EMPPS 2014

Challenges for Non-Hermetic Packaging

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For Hi-rel – “Space” Non-Hermetic Packaging is A disruptive development!

Why Disruptive??

History and Tradition lead to Tried and Trusted technologies

Hermetic packages are shown to:

- Protect the contents
- Prevent degradation of contained parts

Hermetic packages can be controlled & measured to confirm the level of protection (leak rates)

But remember even with decades of history and heritage – Recent changes to MiL std. 750 & 883….

Increasing fine leak requirements!!!!

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Challenge for Non-Hermetic Packages?

Achieve and demonstrate Performance as good or better than Hermetic!

- ≥ Protection from Moisture ingress
- ≥ Protection from Mechanical induced issues (CTE) impact & pressure
- ≥ Protection from Solvents
- ≥ Protection from corrosive / reactive gasses / liquids
- Not induced limitations or restrictions
- Repeatable and reliable performance of processes and products

Challenge for Non-Hermetic Packages?

Many different technologies -

- Flip Chip
- Chip on board – Polymer (PCB) & Ceramic, silicon etc.

  Wire bonded – Aluminum and Gold (and others?)
- Solder assembly
- Conductive adhesives assembly
- COTS
- Stacked devices
- DC & ANALOGUE – Silicon & GaAs
- Etc.

Challenge for Non-Hermetic Packages?

Why should we worry?

≥ Protection from Moisture ingress

- Moisture is the enemy!
    - Contributes to many types of degradation……….
        - With many types of metals….

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      - Aluminium

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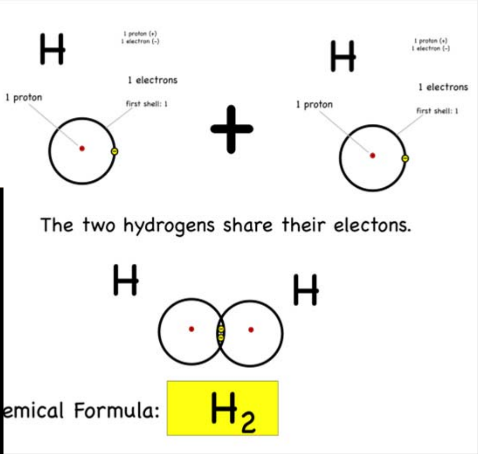
    - With many types of metals….
      - Copper
      - Lead
      - Tin
      - Aluminium
      - Silver
      - And others…….

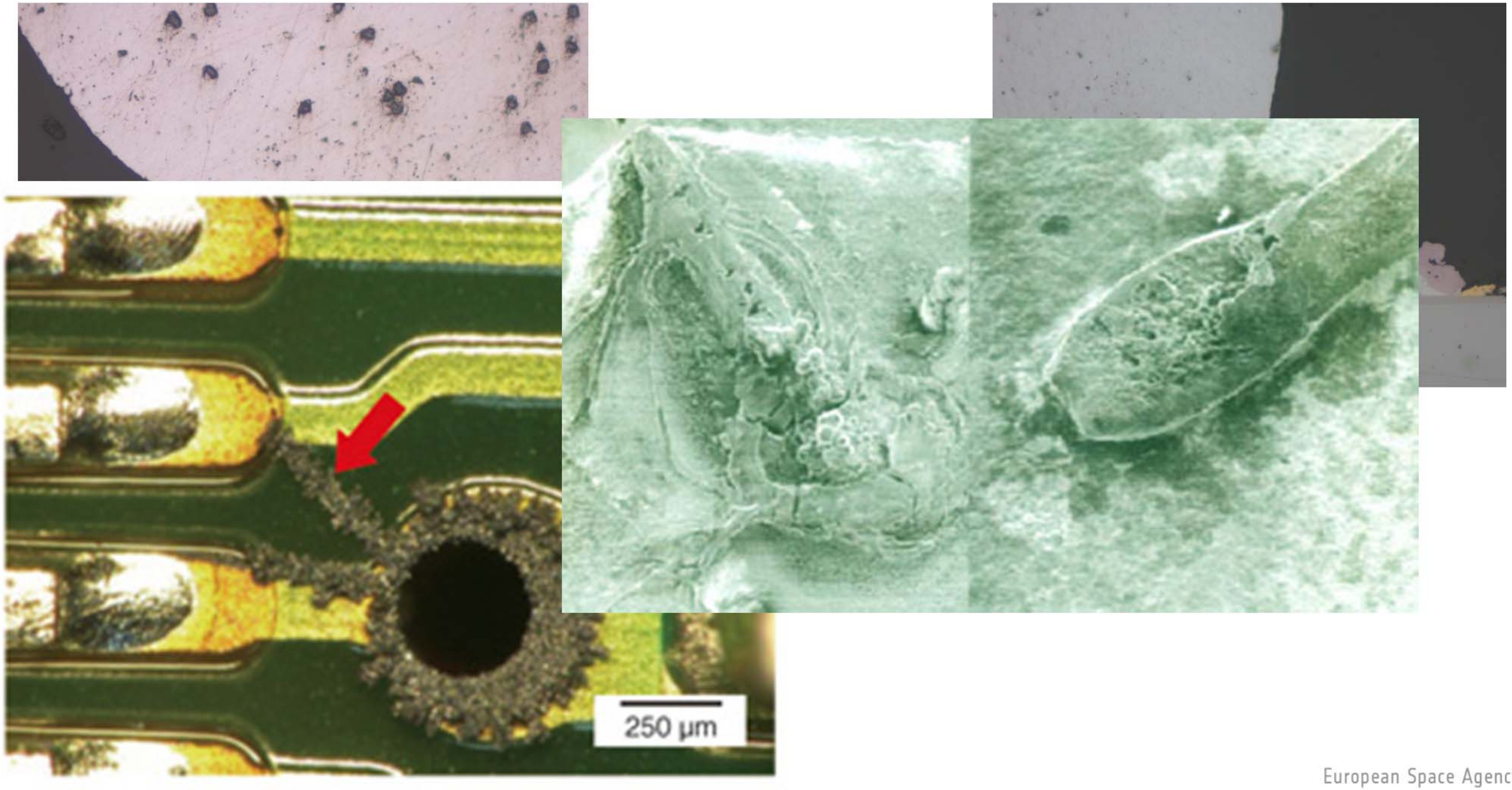
Flip Chip Development

Liquid and Gas Ingress



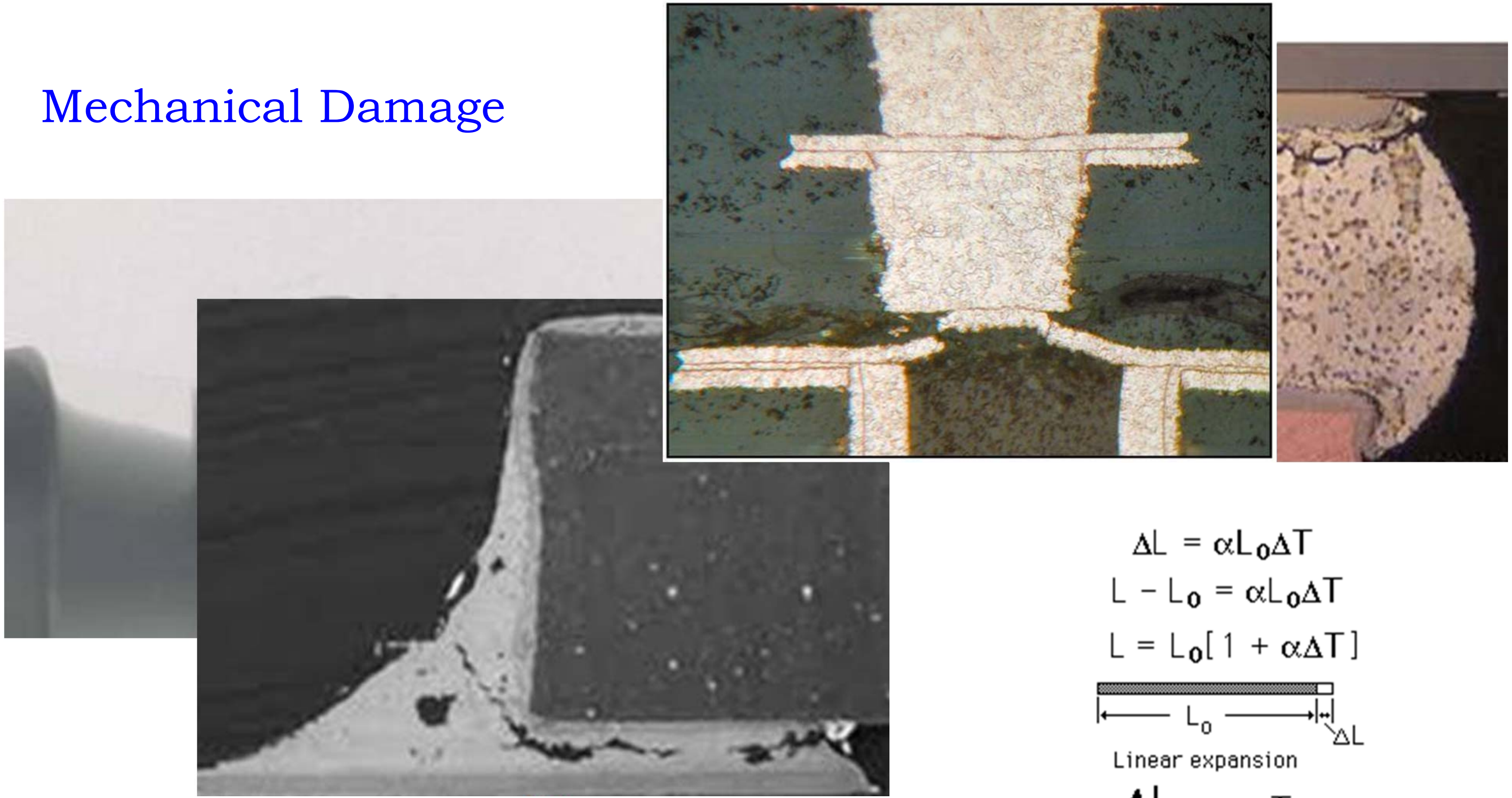
Encapsulation must not act as a selective filter!

Corrosion & Intermetallic formation



Flip Chip Development

Mechanical Damage



$$\Delta L = \alpha L_0 \Delta T$$

$$L - L_0 = \alpha L_0 \Delta T$$

$$L = L_0[1 + \alpha \Delta T]$$

Linear expansion

$$\frac{\Delta L}{L_0} = \alpha \Delta T$$

With Encapsulation CTE has to be considered in 3 AXIS!

Flip Chip Development

Electro Migration & Dendritic Growth

Challenge for Non-Hermetic Packages?

All previous issues are known phenomena.

Methods of detection of issues can be difficult

Issues can take 100’s or 1000’s of hours to evolve or develop

But not all!

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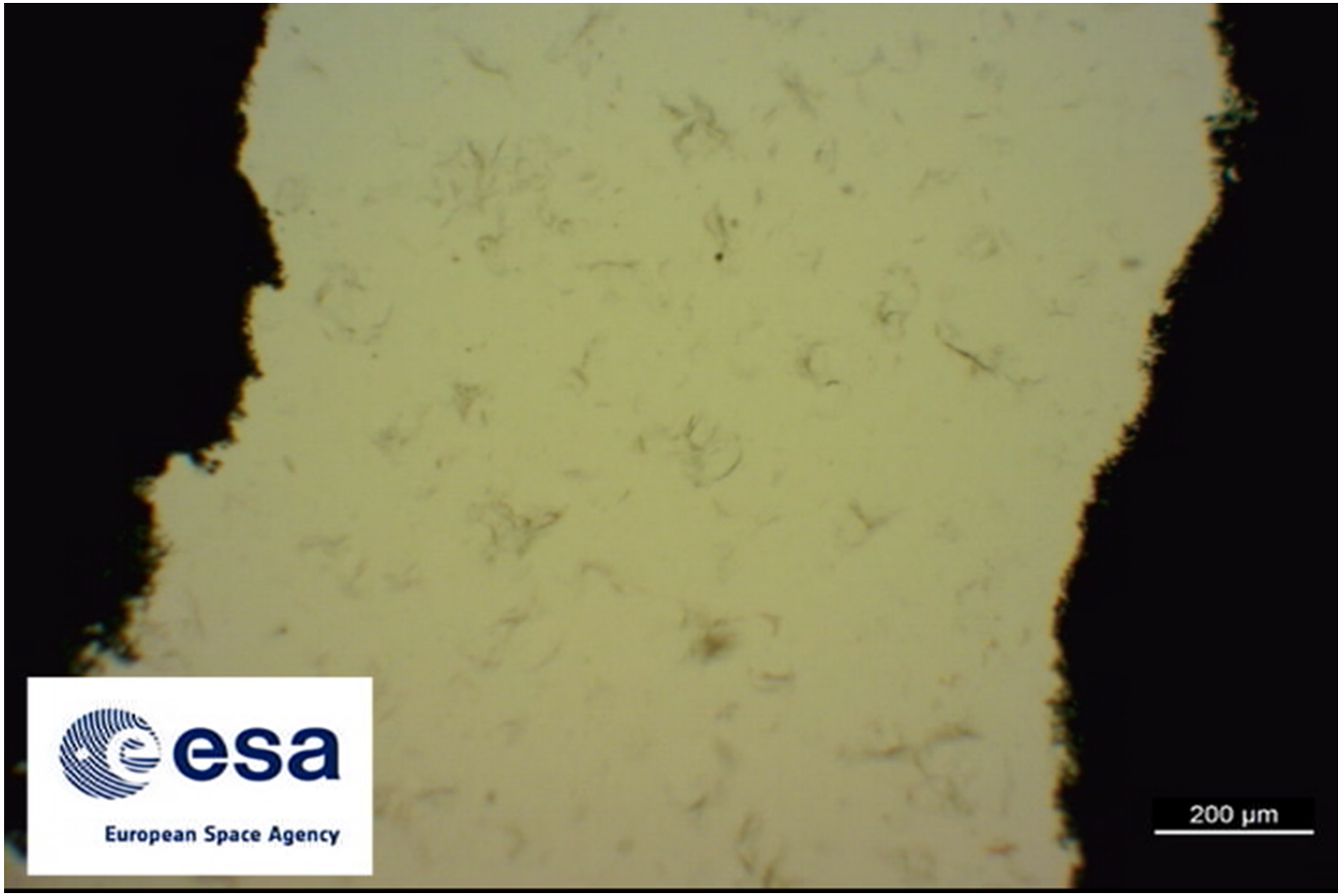
Anode
(+)



Cathode
(-)

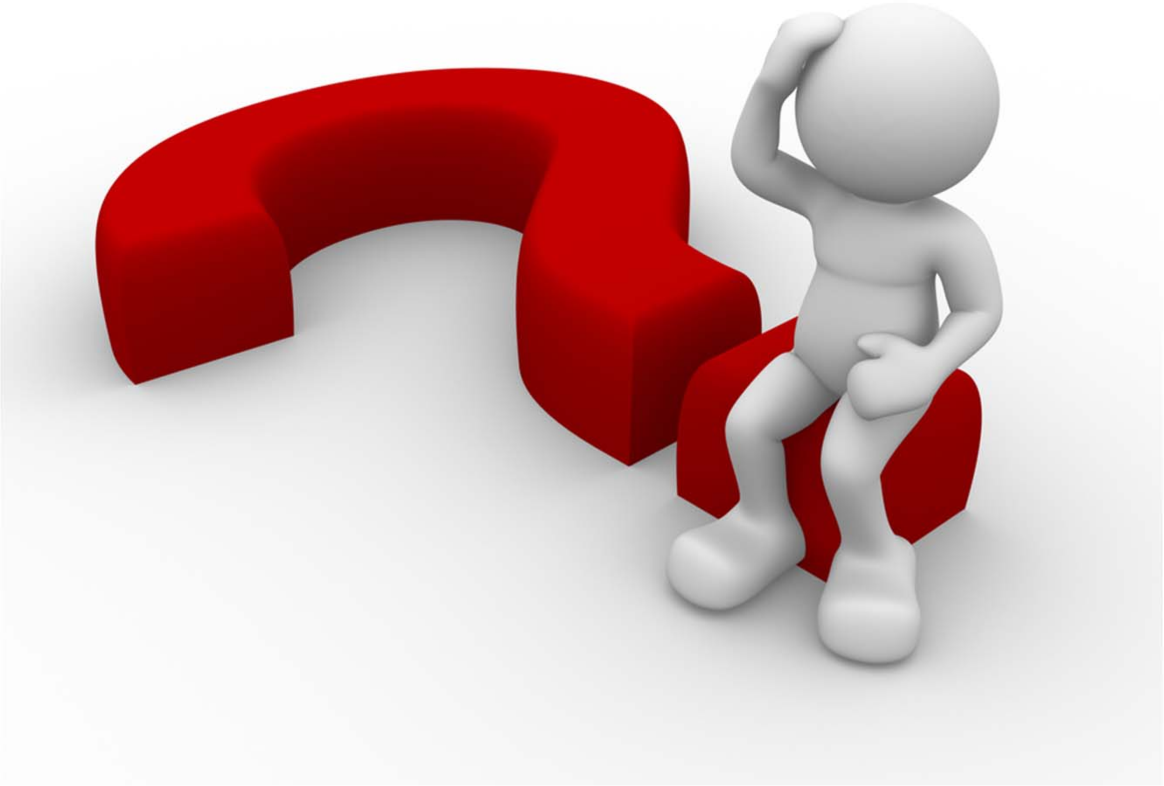
Challenge for Non-Hermetic Packages?

In Conclusion

- Non- Hermetic packaging is:
    - Real
    - Is shown to be reliable (with terrestrial applications)
    - Benefits are in demand
    - Complex

- Has to be proven equal performance (protection & reliability) of Hermetic Packaging.

Questions?



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Thank you for your attention! Goodbye