

# Hermeticity in high reliability devices

**Relpack 2017**  
**Daresbury 30.11.2017**

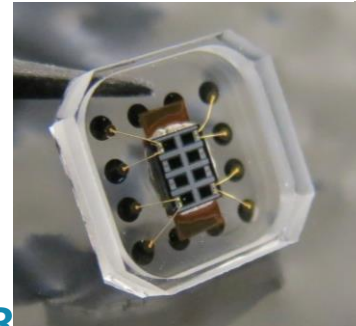
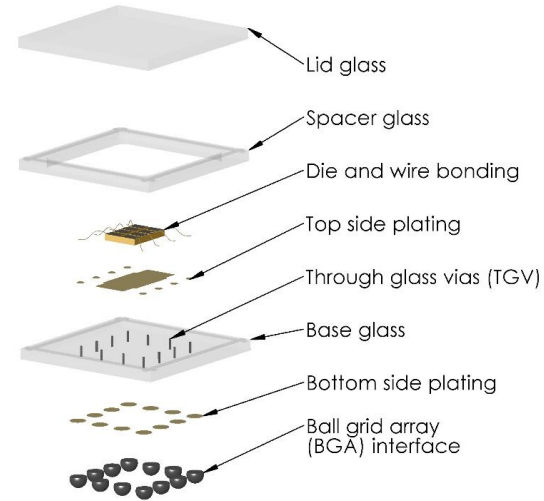
## Hermetic packaging

R&D Services

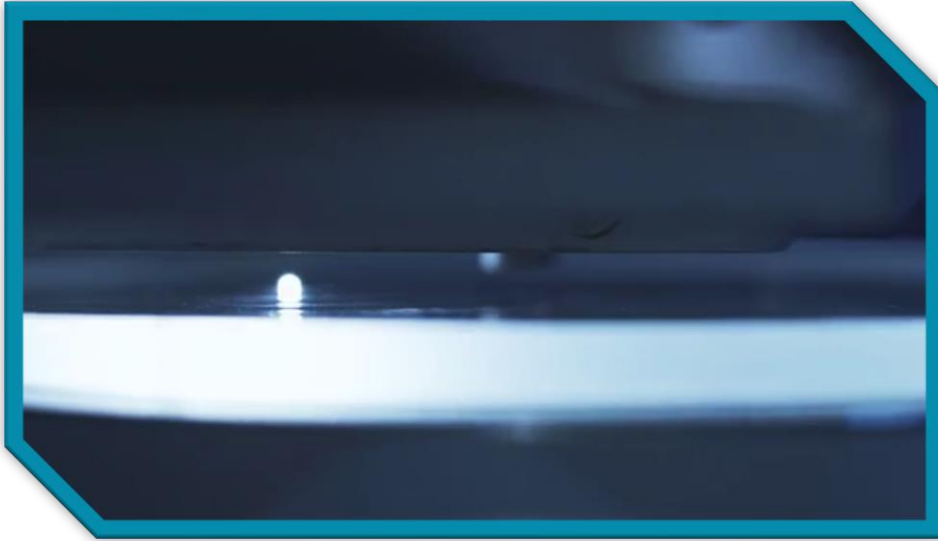
Proof of concept testing and prototypes

Manufacturing services

Reliability validation

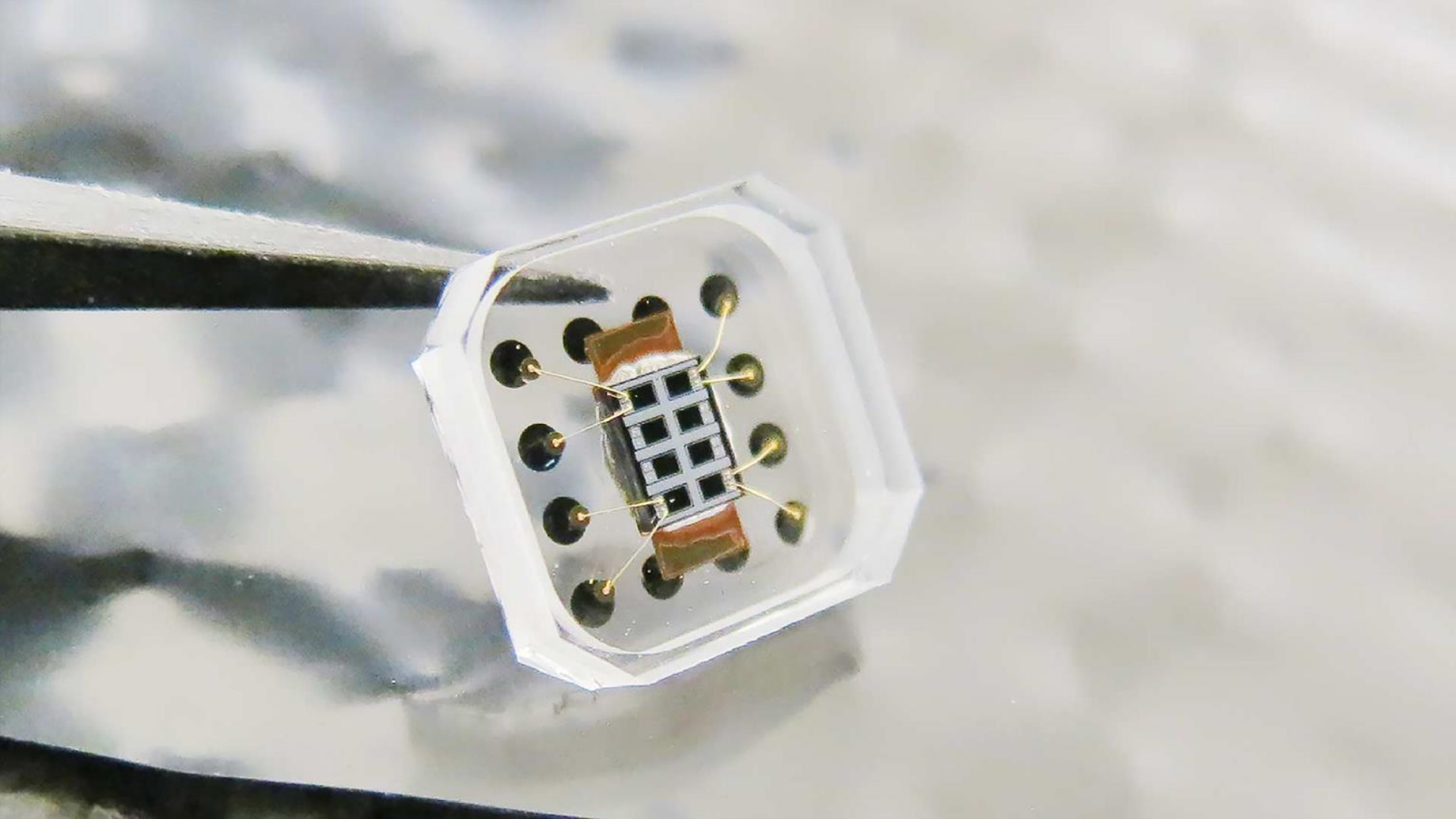


# Primoceler – Glass Micro Bonding

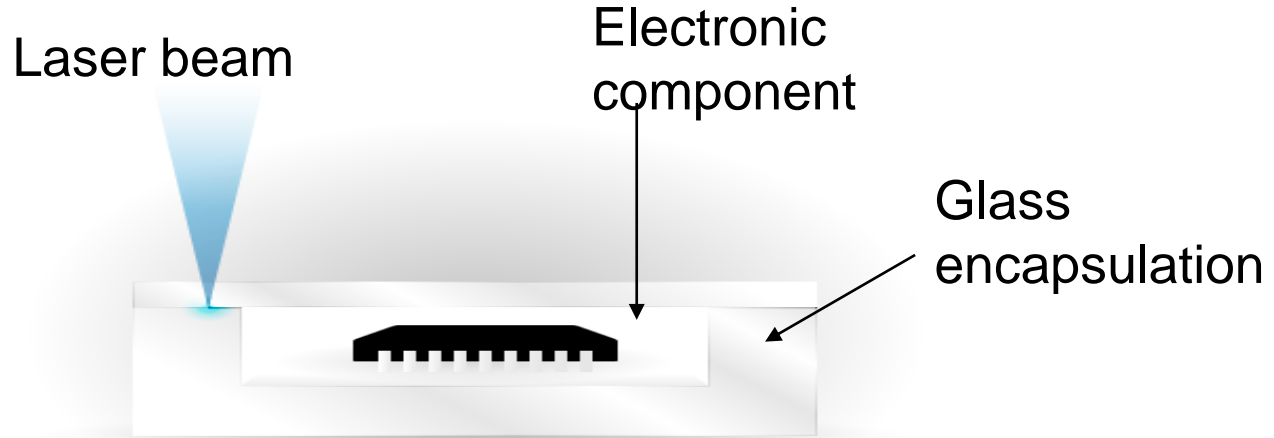


- Laser process
- Material surfaces left untouched
- Room temperature
- No additive materials
- Truly hermetic bond
- Over 200 customer projects





# How it works



## Hermetic packaging to ensure reliability

- Stable environmental conditions – Device retains its performance over time
- Minimize oxidation, corrosion and other failure modes
- Some applications rely on stable conditions inside the package

Many sensor applications, reference cavities, atomic clocks to name a few

- I will focus here on medical implants and aerospace applications

## Active medical implants

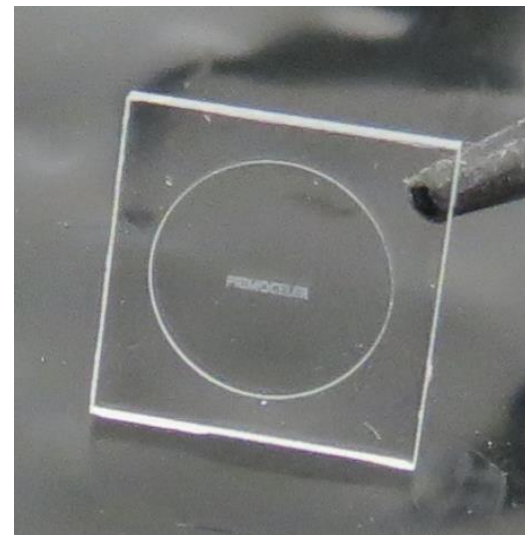
- High level of hermeticity is a must
- Failures in hermeticity can be fatal
- Even in the best case device will fail

Repair or change can be challenging or even impossible

# Hermeticity in high reliability packaging

## Medical implants

- Tested vigorously during implant verification
  - Biocompatibility testing
  - Animal trials
  - Clinical trials
- Failed hermeticity – No product in the market





## Aerospace

- Stable device performance essential

Opto-electronics, imaging, star-tracking, atomic clocks....

- Devices stored on Earth for long periods before launch

Months and even years

- Any moisture inside the package will cause issues after launch

## Dendritic growth

- Potential difference between two conductors causes a flow of ions - dendritic growth
- Also described as ionic migration

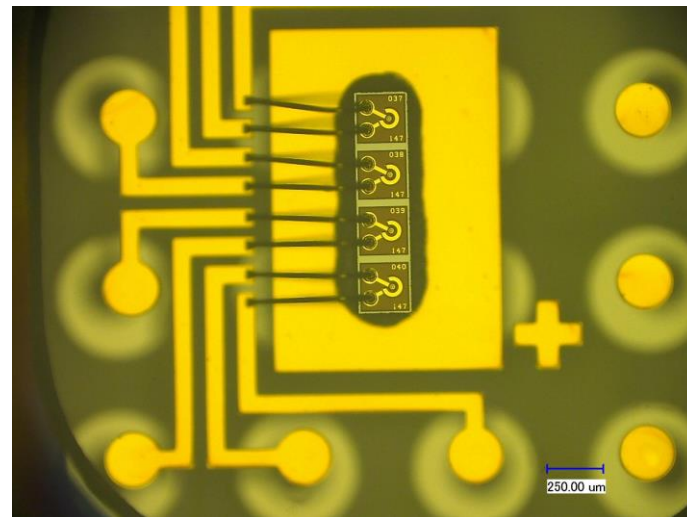
Happens below 100C and high moisture environments

- Happens for example with silver, palladium, nickel etc

Silver known to be a really bad material

## Dendritic growth - Requirements

- Requires material with free or loose ions
- Potential difference between electrodes
- Electrolyte or very high humidity



## Dendritic growth

- No electrolyte – No Reaction
- If moisture dries out the reaction stops. Continues again if moisture returns.
- High moisture enough – No condensation needed
- Special concern for epoxy mounted chip components

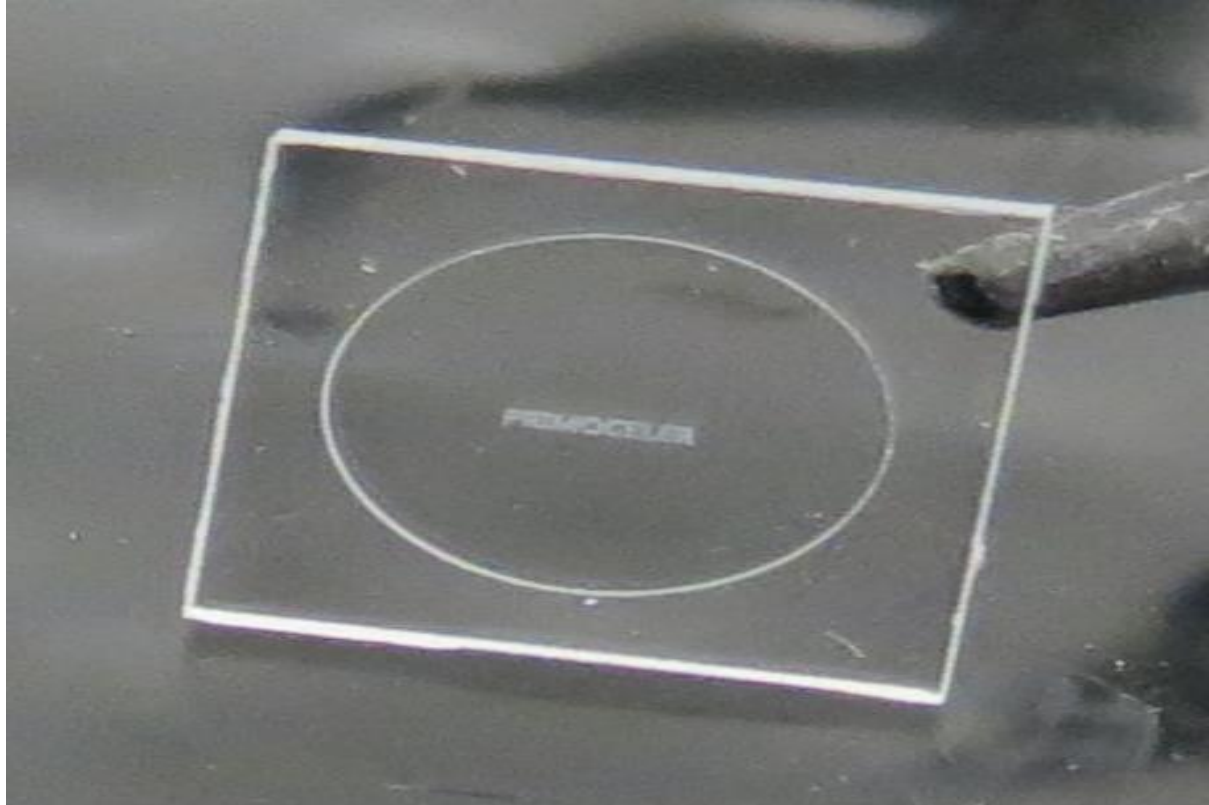
Challenging to bake-out and to inspect

## Dendritic growth

- Does not need a long time to grow – Can cause issues only in minutes
- Video shown next is real time
- Silver dendrites
- Potential difference needed is minimal: In the video 3 volts

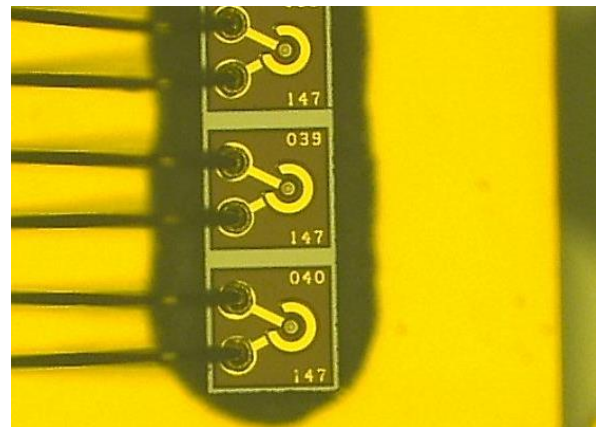
# Dendritic growth – Realtime video

Silver dendrites



# Hermeticity in high reliability packaging

- Hermeticity just one factor  
Hermetic packaging and device only assists in reliability
- Environmental conditions during packaging  
Shield gas, pre-bake
- Outgassing
- Material selections
- Manufacturing steps
- Etc.etc.etc.



## Time for questions

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