Ongoing R&D Activities at CiS Forschungsinstitut für Mikrosensorik: Bump Bonding
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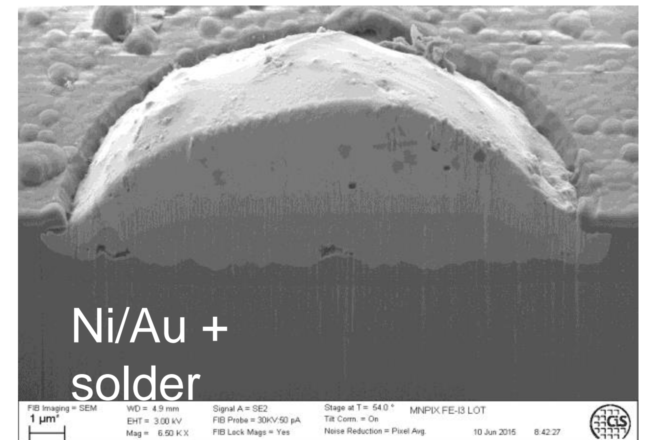
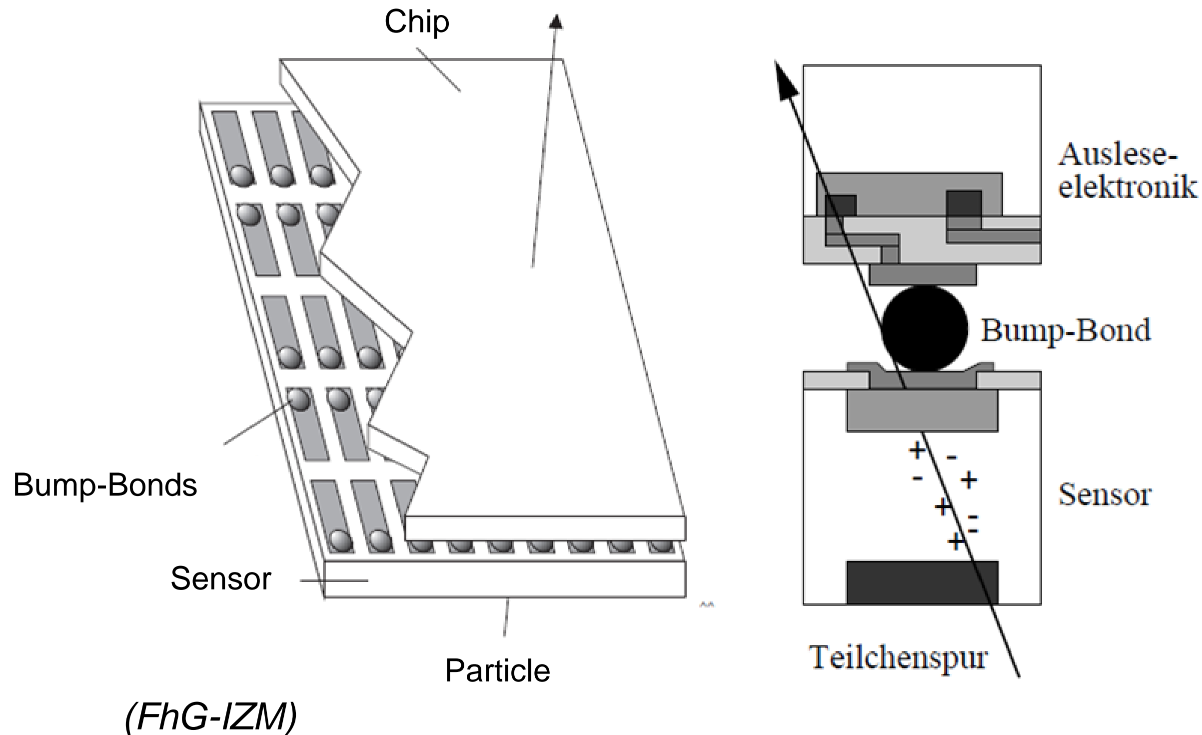
Ongoing R&D Activities at CiS: Bump Bonding Outlook

- Introduction and state of the art of Under Bump Metallisation (UBM)
- Under Bump Metallisation (electroless plating)
- Immersion soldering
- Light-induced plating (LIP)
- Flip-chipping

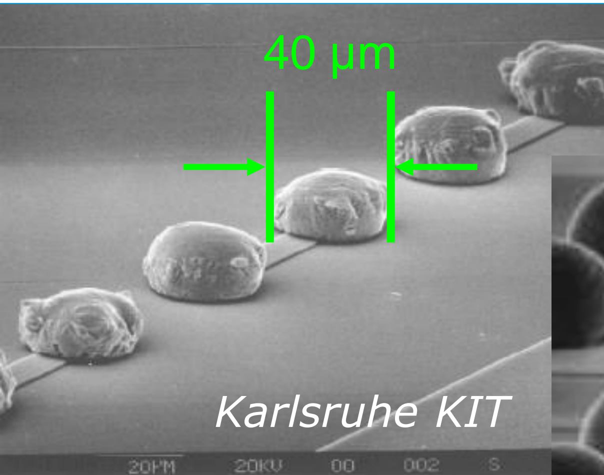


Introduction

Contact points are spread over the whole sensor and chip area, with a high density of small contact points.
Materials have to withstand the high LHC luminosity.
Temperature stability has to be from -40 ° C to RT.



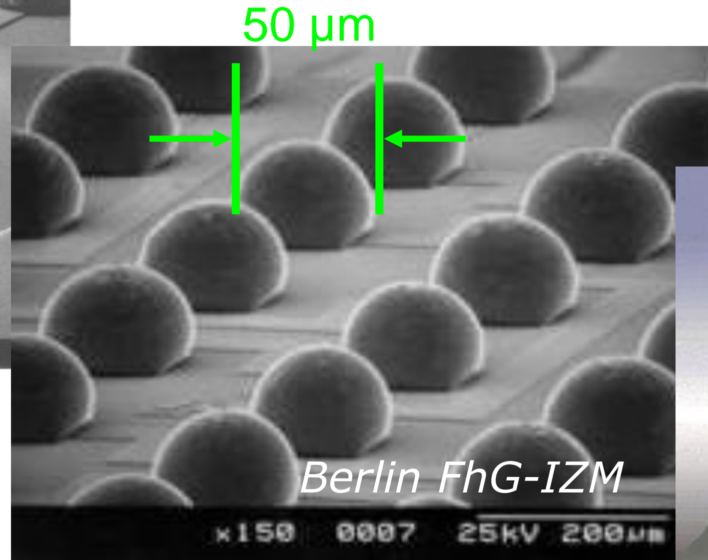
State of the art



UBM: Ti/Pt/Au

Solder: In

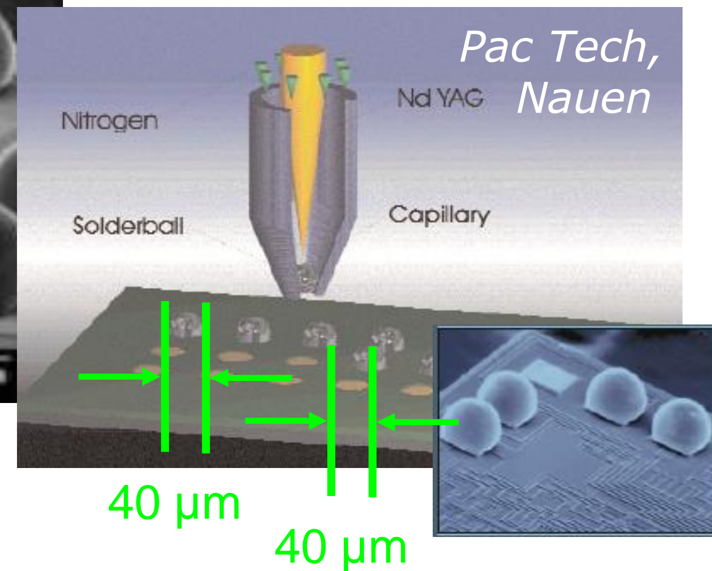
Processing:
evaporation (plating base), lithography & lift-off



UBM: Ti/W/Cu

Solder: SnAg3.5

Processing: sputtering (plating base), lithography, electroplating, lift-off & etching of plating base



UBM: electroless Ni/Au

Solder: SnAg3.5 as solder ball

Processing solder: solderball placement

UBM at CiS: electroless

AlSi pad as the base for electroless Ni + Au plating

Passivation on the AlSi as a mask for the electroless plating

No need for a PVD plating base

No need for lithography and a photoresist

No need for lifting-off (etching) the photoresist

UBM at CiS: electroless

AlSi pad as the base for electroless Ni + Au plating

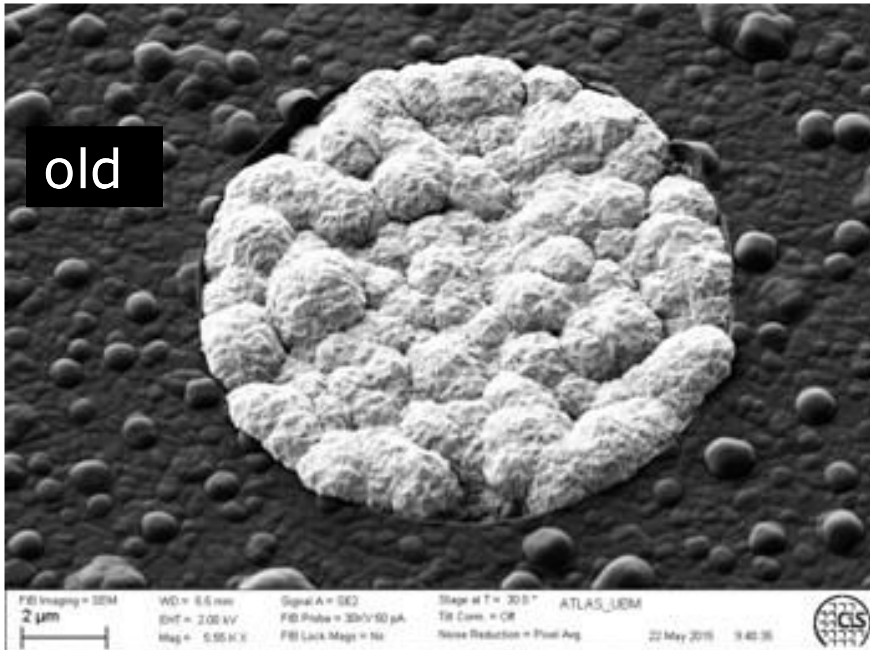
Passivation on the AlSi as a mask for the electroless plating

First trials with older ATLAS/CMS-Pixel sensors

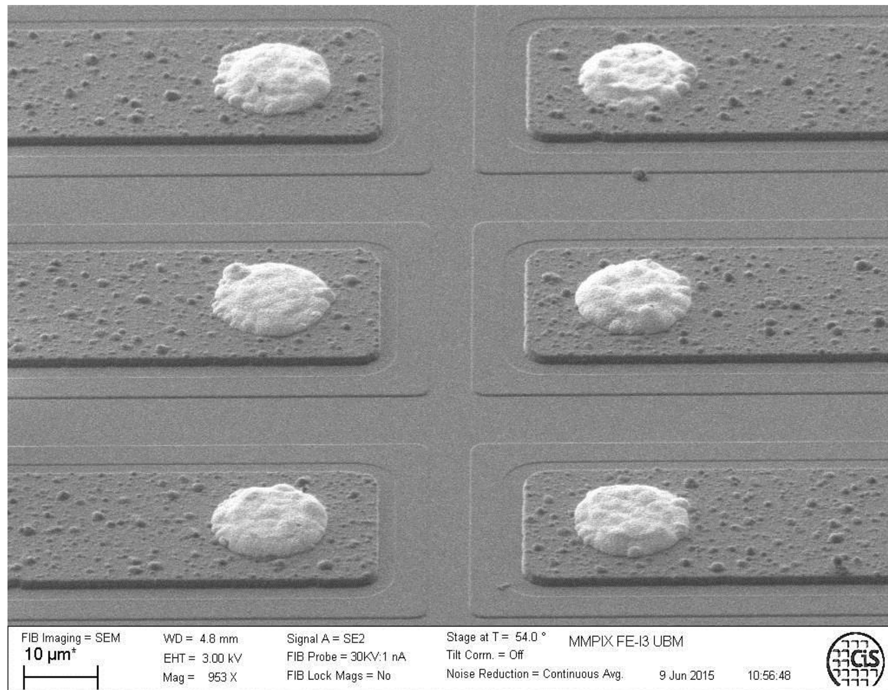
New experiments with new sensors:

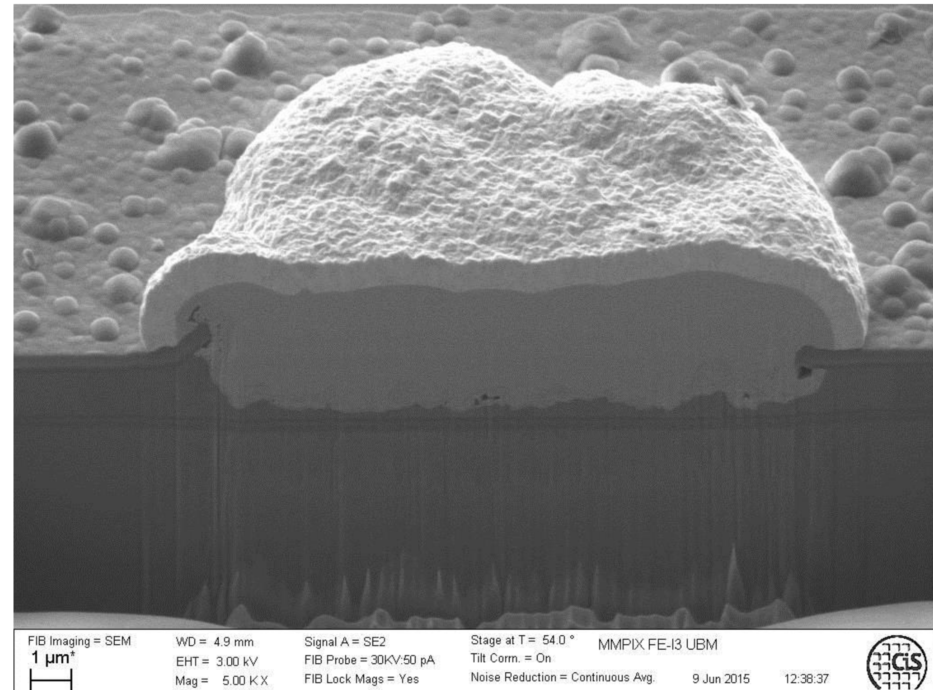
- much better quality, pads are higher: some microns of Ni + thick Au layer.

Surface much more homogenious



UBM at CiS: electroless



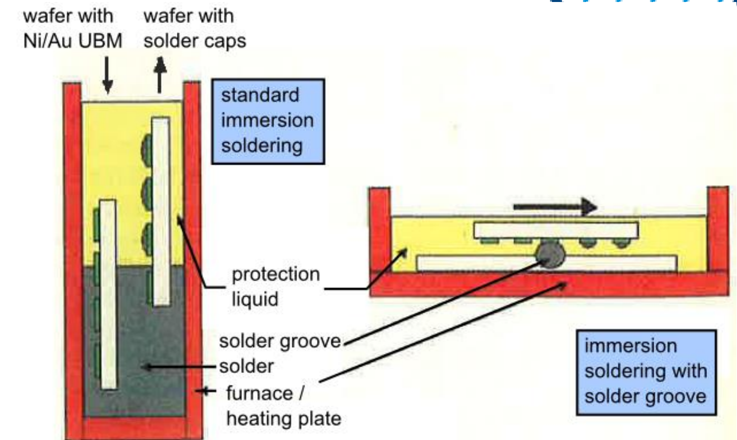


Immersion Soldering

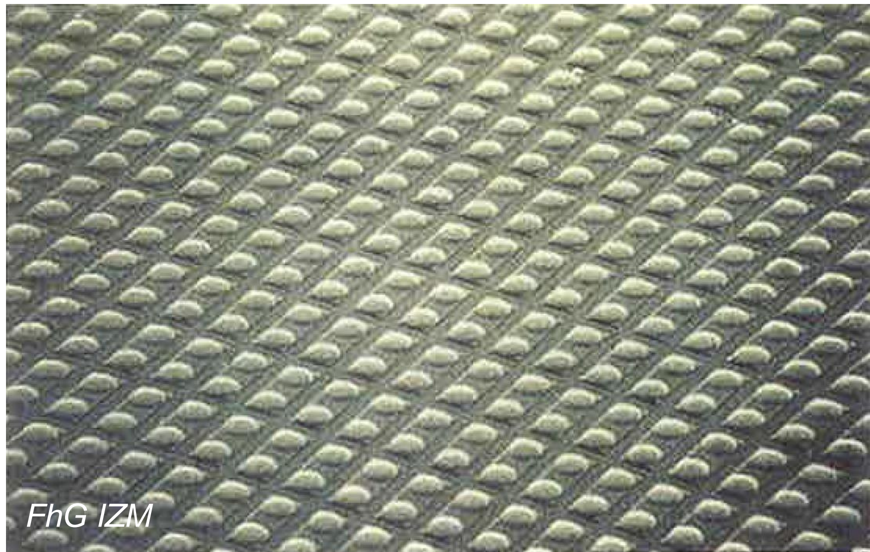
Wafer or diced sensor

- is immersed into solder bath
- or moves along a solder filled groove.

Solder adheres to Ni/Au-UBM & forms bumps.



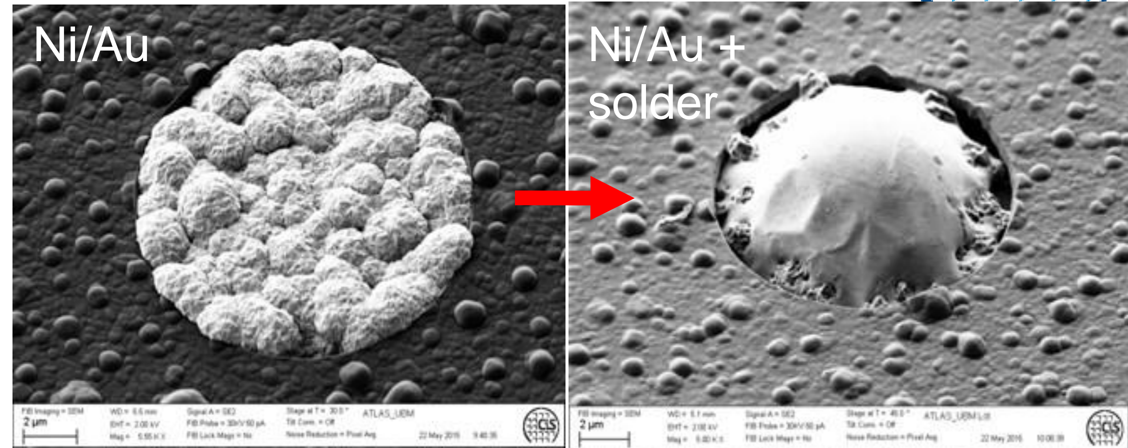
(Berlin FhG IZM)



Ni-UBM + SnAg3.5 solder

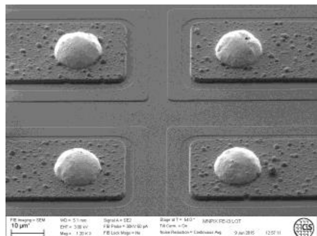
First trials with older ATLAS pixel sensors

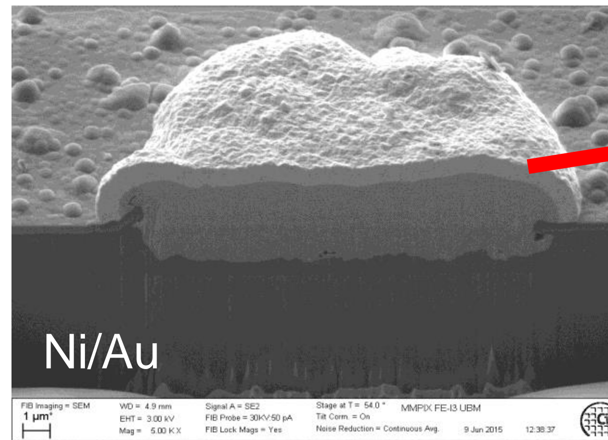
- homogeneity quite well
- height and width still quite small

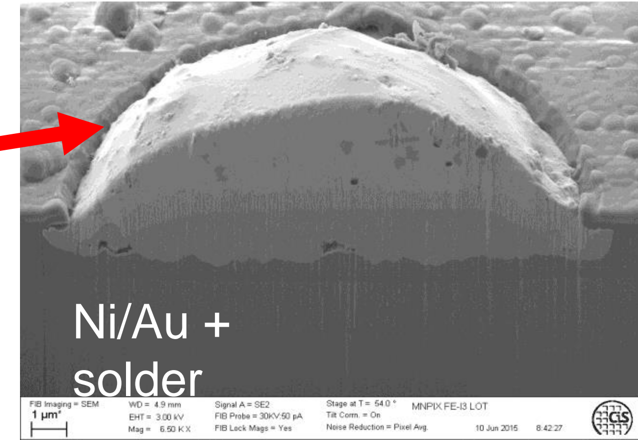


Better results with younger sensors

- Ni/Au pads as well as the solder bumps are higher.
- Pads stick out of the sensor.







LIP – Light Induced Plating

Growth of the UBM and solder is stimulated by laser light.

UBM is only growing on the passivation openings.

No additional process steps are necessary

- no plating base / resist,
- no stripping / etching.

Less cost & time consuming

(in cooperation with TU Ilmenau)

LIP – Light Induced Plating

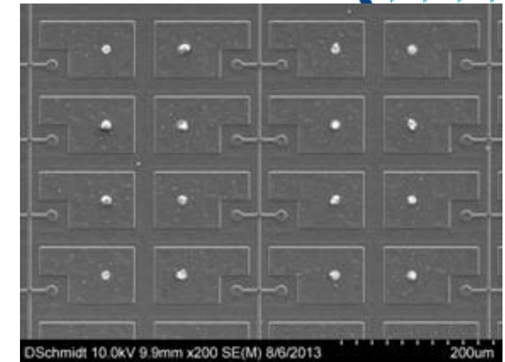
First trials

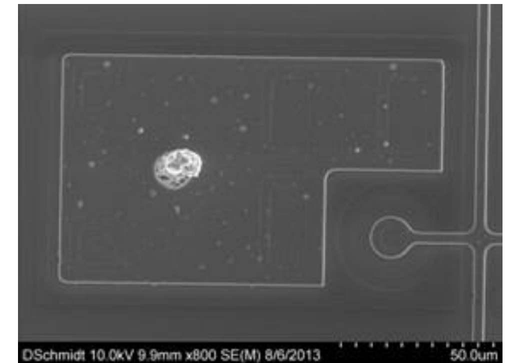
done on CMS-pixel sensors (no difference to ATLAS pixel):

... works in principle.

Homogeneity of Ni is "improvable".

Also old sensor with bad Al surface used (better results expected with new sensors)





Next steps

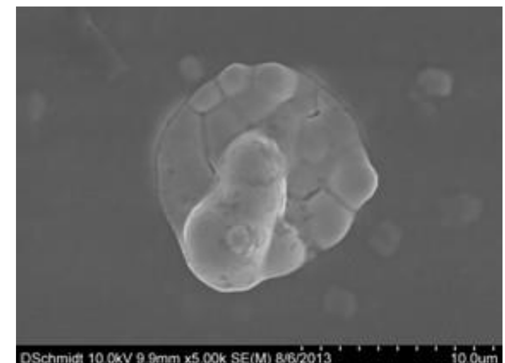
Combine Ni-UBM (LIP or chemical) with LIP solder

Alternative to immersion soldering

different electrolytes

Sn, SnAg3.5, In, In/Sn

Additional usage of lacquer mask to grow higher solder pillars

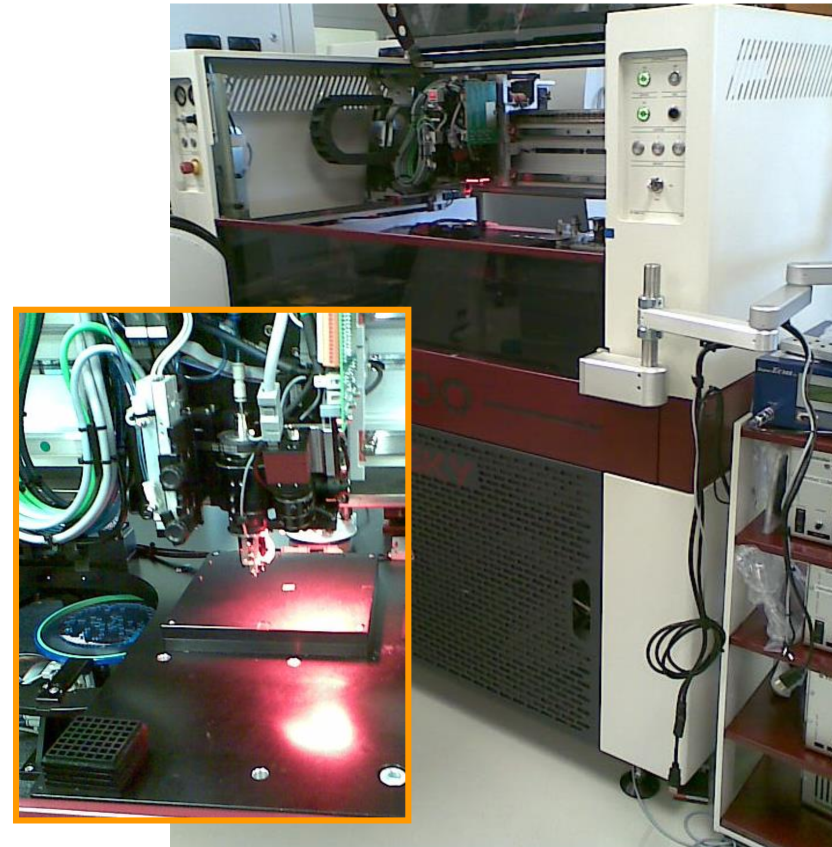


(in cooperation with TU Ilmenau)

Flip-chipping at CiS

Fineplacer

Die-Bonder



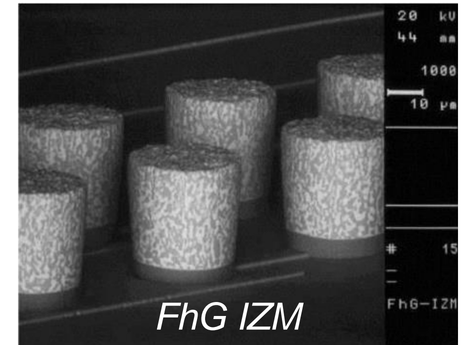
Flip-chipping at CiS: Daisy Chains

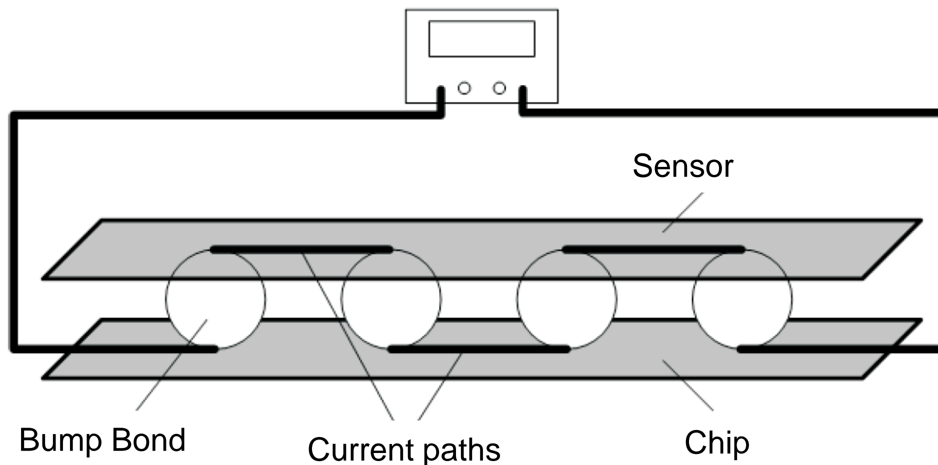
Daisy chain dummies are in production.

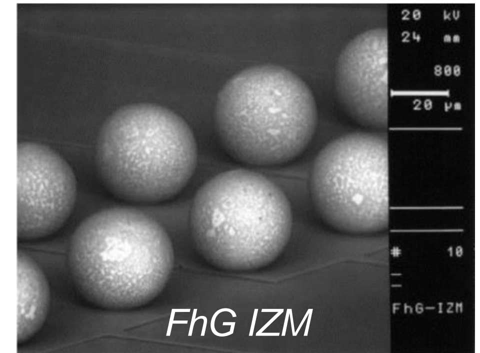
Geometry is based on CMS Pixel.

Different bump pad parameters will be tested:

- different bump pad diameters,
- different UBM and solder variants (also with bumps from FhG-IZM),
- large quantity,
- different sensor/chip sizes.







Conclusion & Outlook

CiS is exploring different kinds of UBM & flip-chip technologies.

Focus is layed on

- cost efficiency,
- dimensions (UBM and solder size),
- in-house processes (complete or partial).

Different technologies are considered and are investigated.

- Mask-less Ni/Au UBM + SnAg3.5 solder look promising at the moment.
- Possibilities of light induced plating and solder immersion are extended.
- Flip-chip tests are on the way.