Flip-chip bonding : how to meet the high accuracy requirements?

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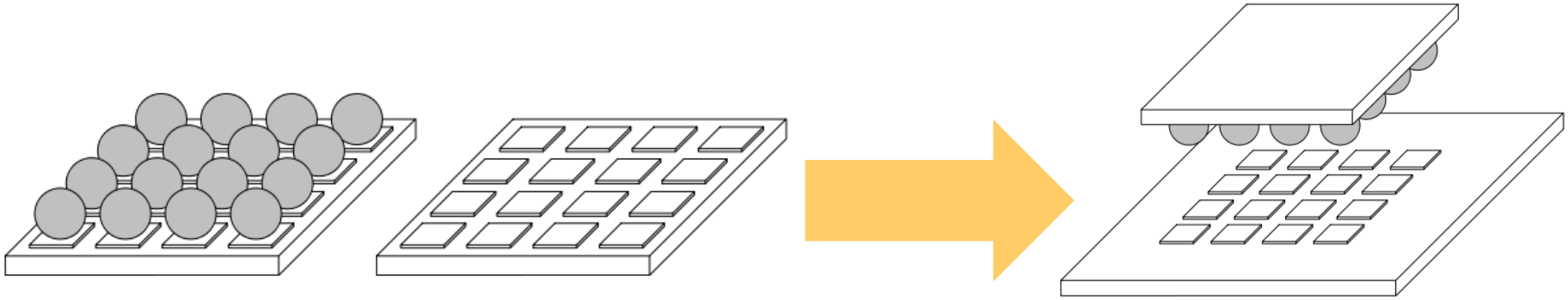
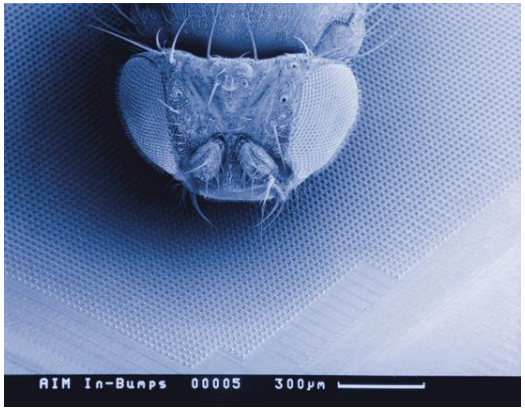
What is flip-chip ?

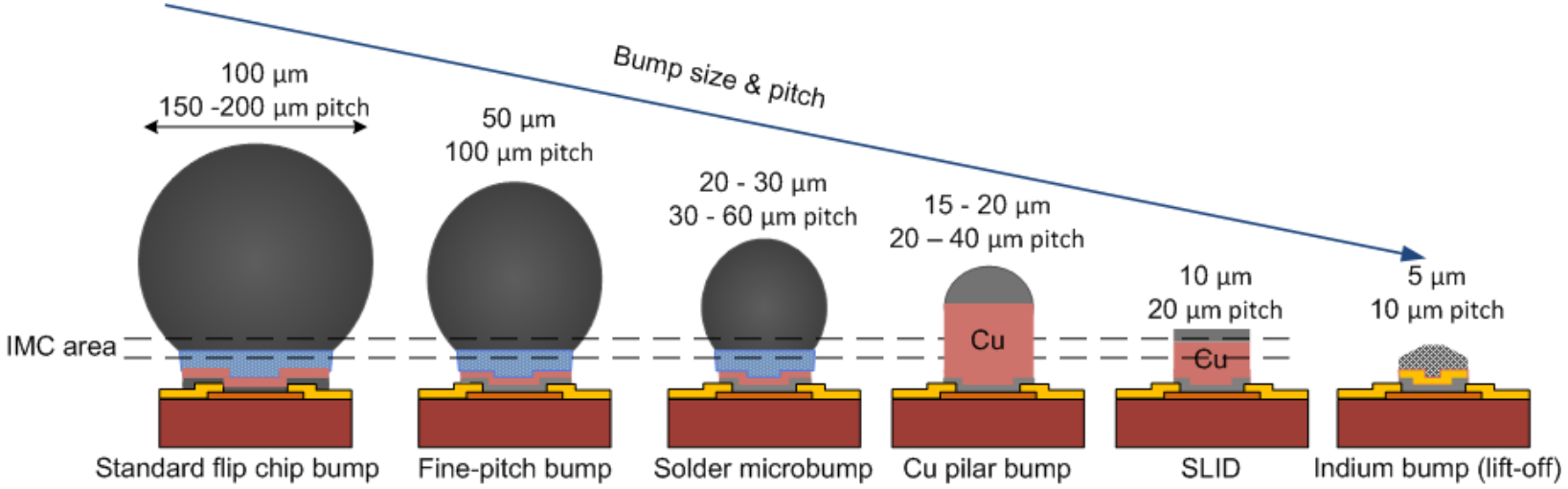


- **Advantages**
  - Reduce the length of interconnections
  - Increase the number of I/O
  - Reduce the size of package

Need for high accuracy

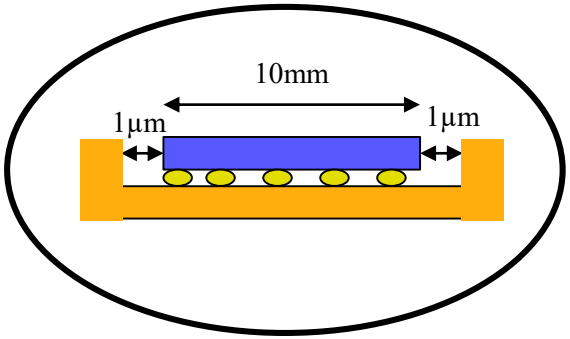


- **Evolution in bumping method**

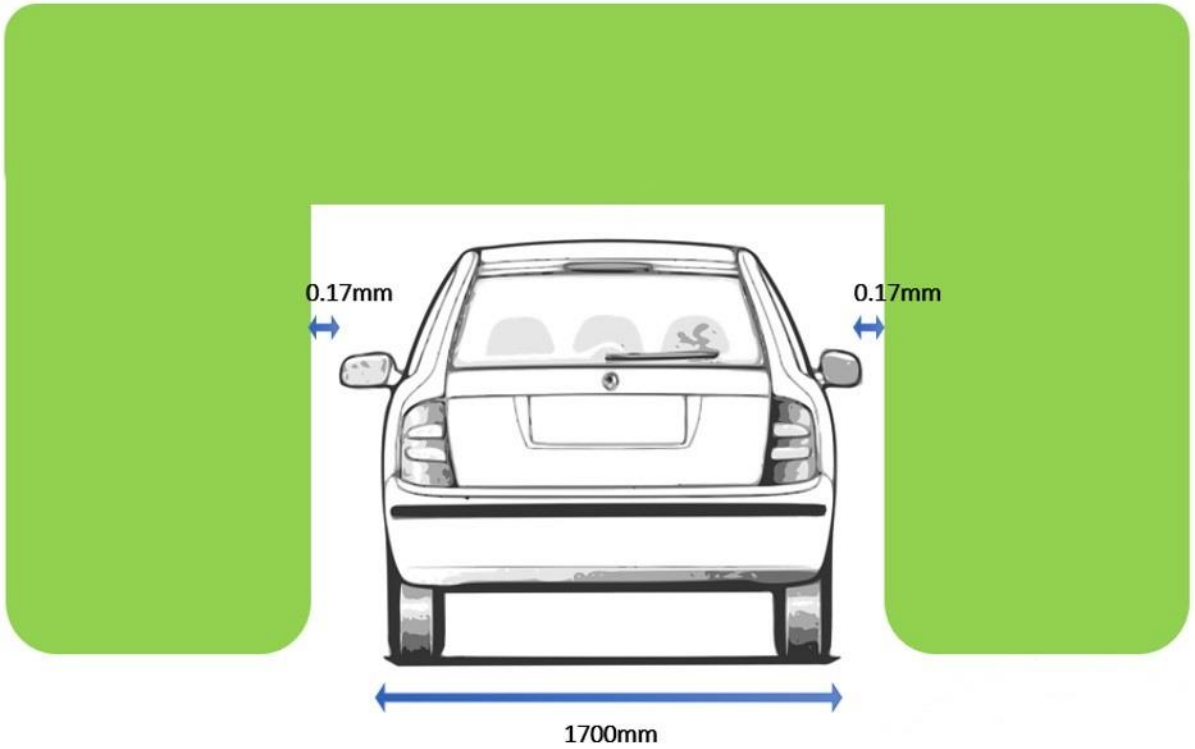


Courtesy of Sami Vahanen – Advacam/CERN – ESE 2010

Need for high accuracy

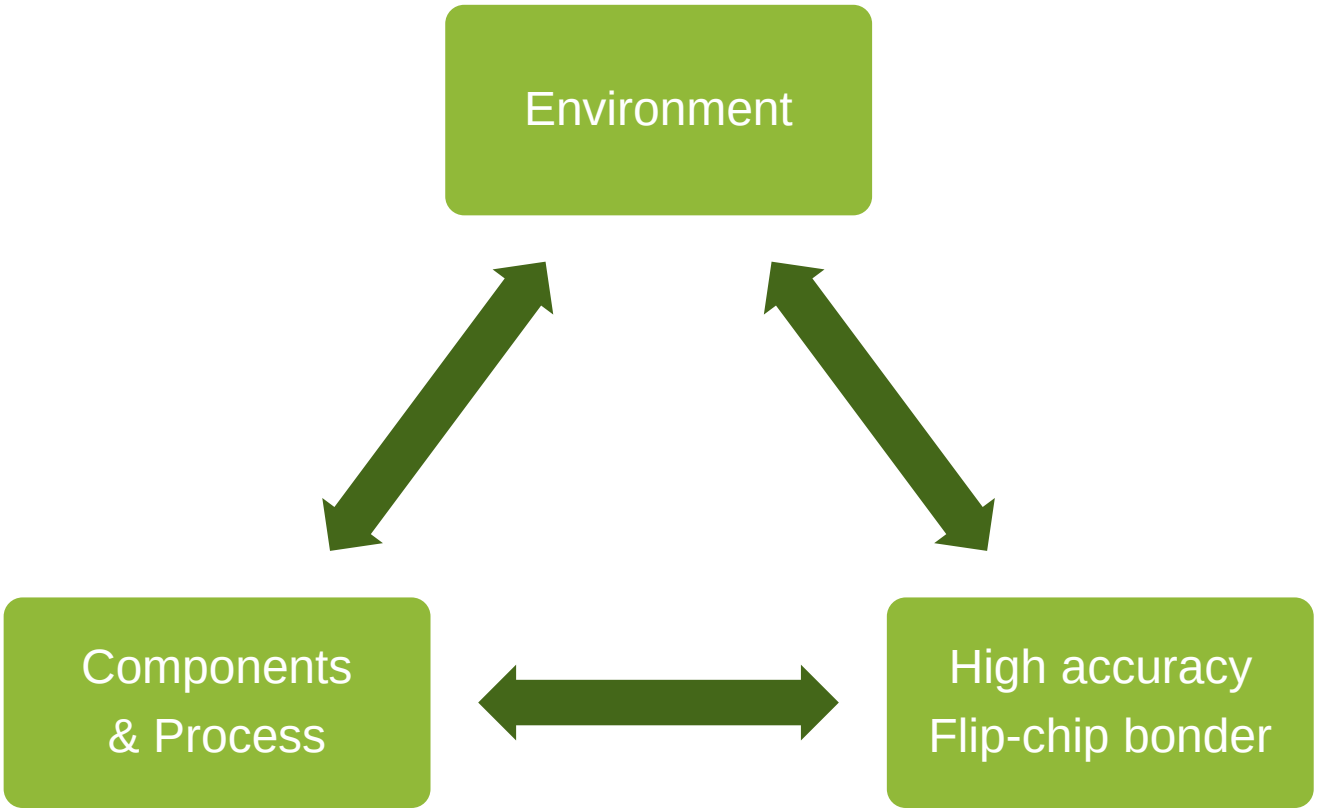


- **What does it mean?**



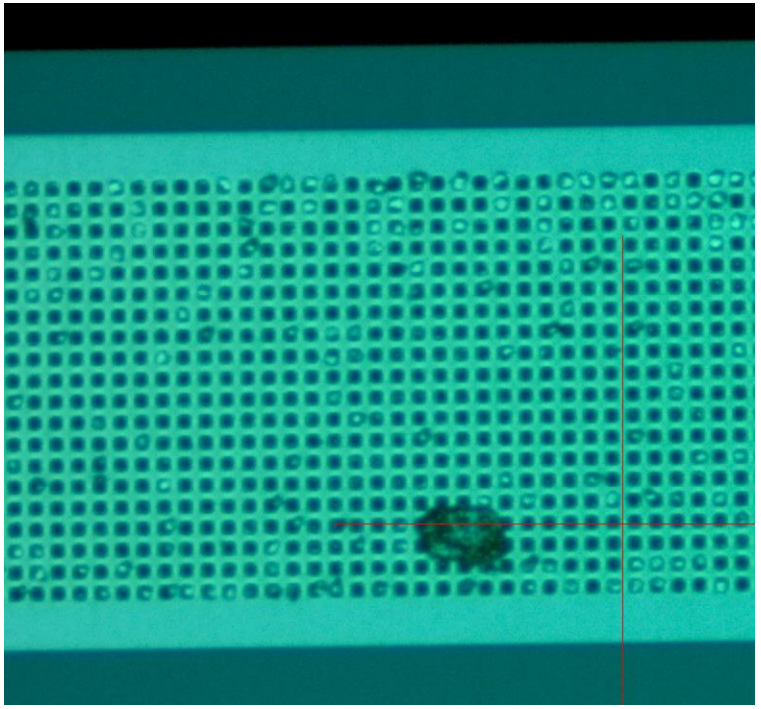
Need for high accuracy

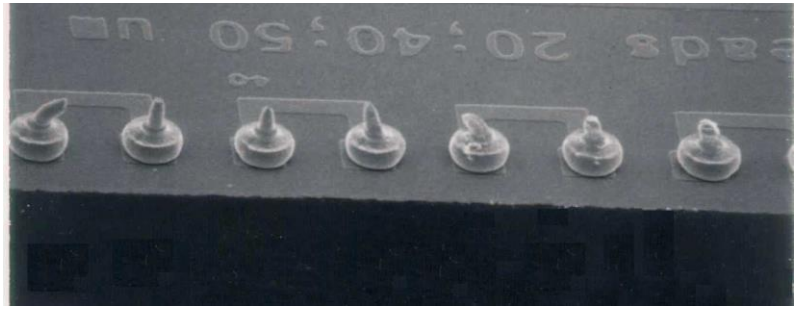
- **Key parameters**

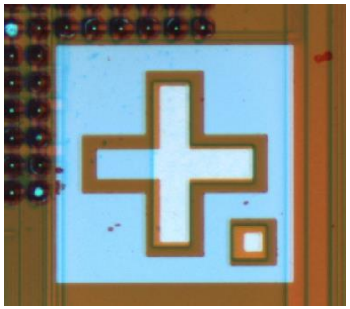


Need for high accuracy

- **Components**
  - Good alignment marks onto the components
  - Shape of bumps
  - Choice of material
  - Cleanliness of components







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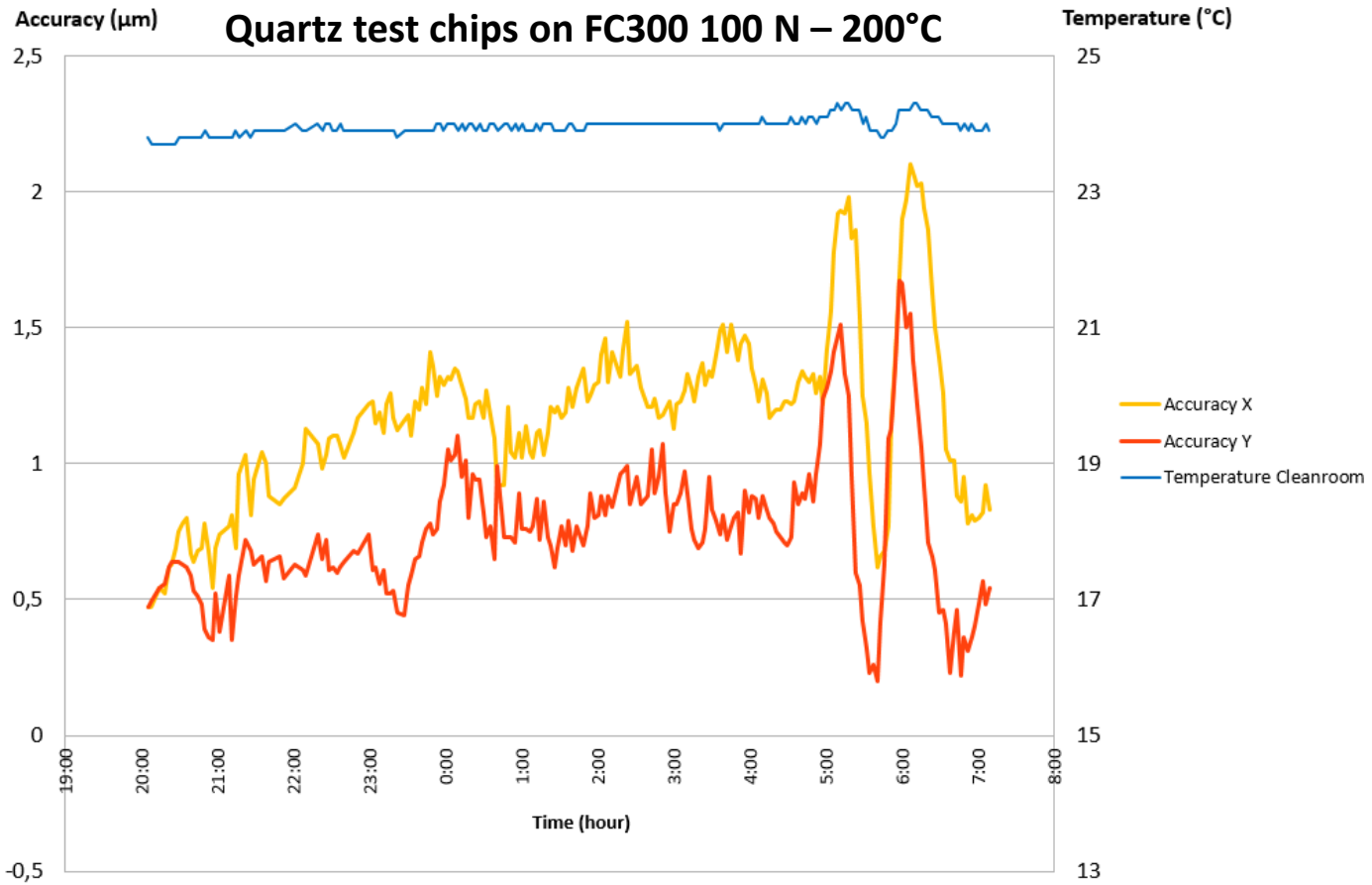
Need for high accuracy

- **Environment**
  - Stability of temperature



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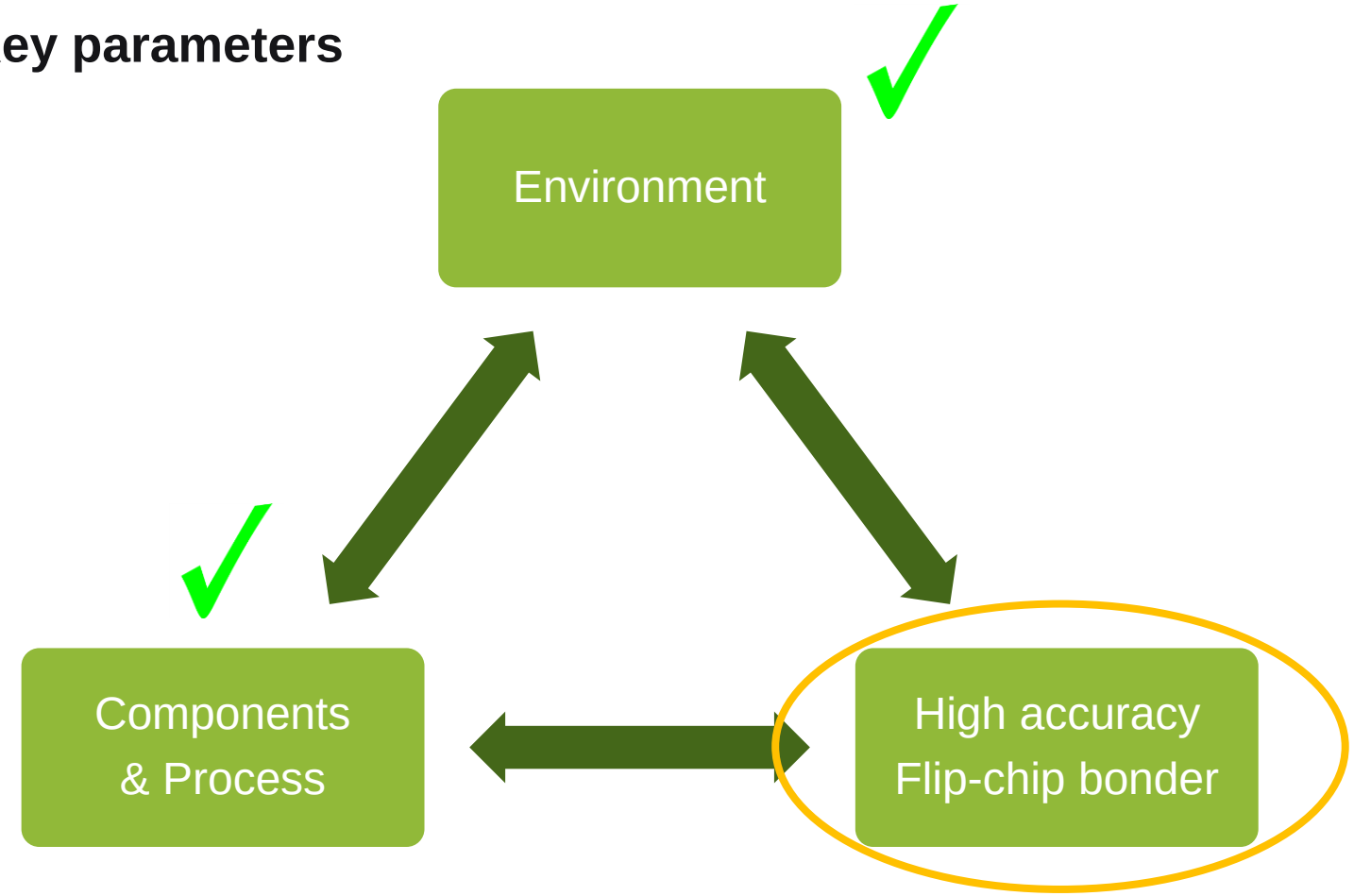
Need for high accuracy

- **Key parameters**



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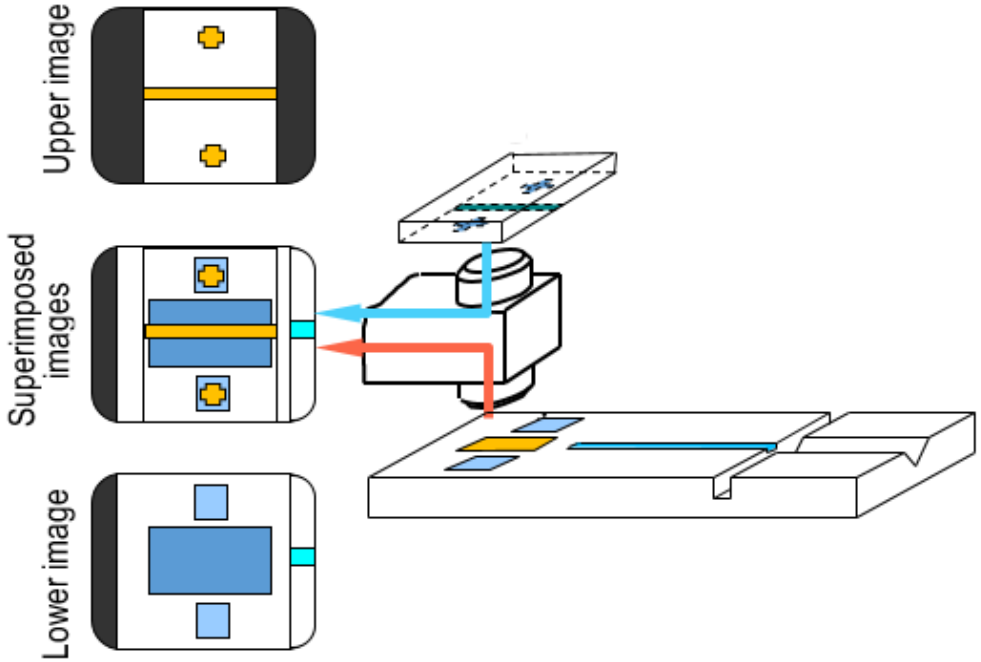
3 steps for achieving high accuracy bonding

- **Alignment step**



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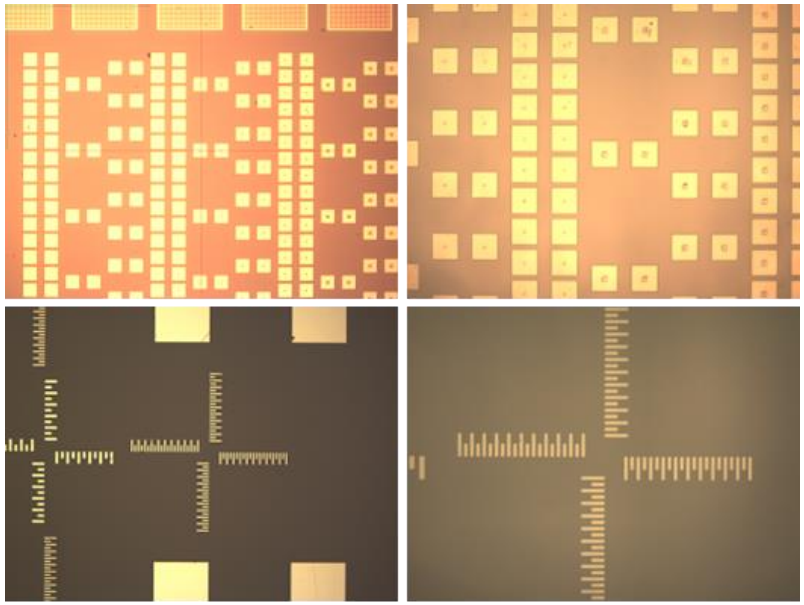
3 steps for achieving high accuracy bonding

- **How to align precisely ?**
  - High resolution optics
    - Objectives
    - Lighting
  - Alignment in live with a real microscope
  - Superimposed images
  - High resolution stages XYZTheta

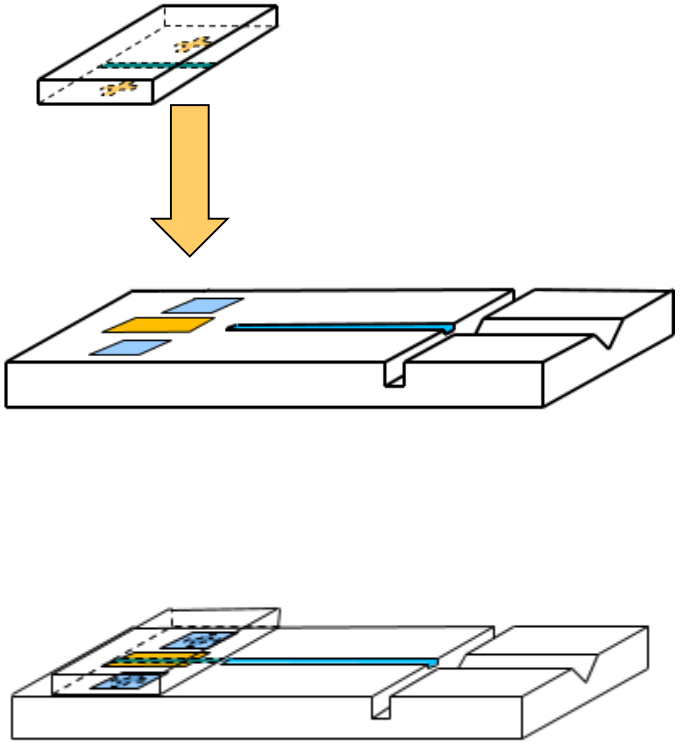


Field of view with 20X objectives

Field of view with 50X objectives

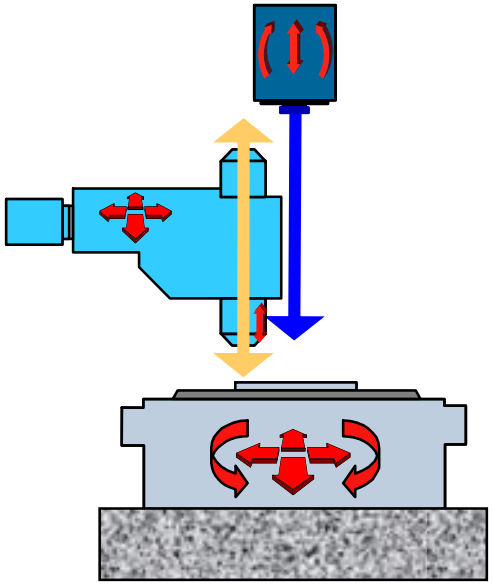
3 steps for achieving high accuracy bonding

- **Placement step**



3 steps for achieving high accuracy bonding

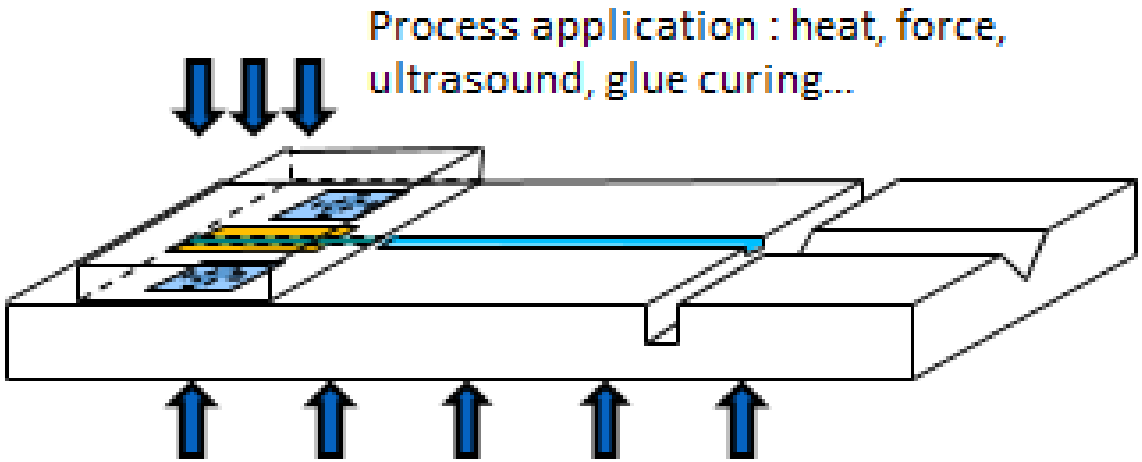
- **How to place precisely ?**



- Calibration method in order to make match the bonding arm axis with the visual axis

3 steps for achieving high accuracy bonding

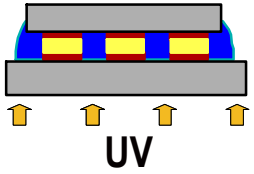
- **Post-bond accuracy**



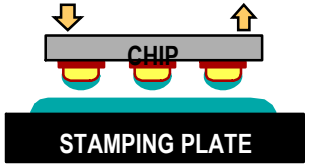
3 steps for achieving high accuracy bonding

Post-bond accuracy

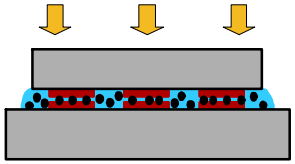
Adhesives: Non-Conductive



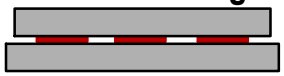
Adhesives: Isotropic Conductive



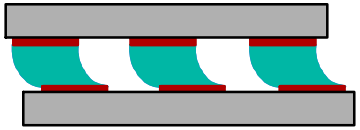
Adhesives: Anisotropic Conductive



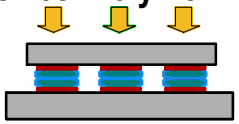
Direct bonding



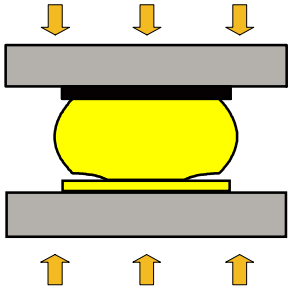
Mass Reflow



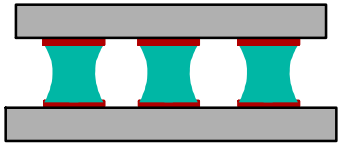
Adhesives: Polymer Bumps



Thermo-compression
Thermosonic



In Situ Reflow



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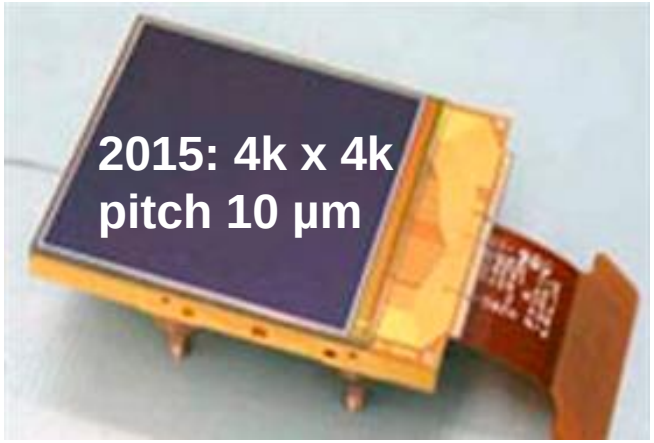
3 steps for achieving high accuracy bonding

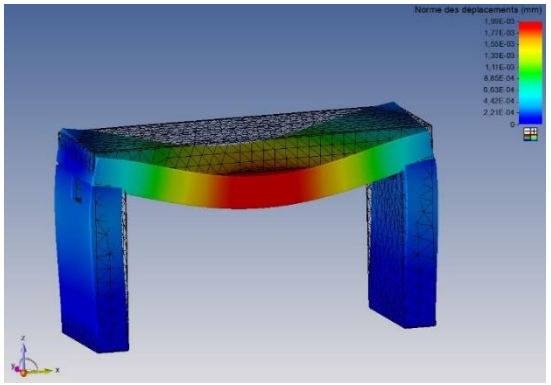
- **Application : Assembly of large IR detector**



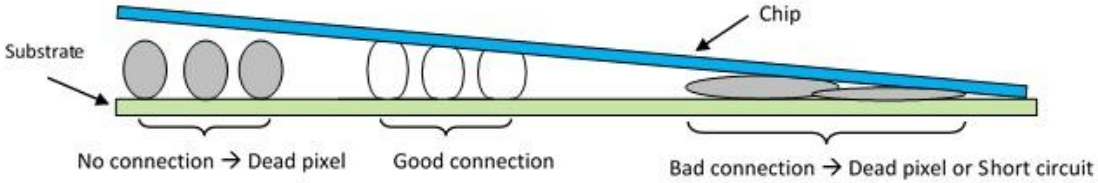
- **Process : Room temperature compression**
  - Metallisation: Indium bumps
  - Force: 2000 N
  - Temperature: RT(~20°C)

- **Challenge**
  - Keep accuracy under high forces

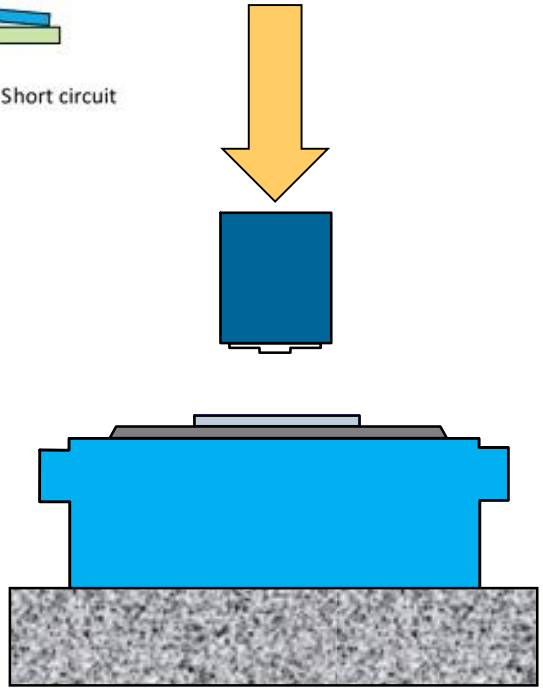
Post-bond accuracy – Key elements



- Stiff structure
- Control of parallelism



- Z-motion bonding arm

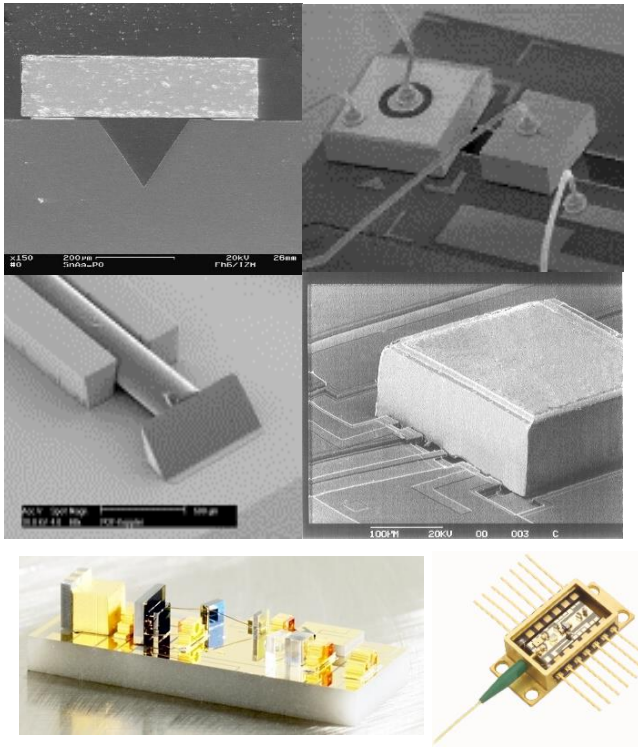


3 steps for achieving high accuracy bonding

- **Application: laser diode bonding**

- **Process: Reflow**
  - Metallisation: Solder
  - Forces: 0,6 N
  - Temperature: 350°C

- **Challenge**
  - Keep accuracy under high temperatures

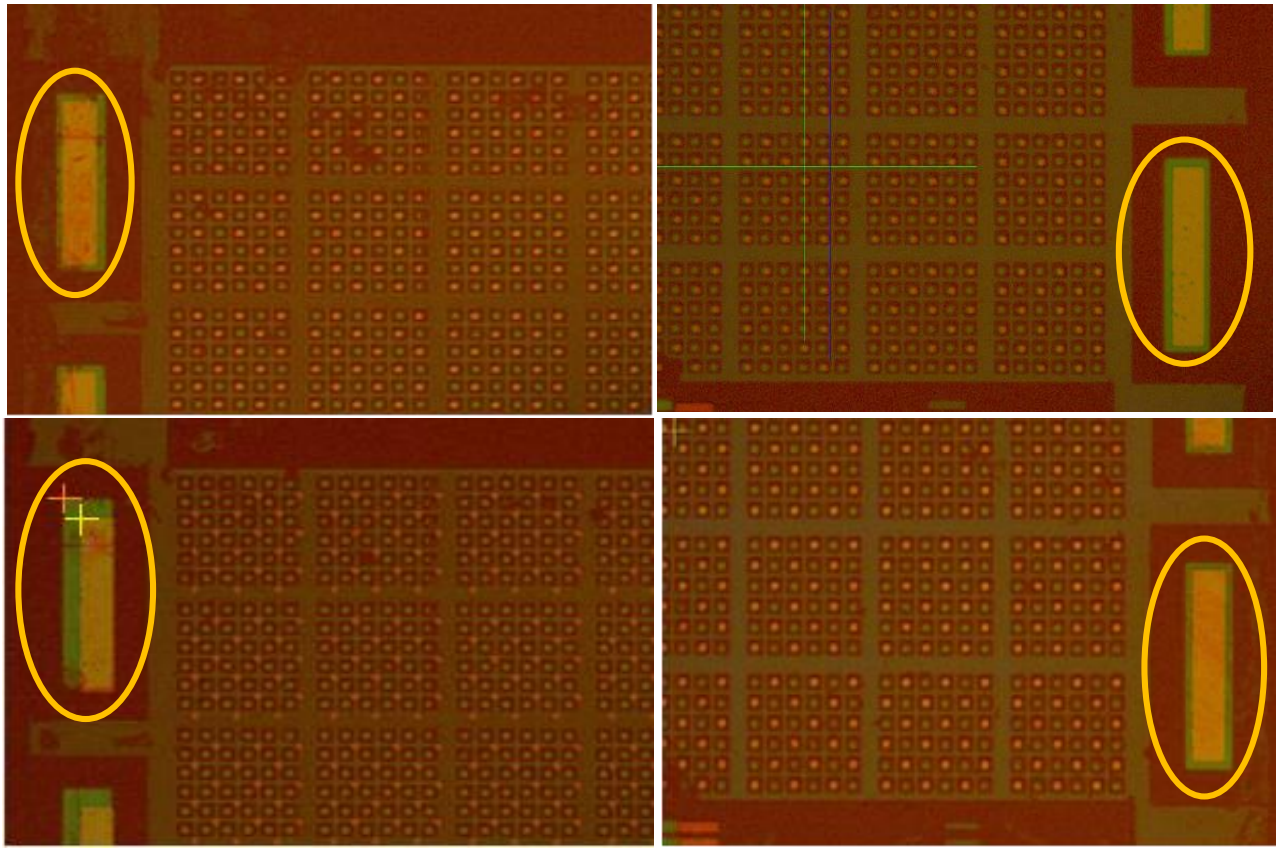


Post-bond accuracy – Key elements

- **Limit the temperature variations**

Alignment at room temperature

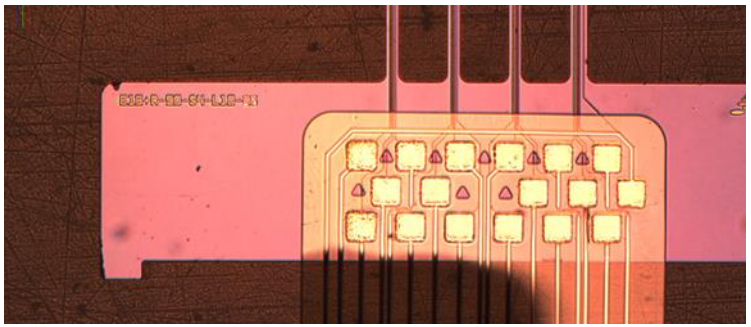
Alignement at 350°C



3 steps for achieving high accuracy bonding

- **Application: Chip-on-flex – Probes for brain**

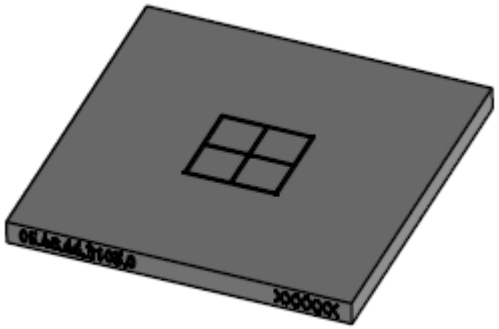
- **Process: Thermosonic bonding**
  - Metallisation: Au stud bumps/Au pads
  - Force: 8N
  - Ultrasonic power: 100W
  - Temperature: 280°C



- **Challenge**
  - Keep accuracy under forces, temperatures and vibrations

Post-bond accuracy – Key elements

- **Handling of components**
  - Customized design
  - Flatness
  - Choice of material



Tool for substrate

Pipette for chip

Post-bond accuracy – Key elements

- Control and record each parameters

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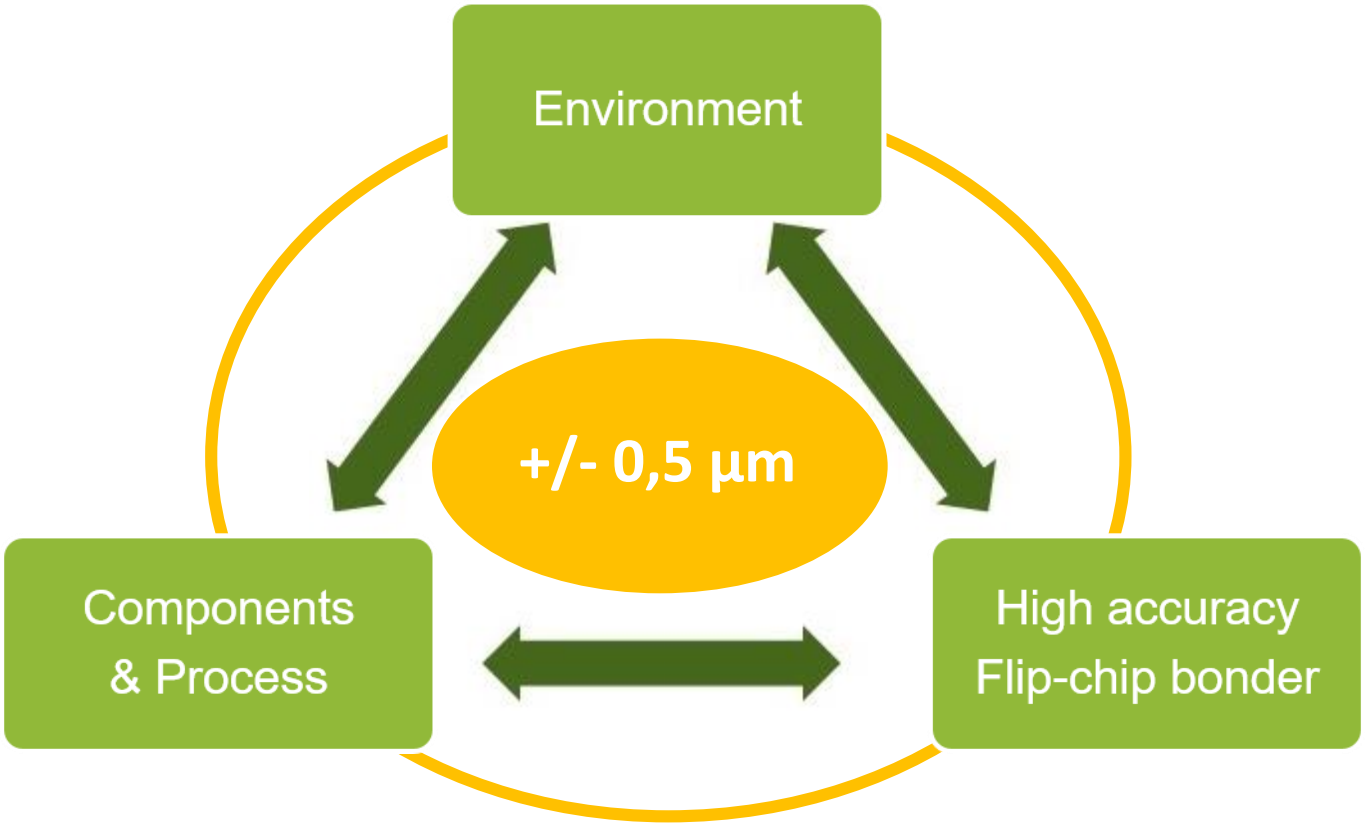
Conclusion



A close collaboration between you and us is the key to get good results

THANK YOU FOR YOUR ATTENTION

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ANY QUESTIONS ?

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