

# COTS and Lead Free – Dealing with the Quandary:-

## The Regulatory position & Technical Uncertainties

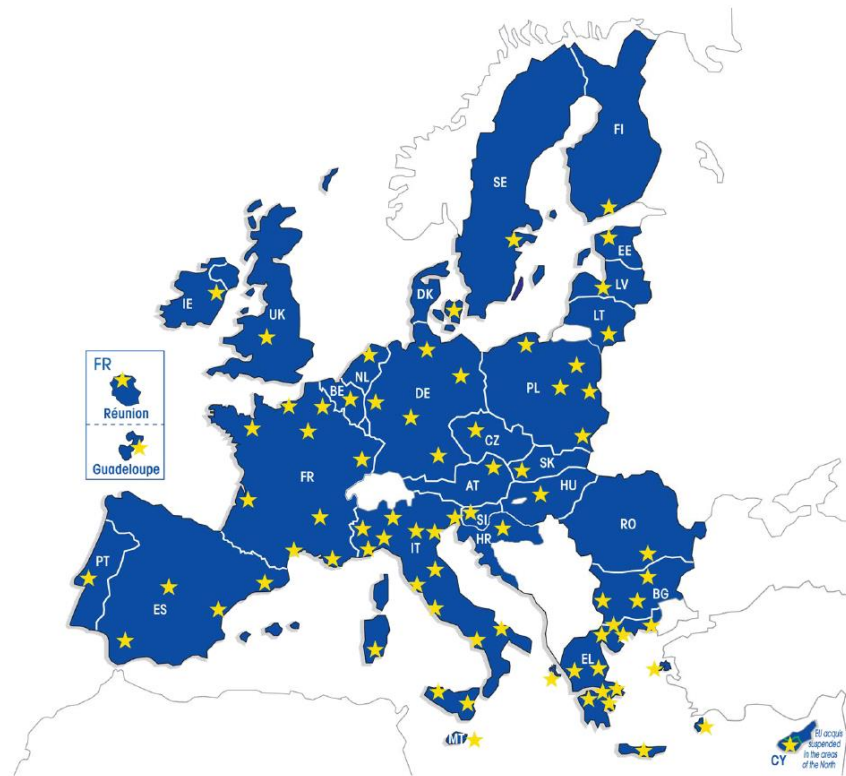
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Main purpose is to

**ensure a high level of protection of human health and the environment**

in relation to the use of chemical substances. \*

\* EU Regulation 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the registration, evaluation, authorization and restriction of chemicals (REACH)



## Registration, Evaluation, Authorisation and Restriction of Chemicals

- Addresses potential impacts of chemicals to human health and on the environment
- And production & use of chemical substances.

Strictest law to date regulating chemical substances.

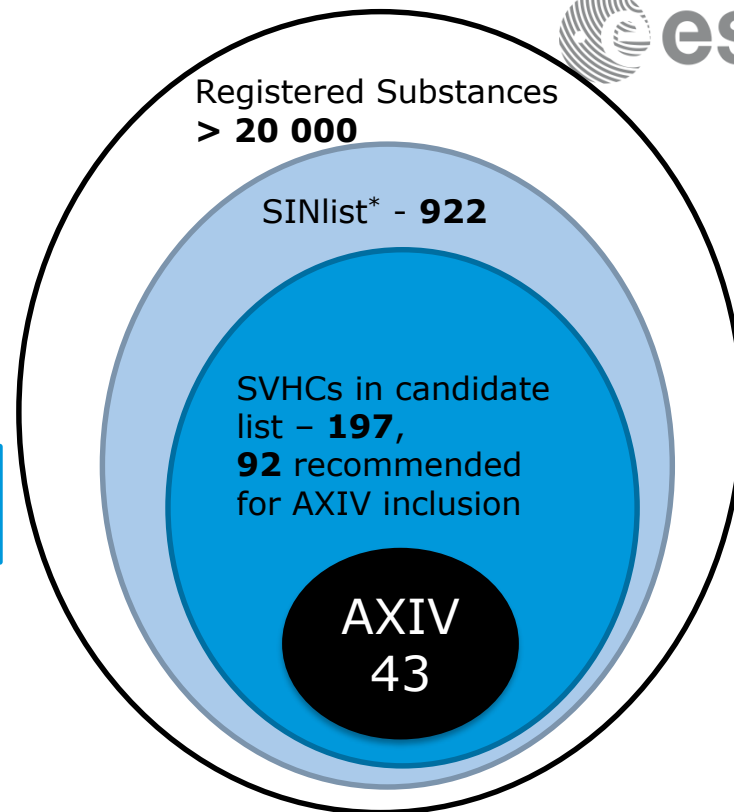
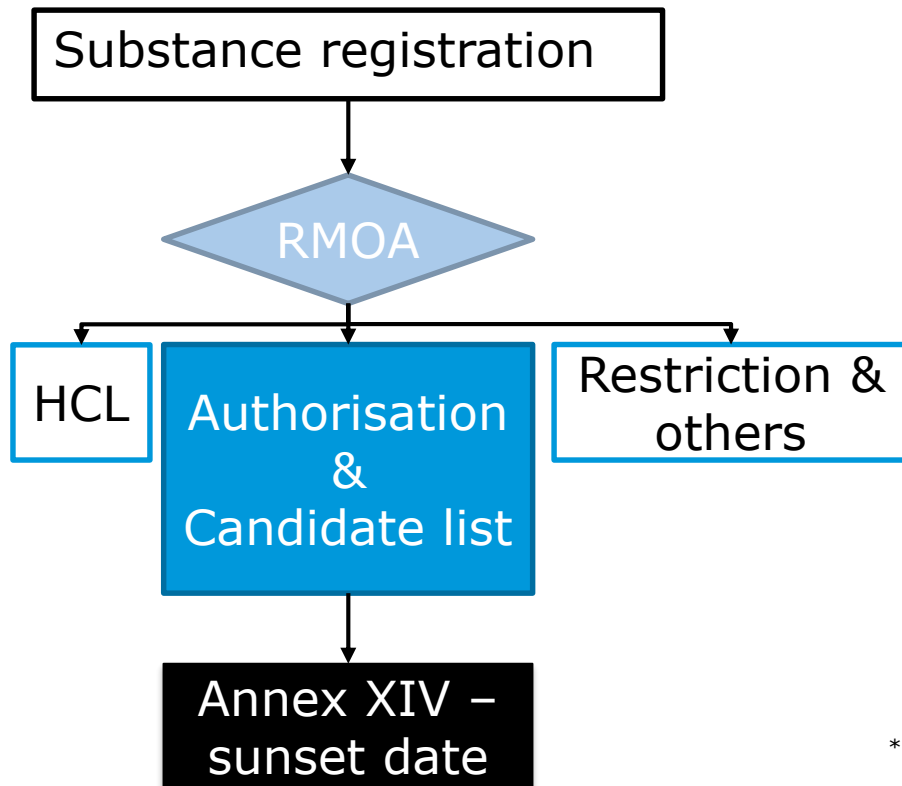
- many chemical substances will face **regulatory or commercial obsolescence**, causing widespread impacts to downstream users.

Very desirable and ambitious regulation to contribute to a safer and healthier environment

**but** causes wide-reaching engineering and management challenges for the space sector which is by nature driven by performance and heritage design.

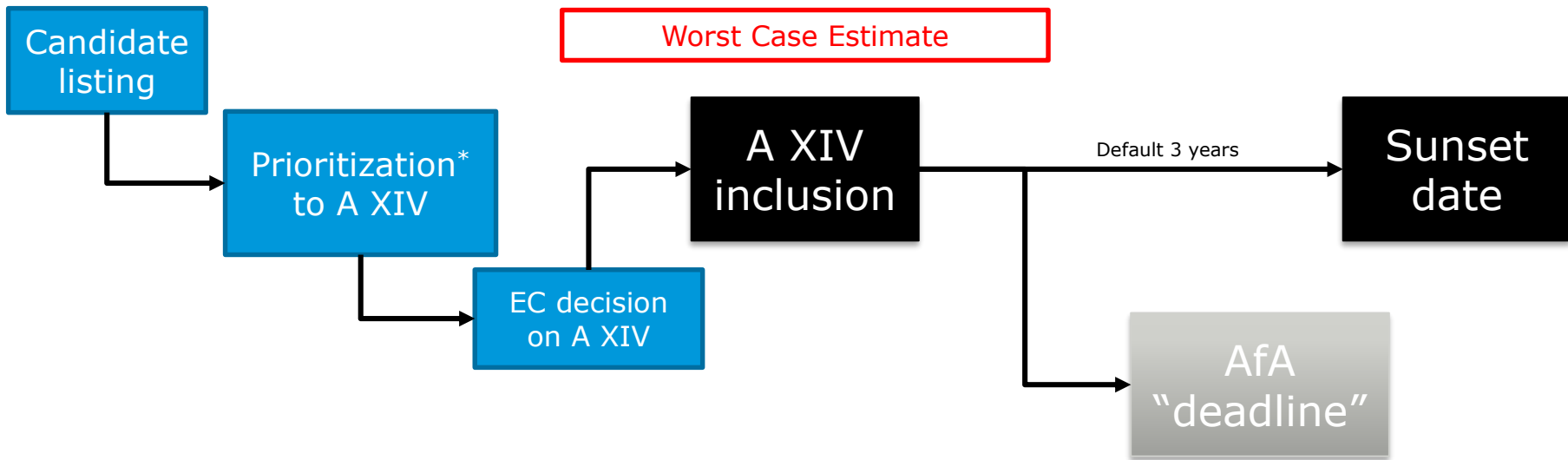
# Introduction – REACH 3/3

R  
E  
A  
C  
H



\*) NGO driven, using criteria from REACH to identify Substances of Very High Concern (SVHC).

# Example timeline of REACH authorisation (Pb)



\*) Swift prioritization likely due to large volume / mass of use

Authorisation normally granted for 4-12 years.

# Joint Working Group for Pb-free transition



During 2019, ESCC CTB and MPTB have formed a **joint working group** that has the following goal:

- In the domain of EEE components, electronic assembly technologies and PCBs, ensure a successful industry-wide transition to a Pb-free technology while preserving or improving current level of quality and reliability, including but not limited to:

- Tin-whisker mitigation and risk assessment
- Lead-free solders and assembly processes
- Accelerated tests for verification of Pb-free materials and processes and qualification of components, and
- Acceptance criteria for Pb-free materials, processes and components

- **Objectives:** Identify the necessary activities and objectives, with
  - measurable outcomes indicating successful completion (e.g. TRL),
  - including schedules and budgets,
  - and their interconnections and dependencies.
- To form a **lead-free transition plan** composing of:
  - Materials and EEE parts selection
  - Supplier compliance and guidelines for procurement
  - Changes in assembly processes
  - Reliability assessment and key reliability risks in lead-free electronics

# So.....Why are there Concerns?

# So.....Why the Concern?



New materials and processes replacing known and trusted technologies.





# So.....What are the Questions?



Examples:-

Metals:

Tin Pest & Tin Whisker

Oxidation and Dendritic growth

Dendrite growth, metallic migration etc.

Corrosion, Intermetallics, Oxidation, Delamination etc.



# An Example

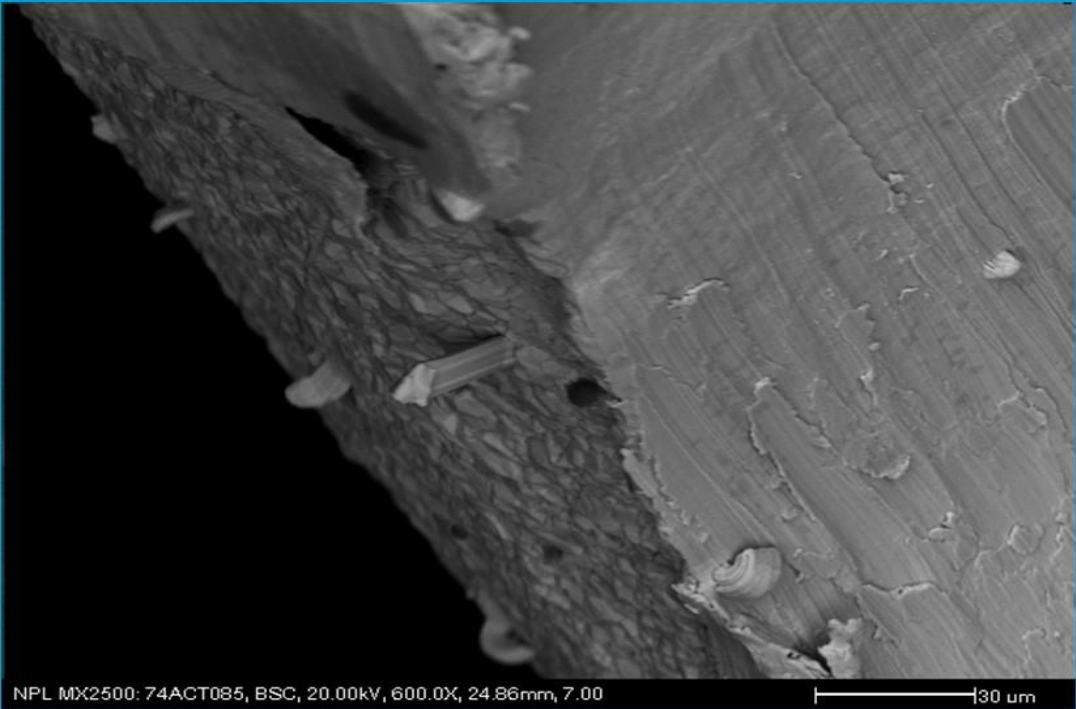


Tin Pest

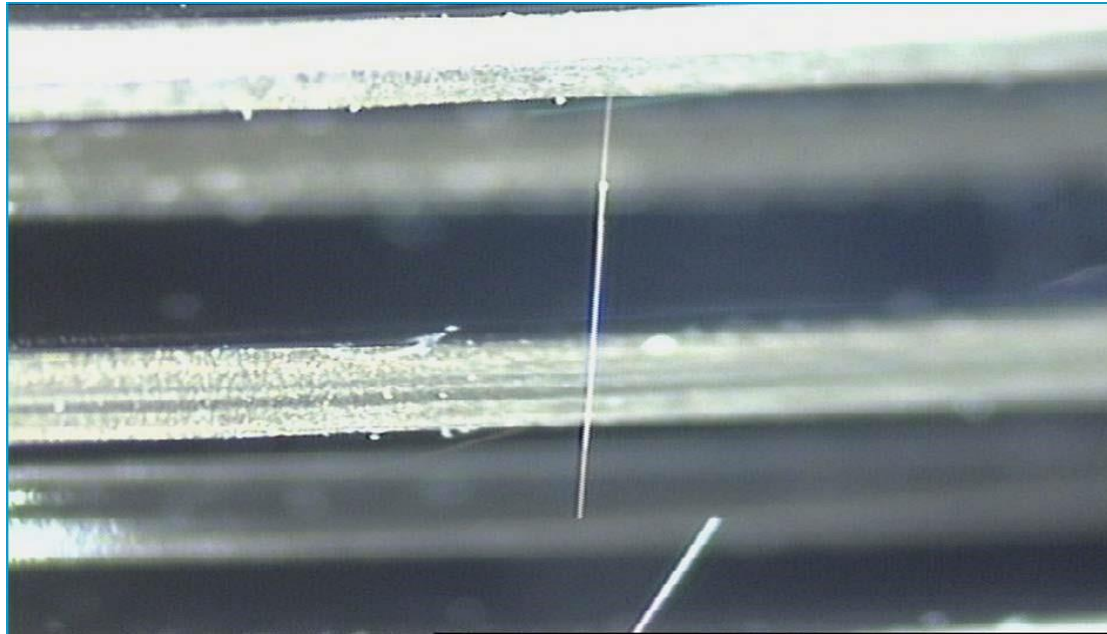
# Tin Pest?



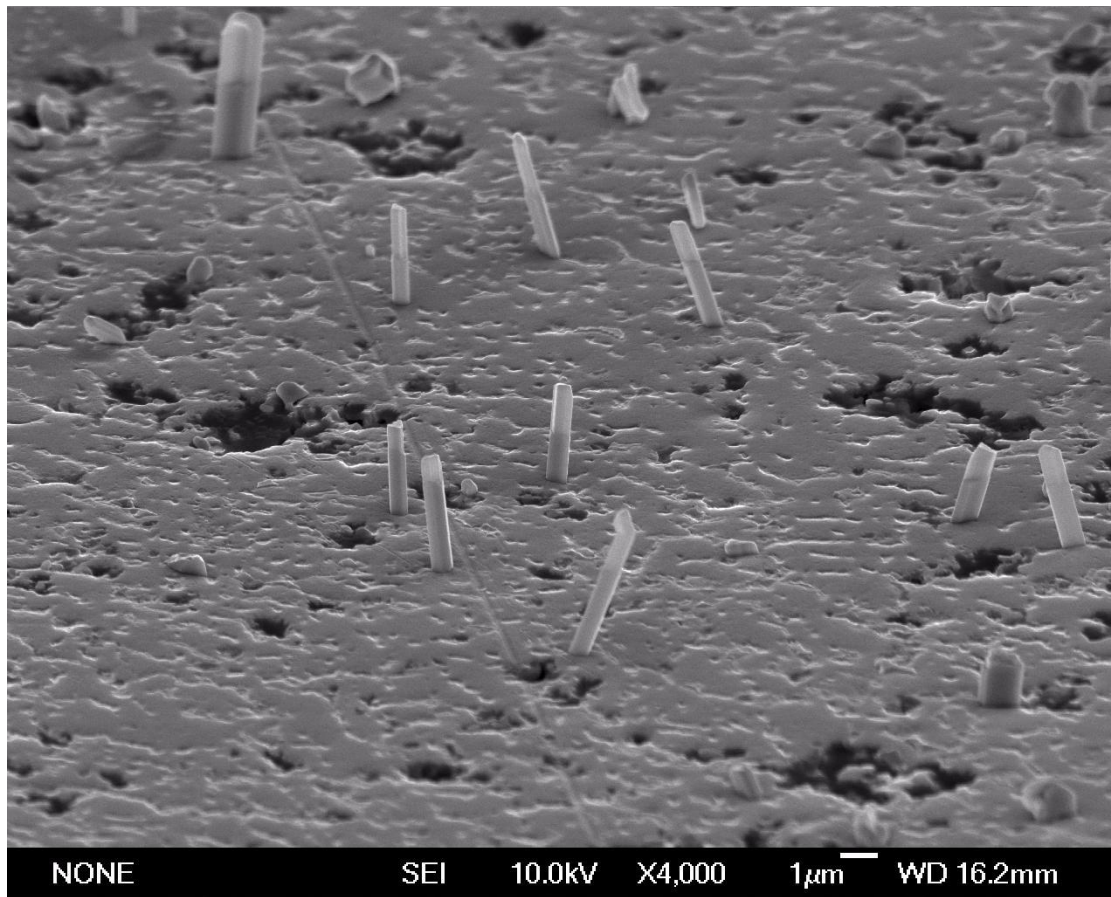
Tin Pest is a self initiating autocatalytic, allotropic transformation of tin, which causes deterioration of tin objects at low temperatures (starting around -13).



## Tin Whiskers



## Whisker Spontaneous growth



Credit H. Begg  
(TWI)

So ?



So what if we get whiskers?  
They will just blow out like a fuse!

Not necessarily!  
In Vacuum things change.  
Hi energy / Large currents Will explode / vaporize a fine short circuit  
Low energy / small current?  
Will not necessarily cause a failure –  
the short circuit element could just get hot!

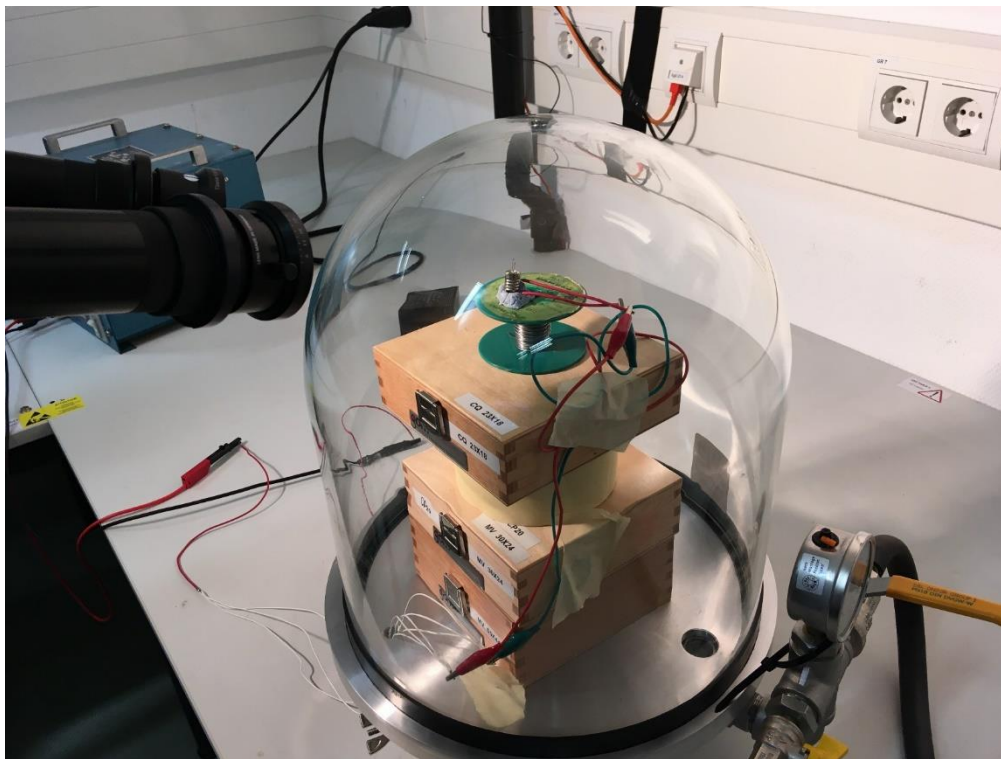


# Simple filament





# Set up



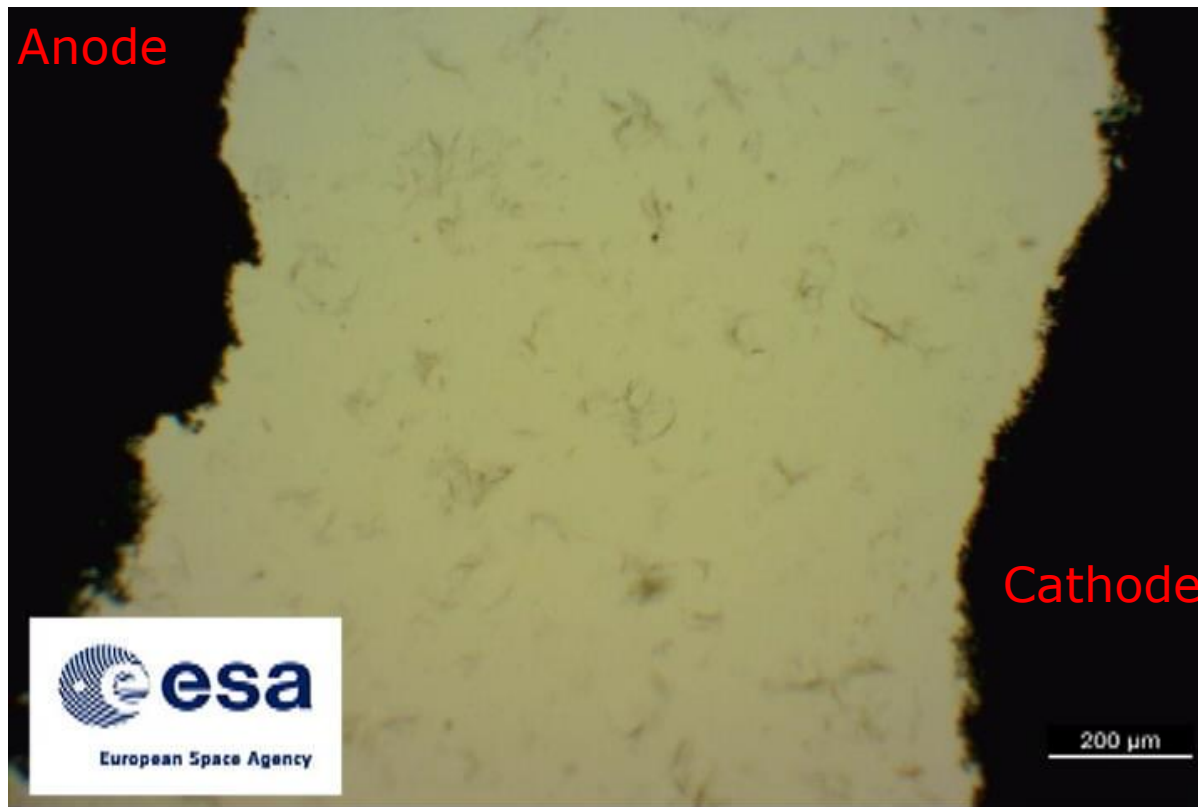
# + Vacuum



## Dendrite Growth risks

- Dendrite growth is the flow of Ions in a conductor, due to potential difference between 2 conductors.
- Described as an Ionic migration, it occurs below 100 Degrees C in moisture conditions.
- Materials affected include Silver, Nickel, Palladium etc. In fact any anodoically soluble metal (requiring low initiating activation energy)
- Known to grow on substrate surfaces, component surfaces, in cracks in capacitors and even Nickle dendrites in cracked glass feed through beads





# What are the Questions ?



So what about Dendrites?

Not known to occur in vacuum (flight) – only atmosphere.

Need bias and humidity (liquid or partial liquid)

Once formed they create a high impedance short.

The longer the power is on (and kept wet) the worse it gets!

They will not easily fuse!



# Conclusions



From the packaging perspective:

- COTS packaging and lead free assembly bring a whole variety of new potential issues to the established market place.
- New packaging and assembly
- Very little heritage and history for flight applications
- Very little data available to the Agency on space level testing performed
- Upcoming packaging materials restrictions (RoHs, REACH)



Please share your  
solutions

Please share your Data

Thank you –  
Questions?