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Cost Effective MEMS to Develop a Sustainable High Tech Business

Liquid Metal Alloy Interconnects

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Liquid Metal Alloy Interconnects

"A Flexible Low Temperature Bonding Solution"

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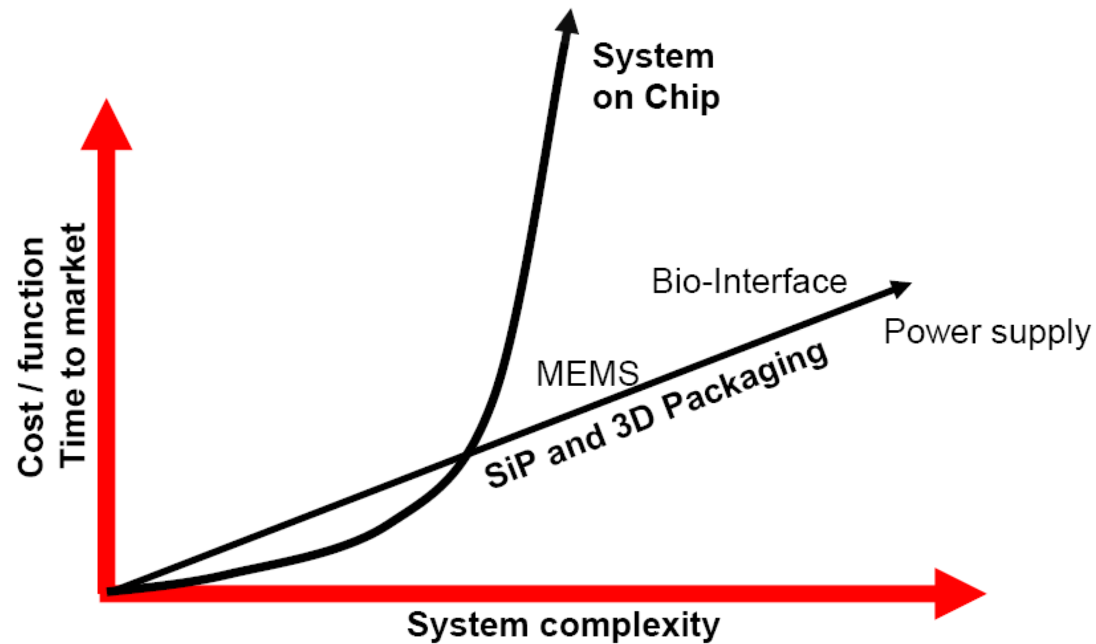
System Integration Solutions



Source: Fraunhofer IZM, Berlin Germany.

Advantages Liquid Interconnects

- Low temperature interconnection process
- Generic solution for heterogeneous systems
- Flexible solution (repair / re-use parts / prototyping)
- Reasonable electrical and thermal conductivity
- Interconnects are able to cope with CTE-mismatches

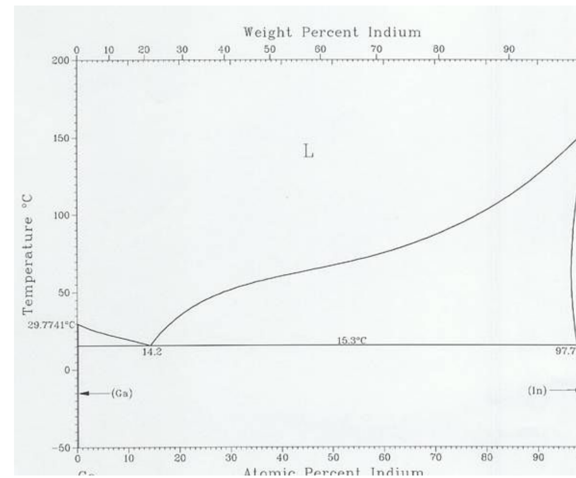
New process required!

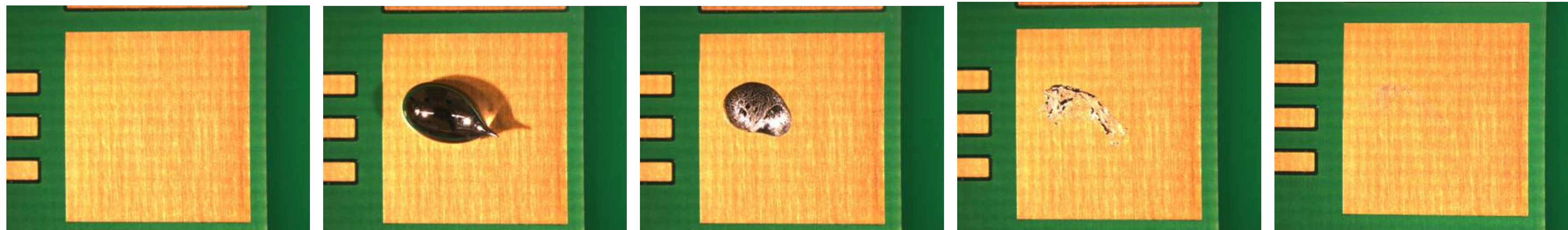
Liquid Metal Alloy: Ga-In

GaIn21.5wt.%

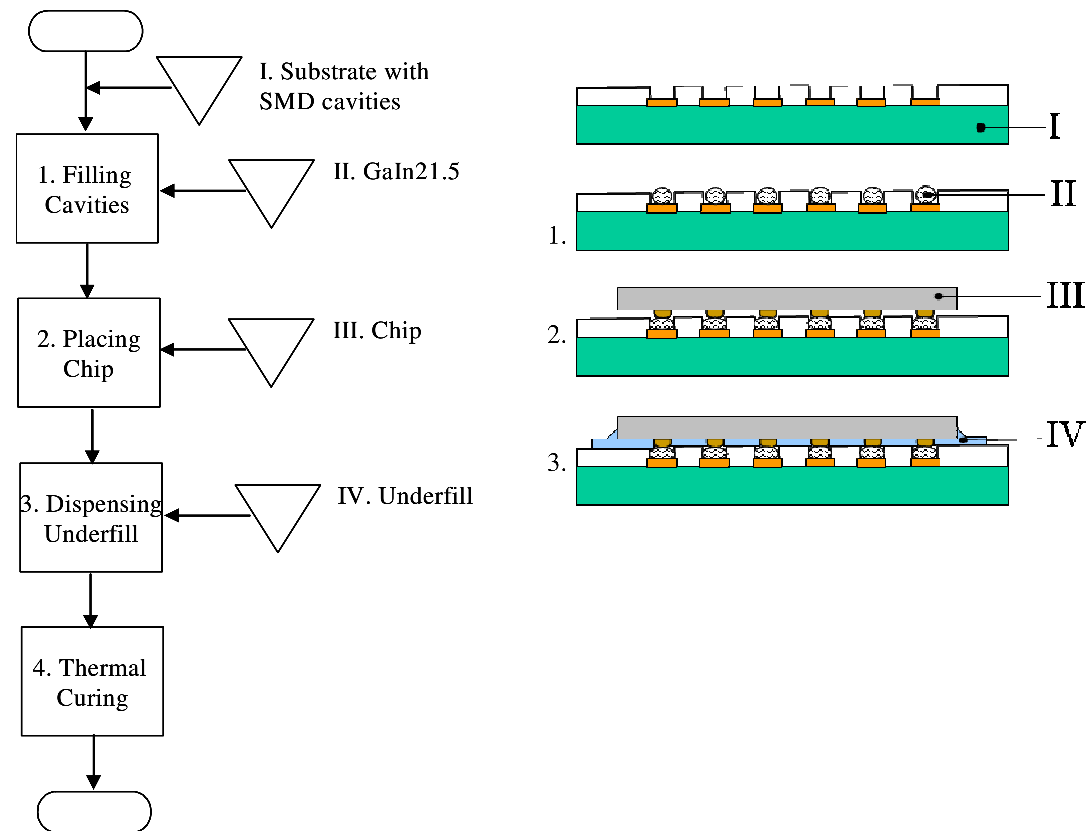
T_{EUT} = 15.3 °C

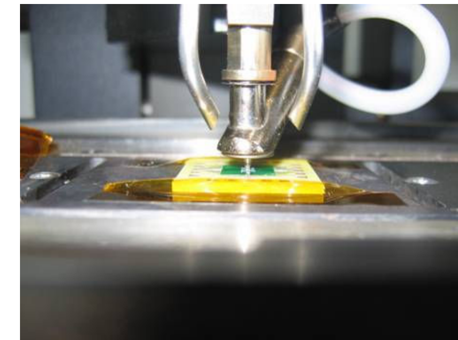
Supplier: Mat-Tech





Interconnection Process

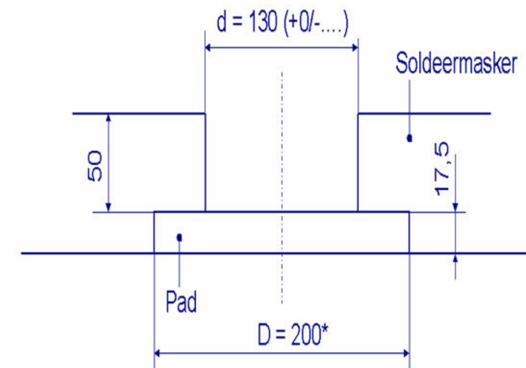


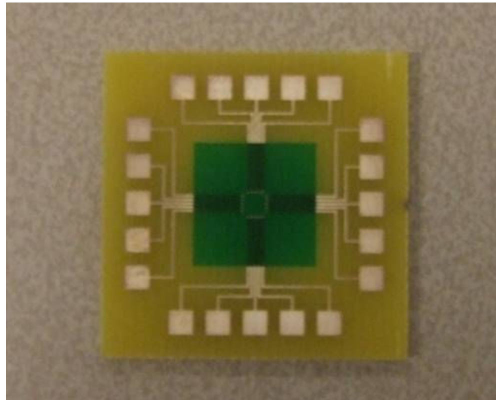


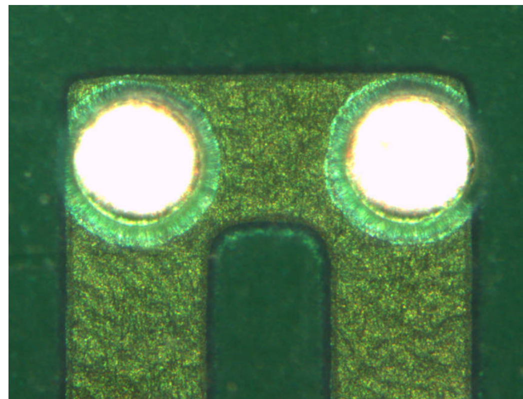
Low temperature bonding process (< 100 °C) with Emerson & Cuming E1172A (fast flow snap cure capillary flow underfill)

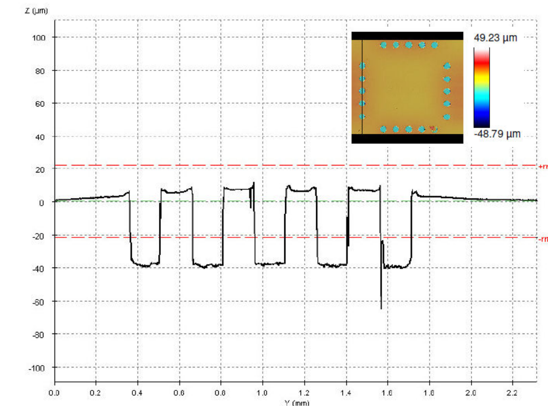
Solder Mask Defined (SMD) Cavities

Substrate: FR4 (rigid)
Dimensions: 25 x 25 x 1,6 mm
Conductor: 17,5 µm Cu, Finish: Immersion Ag
Solder mask: dry film photoimageable (SMD)
Manufacturer: Cyner Substrates





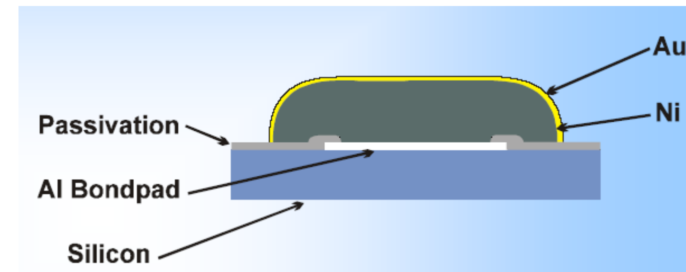


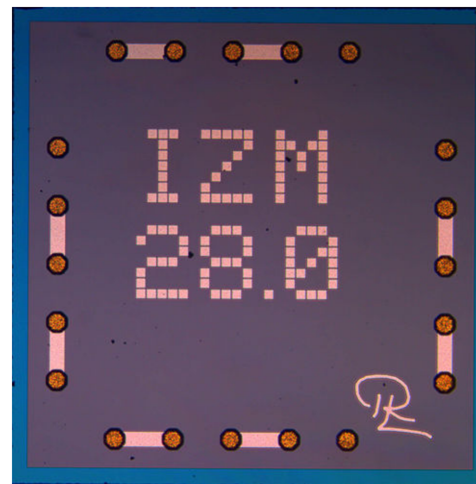


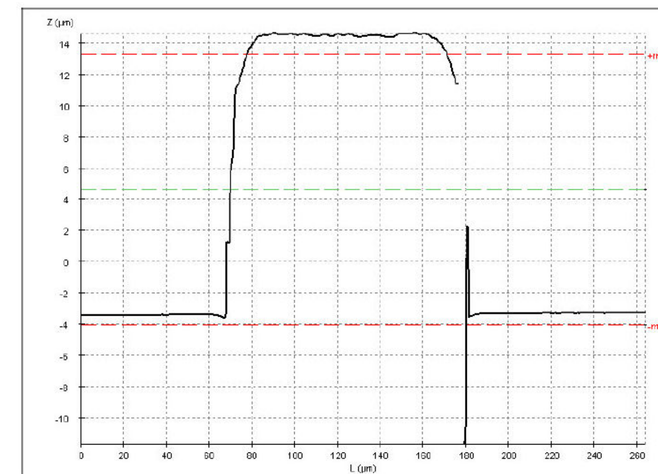
Chip and Bump Design

Daisy chain test chip designed and manufactured by Fraunhofer IZM

Dimensions: 2,5 x 2,5 mm (thinned by Disco till 150 µm), 20 I/Os, 300 µm pitch. Bumps: Electroless Ni Immersion Au (20 µm height)







Applying Liquid Metal Alloy

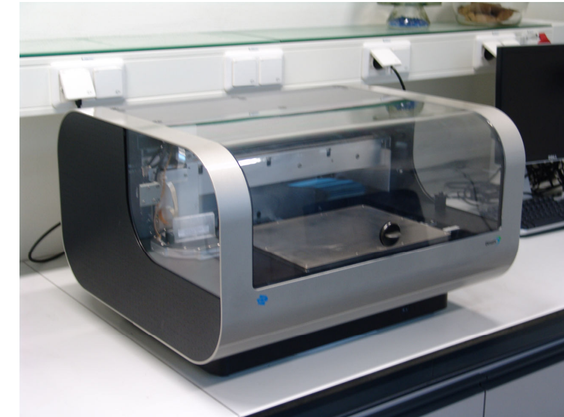
Tests to apply GaIn24,5wt.% and GaIn21,5wt.%

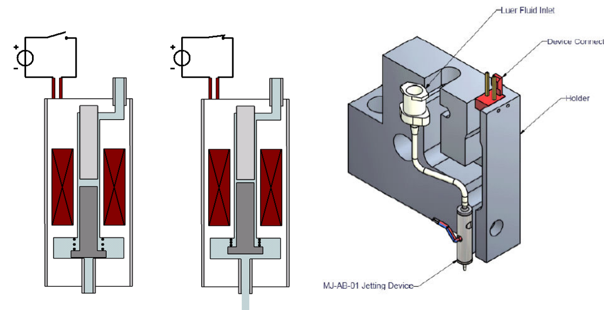
Dimatix printer: 3D translation system with disposable print cartridge/head combination

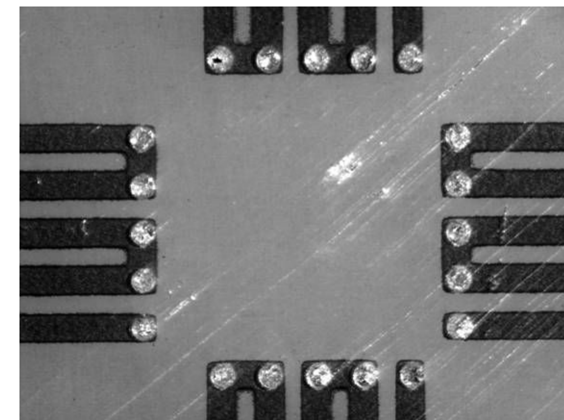
Valvejet: 80 um nozzle diameter, drop sizes between 250 and 400 um

HV print system: high pressure pump and a piezo electronic actuated print head

Microfab / Microfab with High Temperature print head: contraction of a glass tube by piezo elements

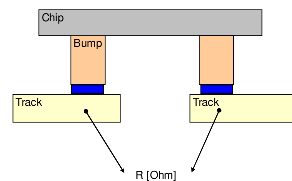


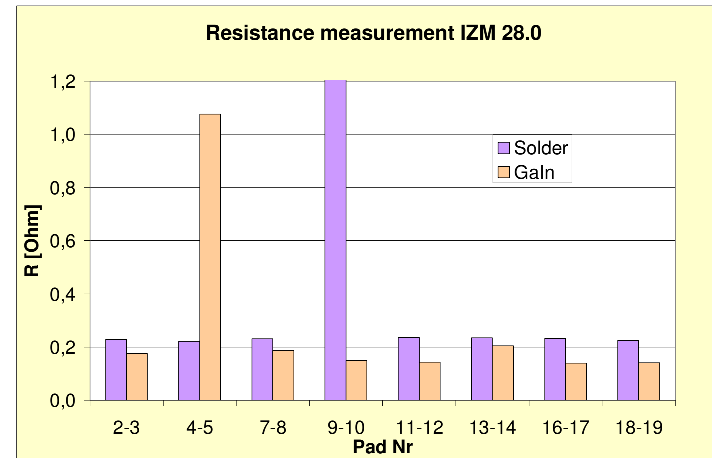


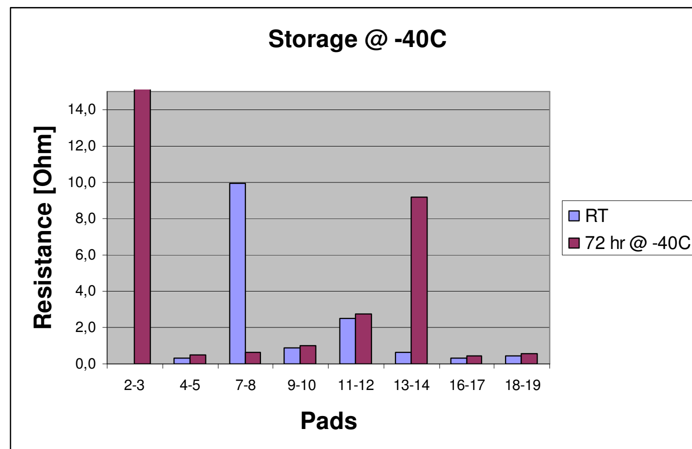


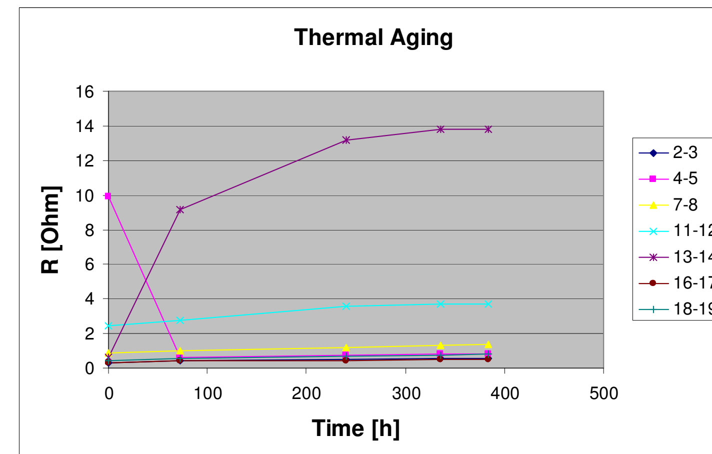
Electrical Resistance Joints

- Comparison with SnPb37 (RT)
- Thermal aging @ 85C
- 72 hr storage @ -40C



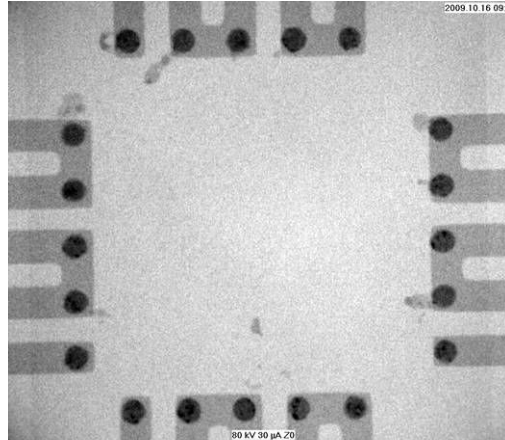


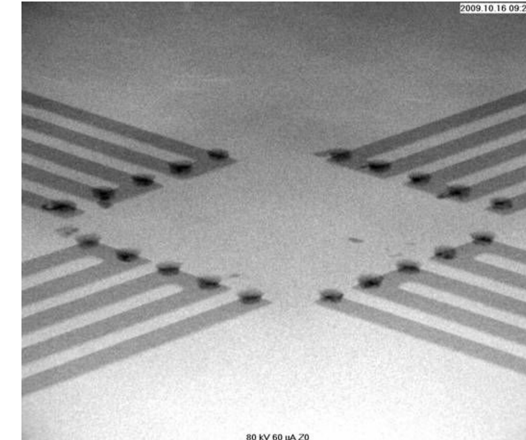




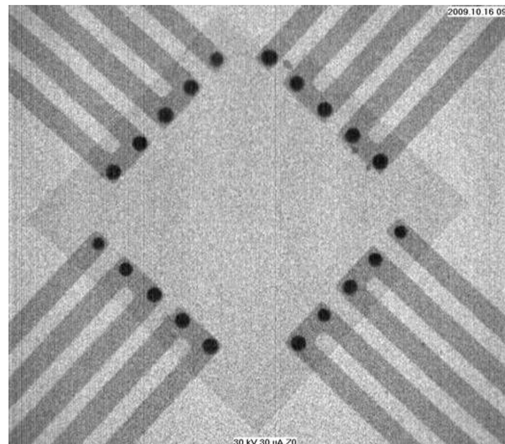
Joint Inspection: X-Ray Analysis

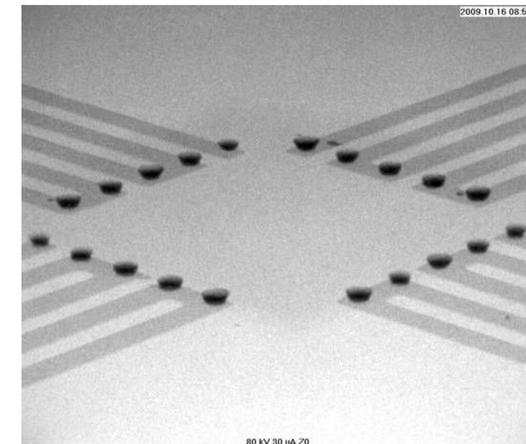
Liquid Metal Alloy:





SnPb37 Solder:





Folded 3D Package

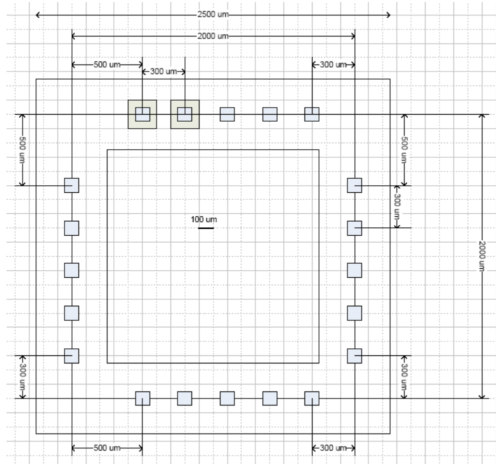
Thinned daisy chain flip chips

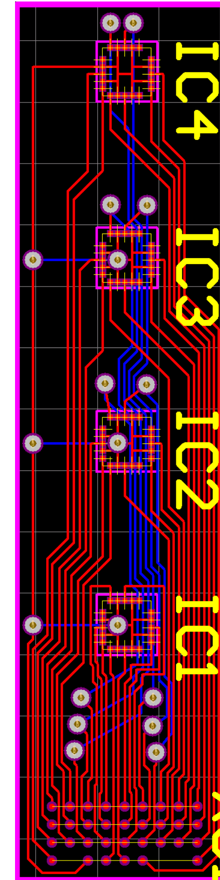
Foil material: polyimide

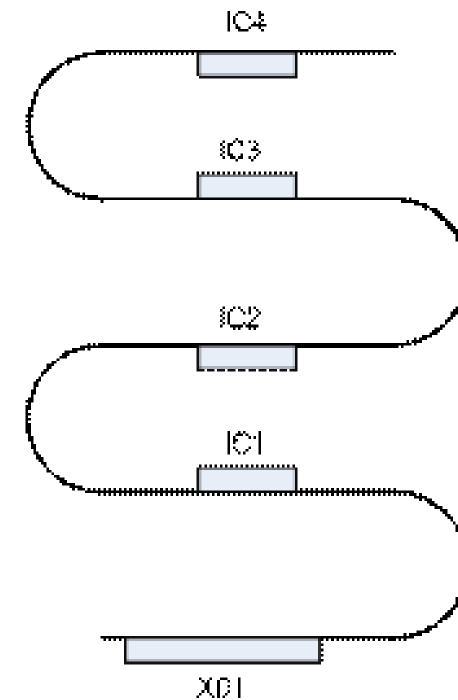
Line width / spacing:100 / 100 µm

Metallization: Immersion Ag

2nd level pads : Ø 250 µm







Conclusions

- Ga-In has been used as a liquid metal alloy to connect flip chips to substrates.
- A process has been developed to demonstrate the potential of the technology and investigate joint properties.
- The initial results are promising: low temperature bonding process (<100 °C), electrical resistances joints ≈100 mΩ.
- Flexible and generic solution (heterogeneous system integration).
- Next step: applying liquid metal alloy in a controlled way into the cavities.

Thank you for your attention

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