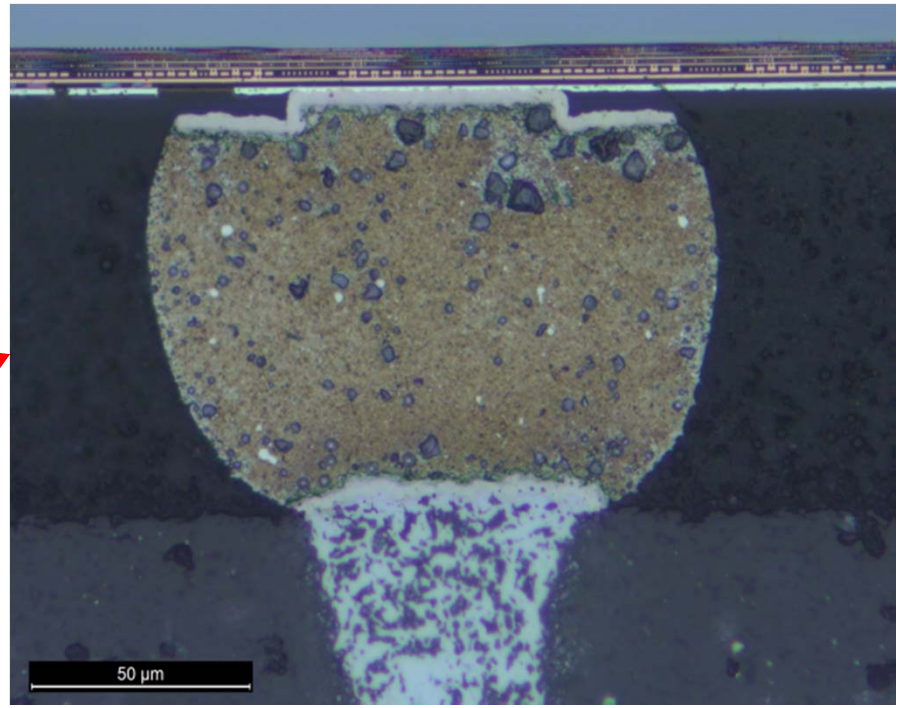




3. µsection

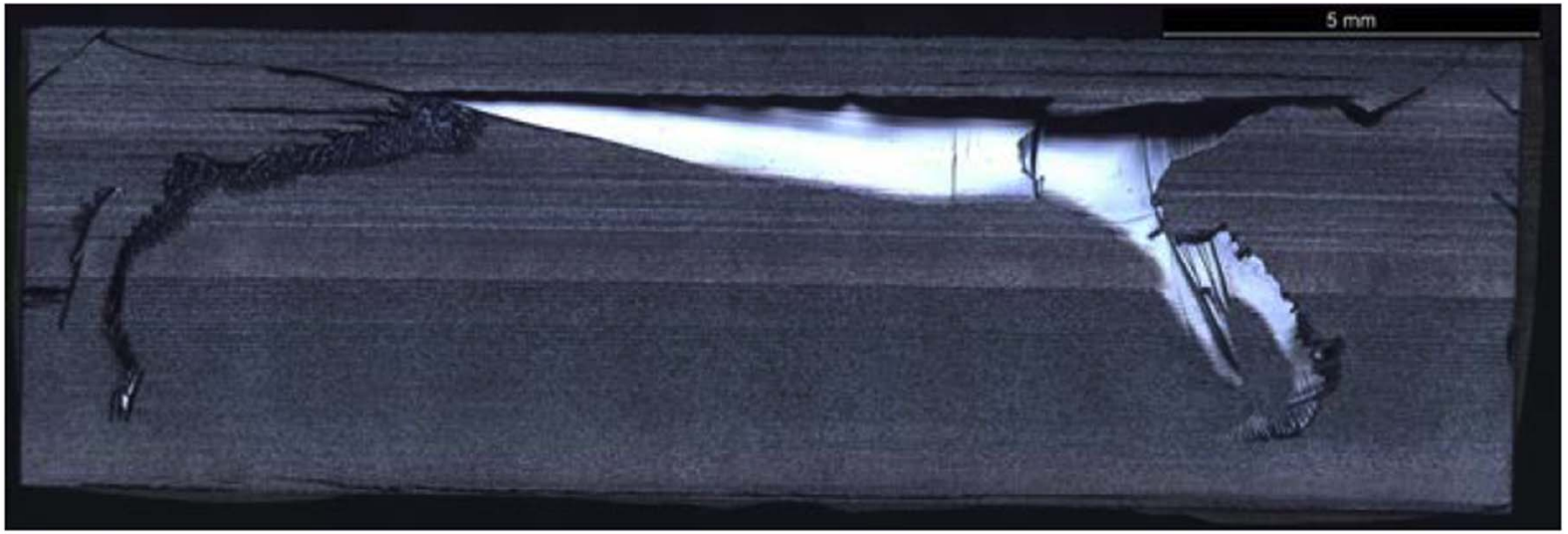
Bump, underfill, UBM (b. d. e.)





3. µsection

Die surface !!!



Conclusion Assembly Level

1. Methods to check the parts on the assembly level :

	Advantages	Limitations
C-SAM	Non destructive, Accurate to find porosities	**Res** Vs penetration, not enough for the bump "area"
X Ray	Non destructive	**Res** Vs dimensions, no value for low density materials
Microsection	Very accurate, give a lot of information concerning the nature of the defaults	Destructive, **take a lot of time** to grind and polish

General Conclusion

1. What can we check?

	YES, We can	No, We cannot
C-SAM	Check porosities, voids, cracks (adhesive, solder joints…)	Check underfill defects
X Ray	Check porosities and any defects in high density materials	Check die surface, underfill, ceramic… bumps.
Microsection	Check almost all the parts	Underfill, die surface

General Conclusion

1. Standard methods good but not enough to check all the requirements

2. Microsection really difficult on a Flip-Chip component

3. Next step :
    a. Investigate Alternative solutions
    b. ITT :
        - "Investigation into Applicable Inspection and Analysis Techniques for Flip Chip Devices"
        - "Methods of Validating Susceptibility of resins to cleaning materials used for Non-Hermetic Electronics Devices"

thanks for your attention