microelectronic packaging dresden

Aufbau- und Verbindungstechnik für optische Sensoren in der Medizintechnik

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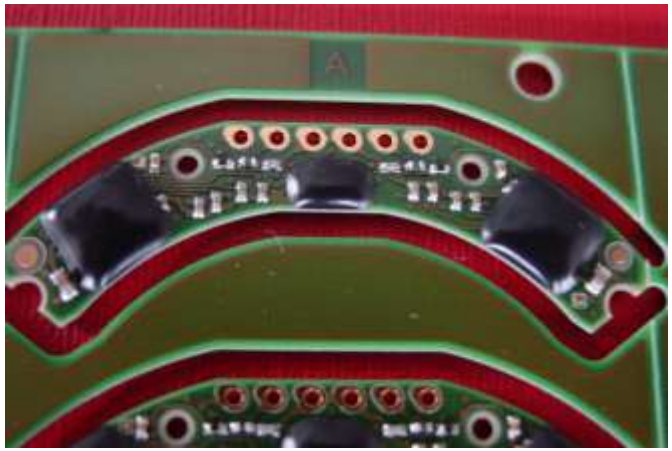
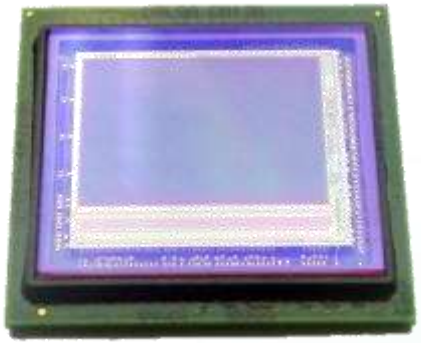
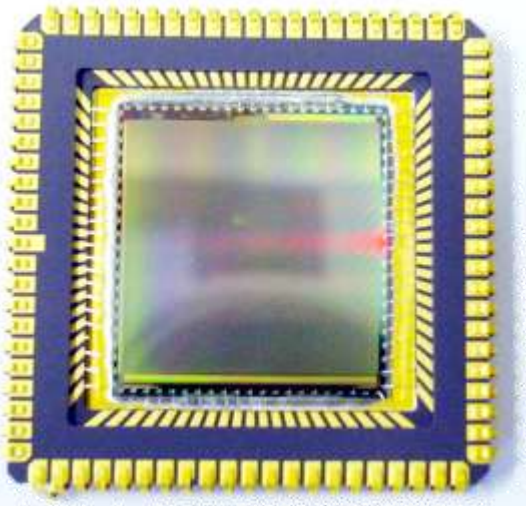
MPD GmbH Dresden

Sensorbeispiele im Microelectronic Packaging







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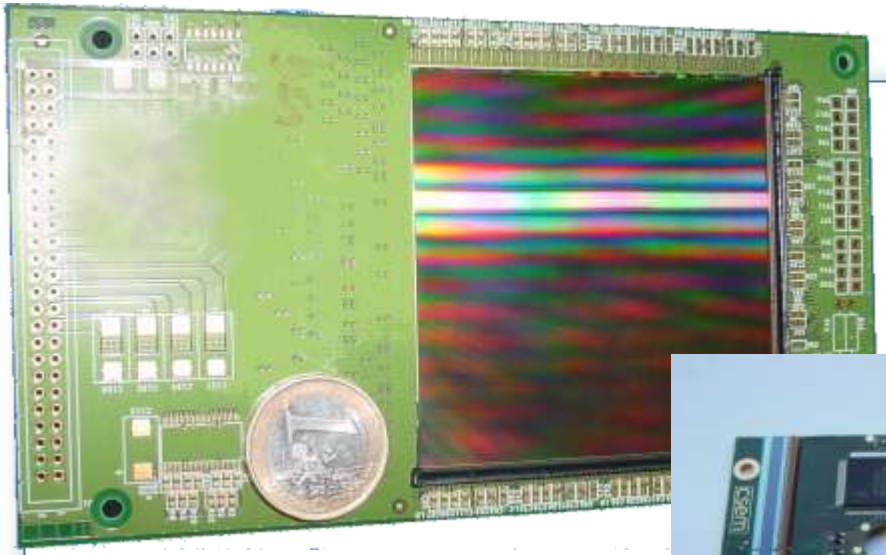
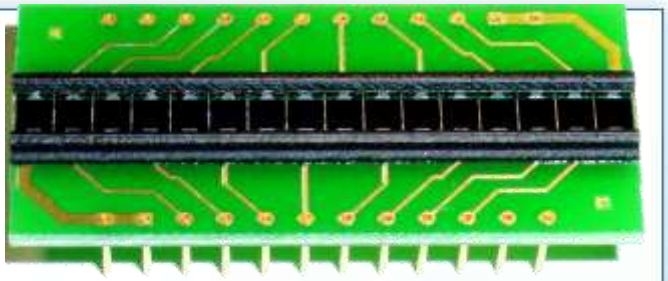
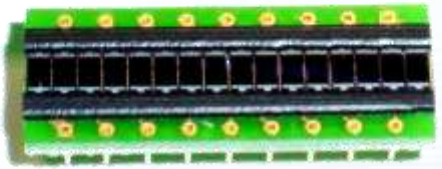
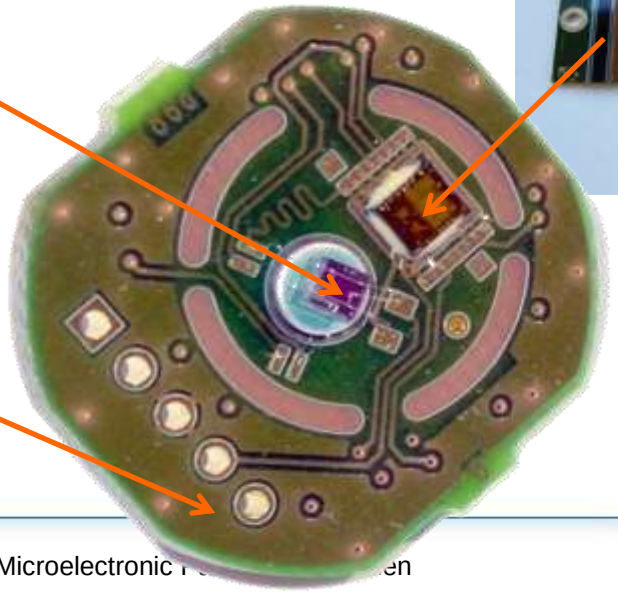




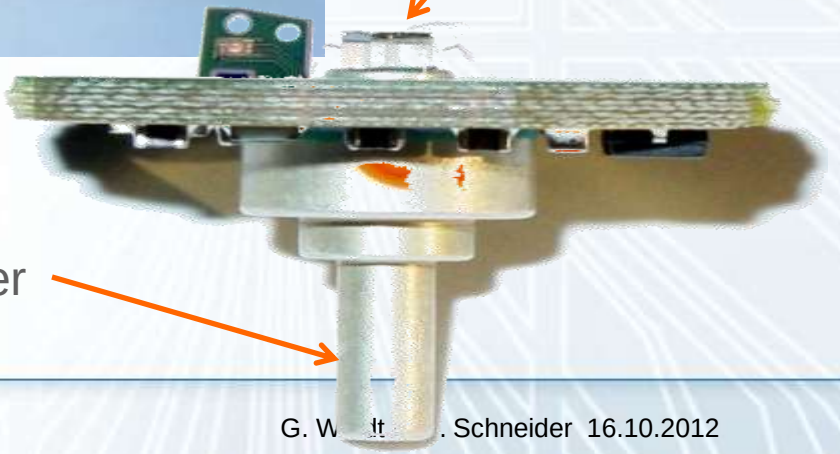


MEMS



PCB

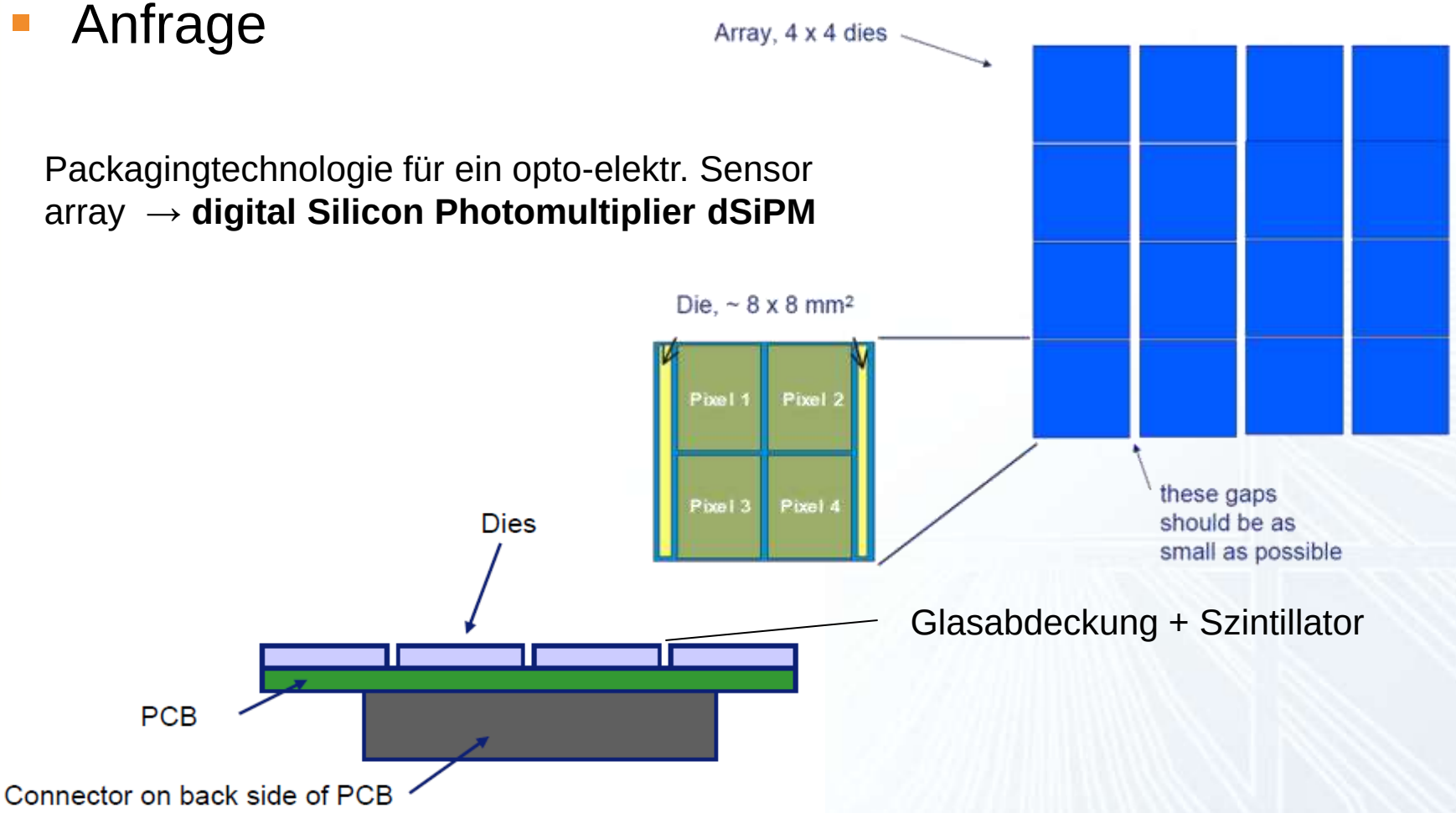
MEMS



Carrier

- Anfrage

Packagingtechnologie für ein opto-elektr. Sensor array → **digital Silicon Photomultiplier dSiPM**



Anfrage

- Technisch / technologische Herausforderung

PCB – Entwicklung (Layout, Technologiekonzept)

Die – Bonden

Wire – Bonden

Glas – Montage

Weiterverarbeitungsanforderungen beim Kunden

Packaginggesamtkonzept (Layout, Werkstoff, Technologie)

Zuverlässigkeitsanforderungen (-20°C/+75°C)

→ Anforderungen gehen weit über die der bisherigen Standardmodule wie Imagesensoren, Photodiodenzeilen, Power LED`s etc, hinaus

Aufgabenstellung

Aufgabenstellung / Spezifikation

- PCB: 32,6 x 32,6 mm²

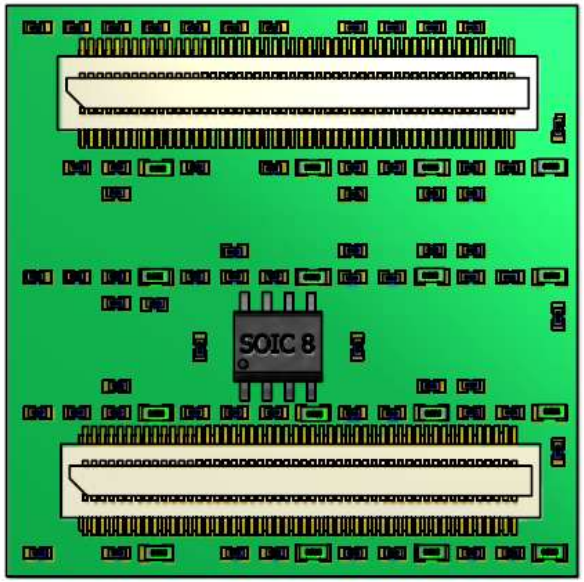
- Abstand Die zu PCB ohne Drahtbonds: 0,4 mm
- Abstand Die zu PCB mit Drahtbonds: 0,8 mm
- Abstand Die zu Die ohne Drahtbonds: 100 µm
- Abstand Die zu Die mit Drahtbonds: 800 µm

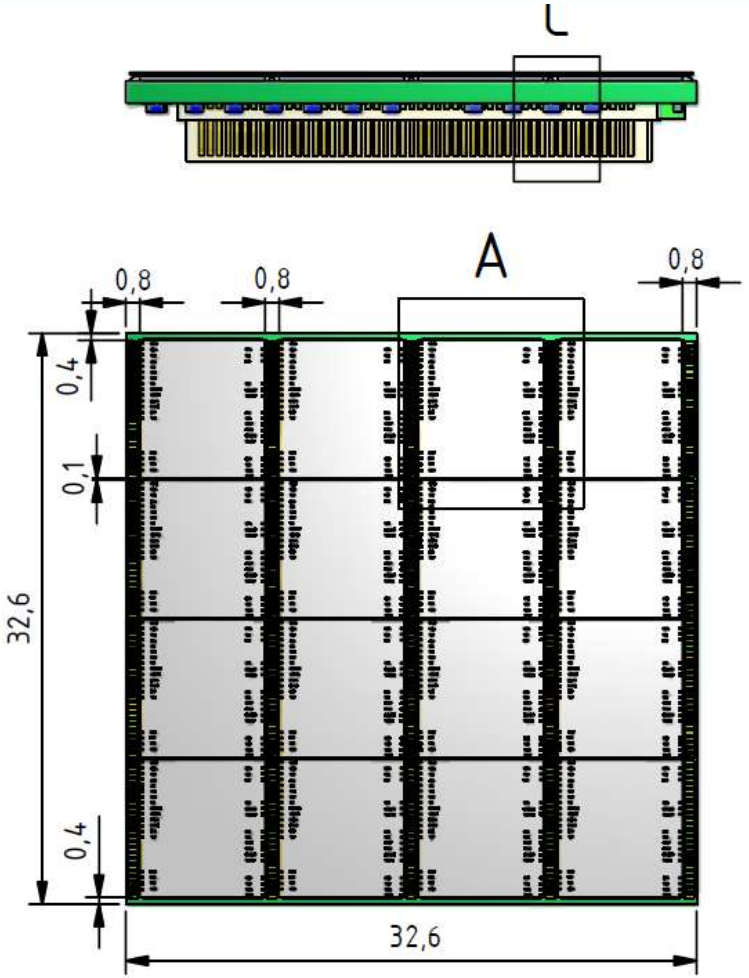
- Abdeckung Chip-Array mit Glas: 0,2…0,1 mm
- Abstand Glas zu Chipoberfläche: <100 µm

- PCB Krümmung: <100 µm
- Die-Krümmung <10 µm (Die-Biegeradius > 1m)

Lösungskonzept

- Lösungskonzept

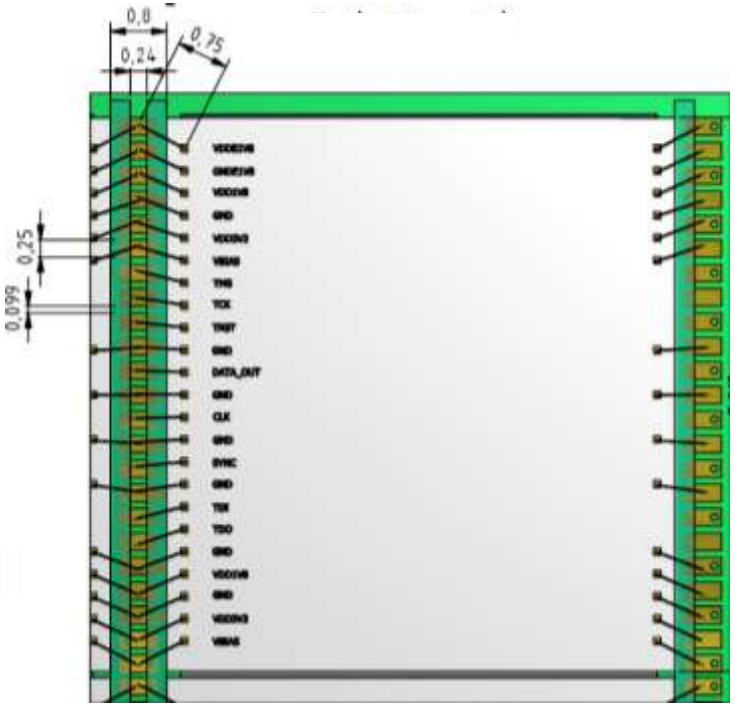




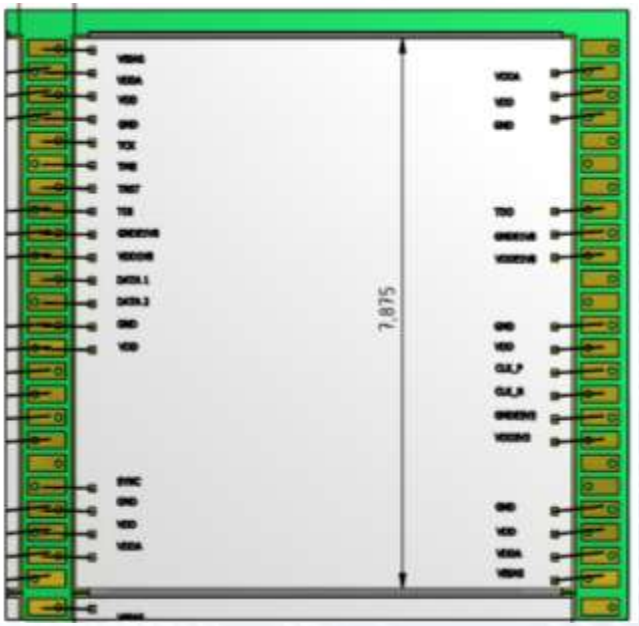
Neu: FBGA, Zunahme der SMD - Komponenten

Lösungskonzept

- Chip- und Bondbereich



Erstes Kundenchiplayout



"Packaginggerechtes Layout"

Layoutentwicklung

- Layoutentwicklung
  - COB nur Top Side
    - Drahtbondpadbreite > 100 µm
  - SMD nur Bottom Side
    - SMD-Platzierung ⇨ symmetrisch
      - Randbereich frei von SMD`s
      - Stecker mittig
      - IC mittig
  - Verdrahtung fertigungsgerecht
  - Lagenaufbau ⇨ symmetrisch (6, 10 ⇨ 8)
  - Marken für SMD und COB
  - Nutzengestaltung
  - Automatengerechte Fertigung in mittleren Stückzahlen

Layoutentwicklung

- Platinenaufbau

Stackup

Layer	Min	Max	Nom.	Tol-	Tol+	Thickness (Millimeter)	Stackup Picture	Family	Description	Type
smfr						0,0200		Prob 65 (Hal.Free)	Prob 65 Green	
epfr	0,0250	0,0400	0,0250		0,0150	0,0350		Cu	12µ + 25µm	SIGNAL - Foil
						0,0689		R1551W	1080 (0073)	
ip2	0,0150	0,0350	0,0150		0,0200	0,0230		Cu	18µ_dä z12 + 13µm	SIGNAL - Foil
						0,0461		R1551W	0106 (0058)	
ip3	0,0150	0,0350	0,0150		0,0200	0,0270		Cu	18µ_dä z5-8 + 20µm	SIGNAL
						0,3000		R1566W	0300	
ip4					0,0990	0,0150		Cu	18µ	SIGNAL
						0,1985		R1551W	7628 (0204)	
ip5					0,0990	0,0150		Cu	18µ	SIGNAL
						0,3000		R1566W	0300	
ip6	0,0150	0,0350	0,0150		0,0200	0,0270		Cu	18µ_dä z5-8 + 20µm	SIGNAL
						0,0498		R1551W	0106 (0058)	
ip7	0,0150	0,0350	0,0150		0,0200	0,0230		Cu	18µ_dä z12 + 13µm	SIGNAL - Foil
						0,0689		R1551W	1080 (0073)	
epba	0,0250	0,0400	0,0250		0,0150	0,0350		Cu	12µ + 25µm	SIGNAL - Foil
smba						0,0200		Prob 65 (Hal.Free)	Prob 65 Green	
			0,1650			**1,2721**	**Total Thickness (Calculated)**			
			0,1000			**1,2000**	**Incl.Mask over Laminate (Customer)**	**+0,1200**	**-0,1200**	
			0,1240			**1,1800**	**After Press (Customer)**	**+0,1180**	**-0,1180**	

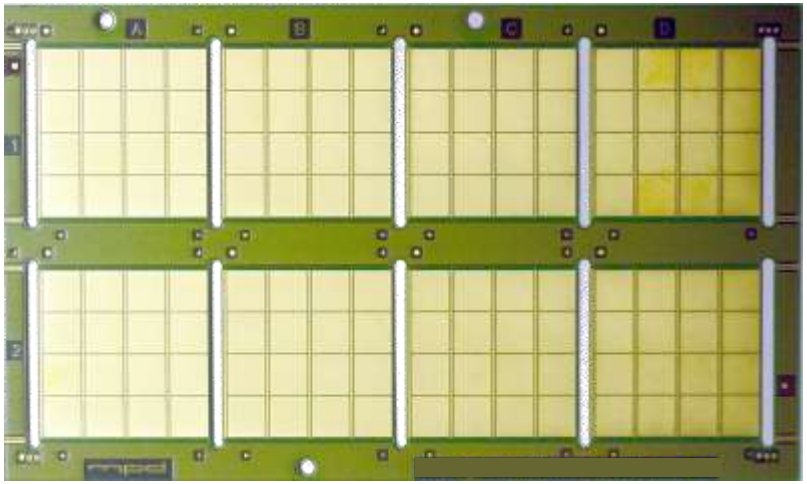
Microvias L1→ L2, L3; L8 → L7, L6

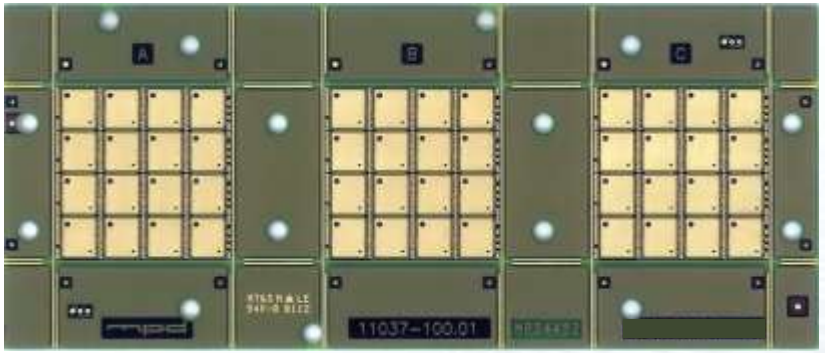
Prinzipieller Lagenaufbau: Kombination Plugging + MicroVia

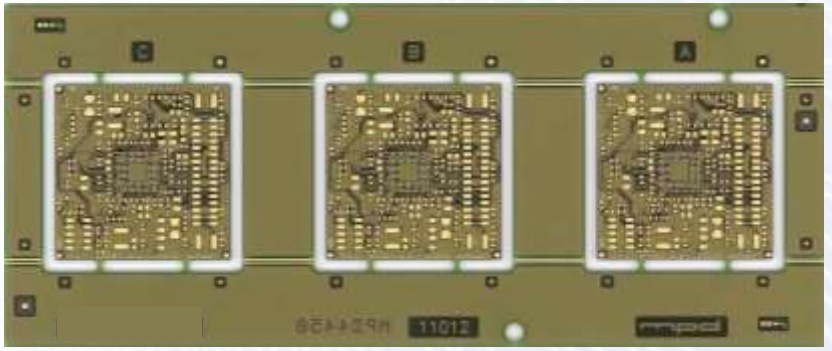
2 – 4 – 2 Aufbau

Layoutentwicklung

- Nutzengestaltung
  - Marken für SMT und COB
  - Sägenmarken
  - Justierhilfen
  - Produktkennung



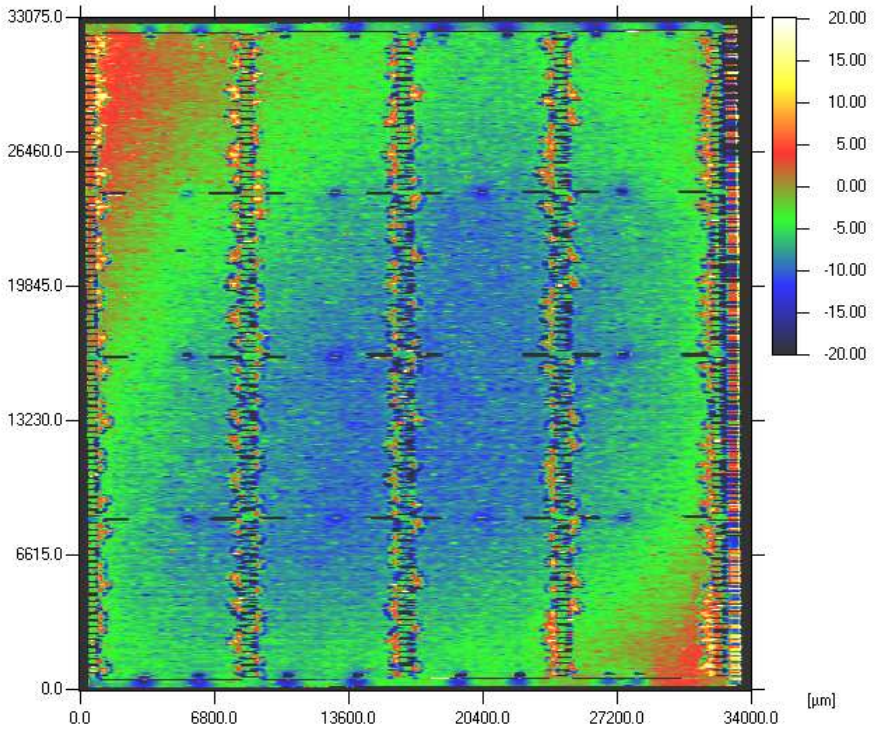


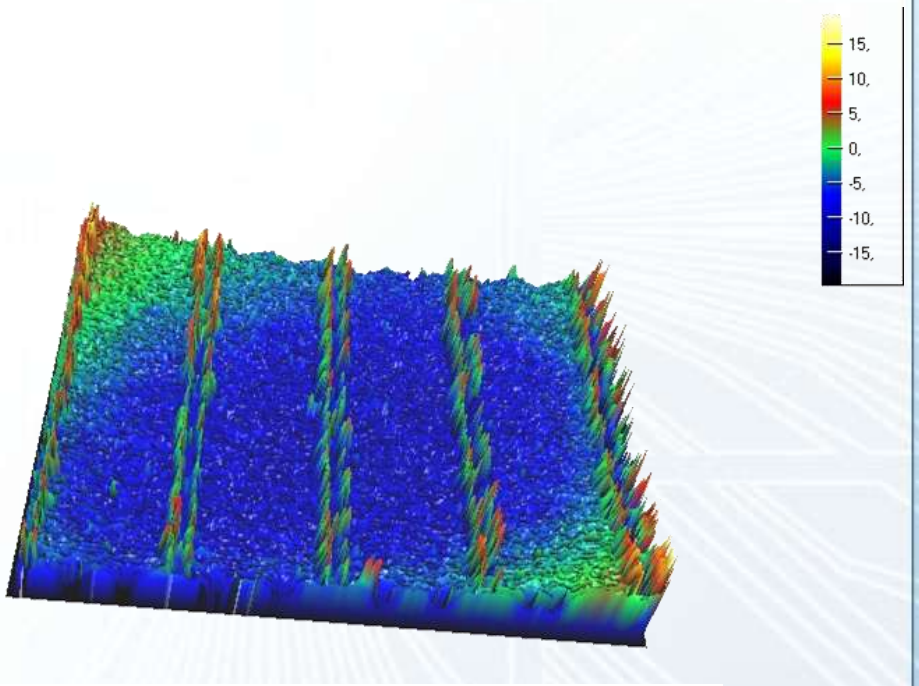


Board

- Boardkrümmung

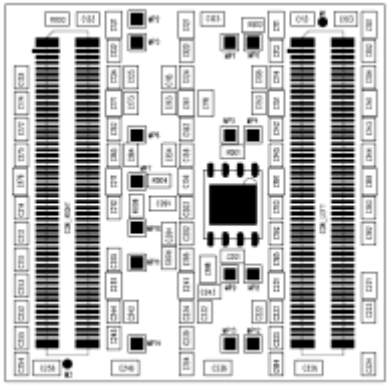
(IPC 1 % der Boarddicke)

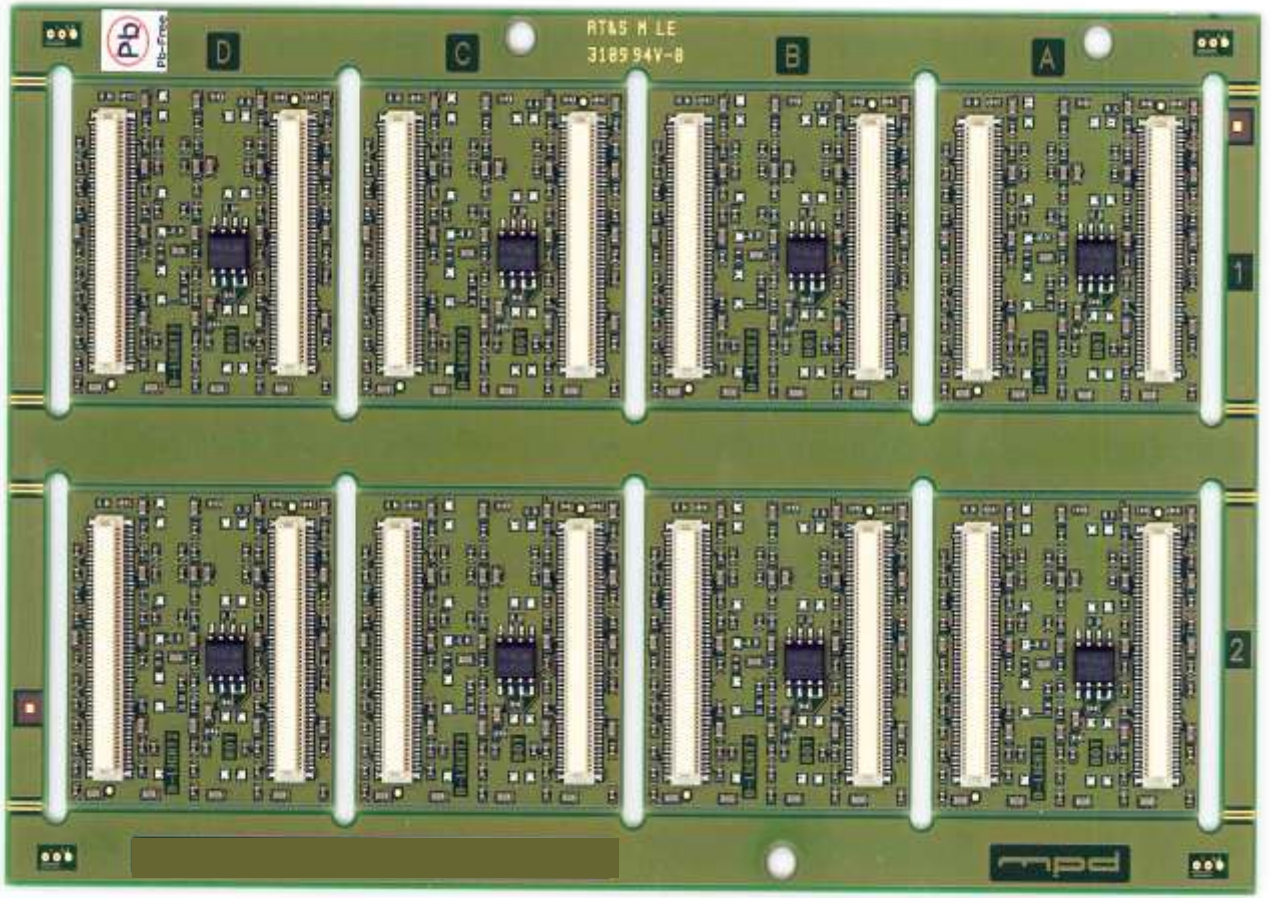




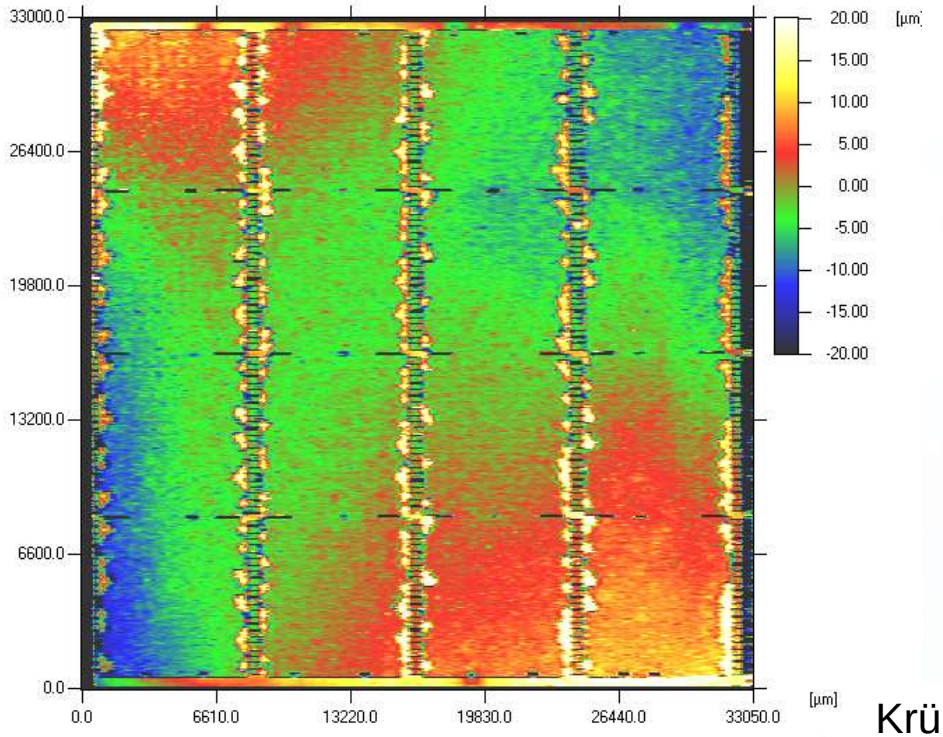
Krümmung max. 15µm; leicht konkav

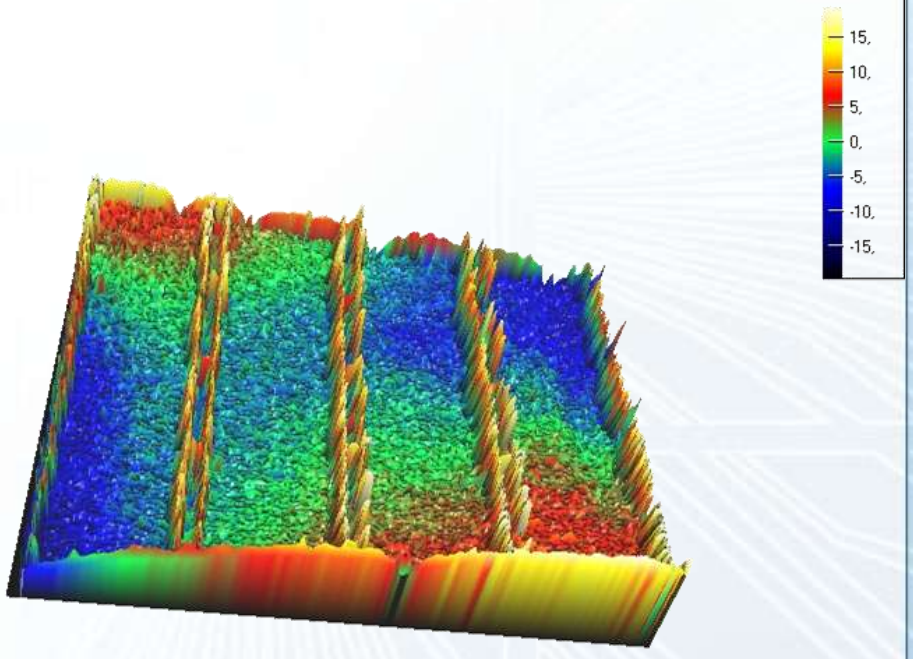
- SMD-Bestückung





- Boardkrümmung nach SMT





Krümmung max. 27 µm; leicht konvex

Chipbonden

- Chipbonden
  - Stressarme Technologie erforderlich
    - Klebstoff (elektrisch leitfähig)
    - Verfahren
  - Lagegenauigkeit der Dice gemäß Vorgabe (+/- 25 µm)
  - Leitende Verbindung zum Board
  - Klebstoffbenetzung lateral begrenzen

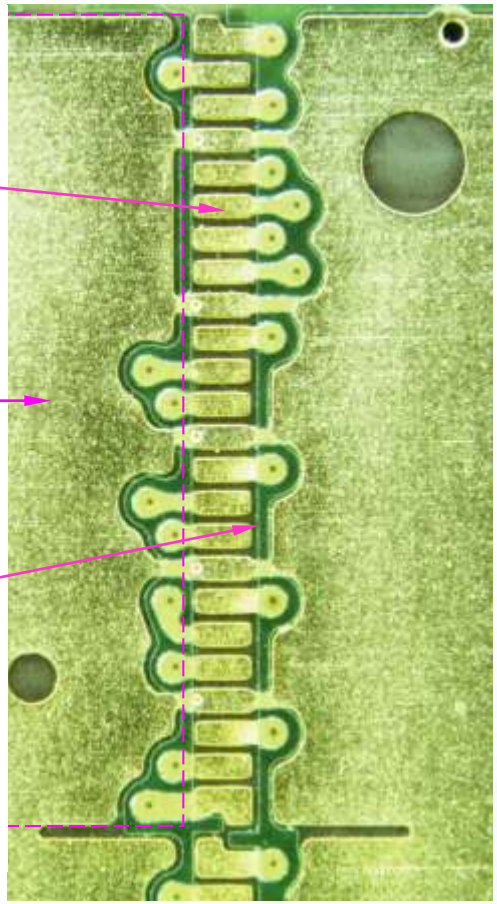
Chipbonden

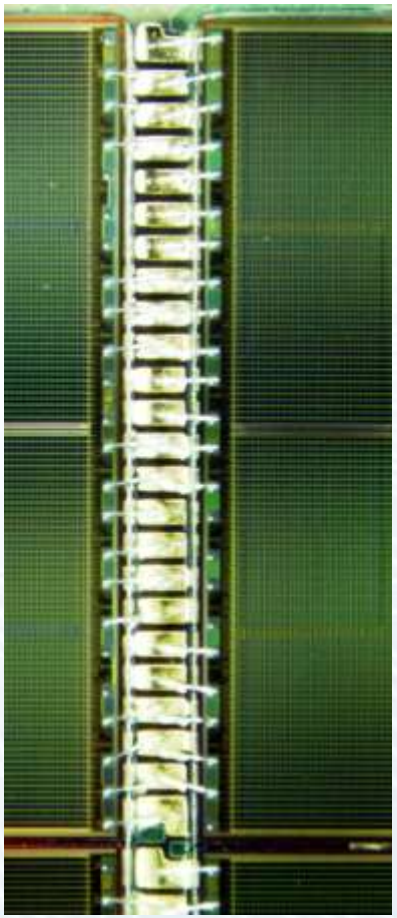
- Chipbondpadbereich

Drahtbondpads

Chipbondpad

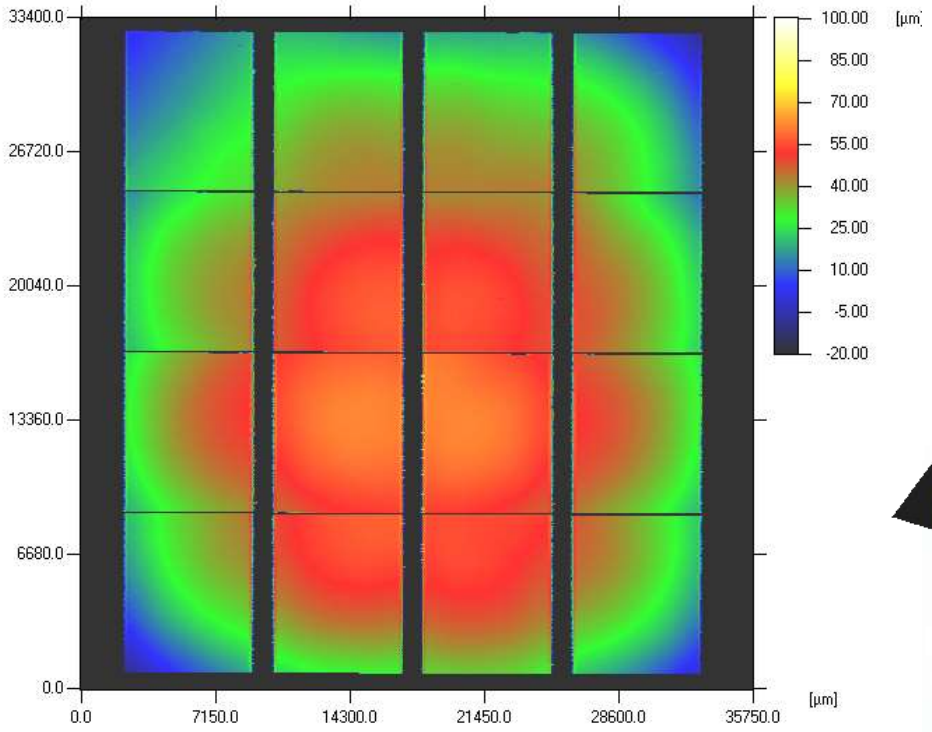
Lötstopp -Steg

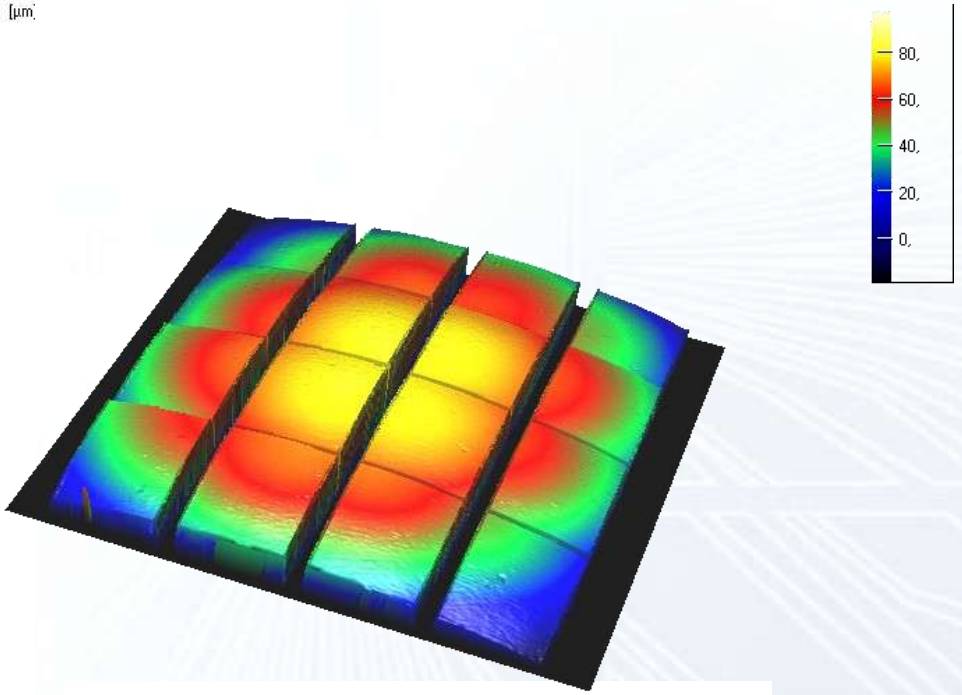




Chipbonden

- Modulkrümmung nach Chipbonden

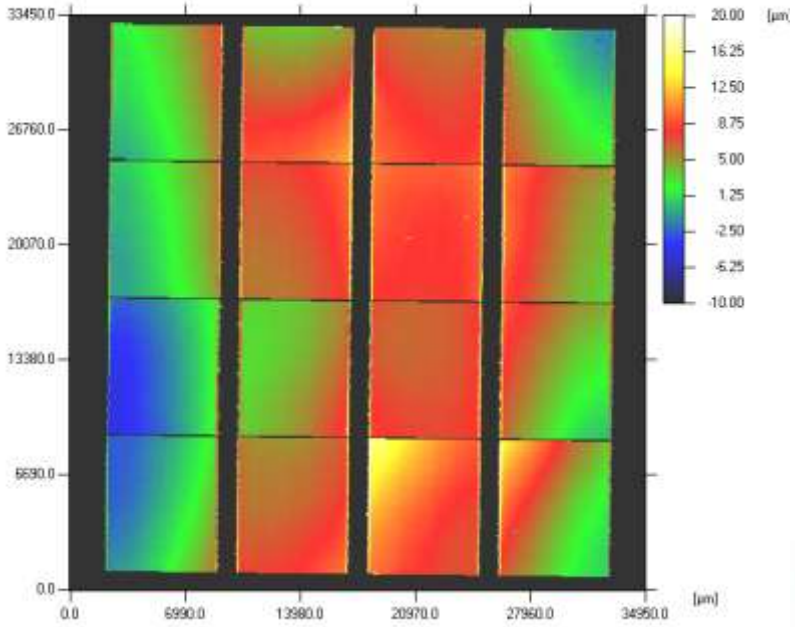


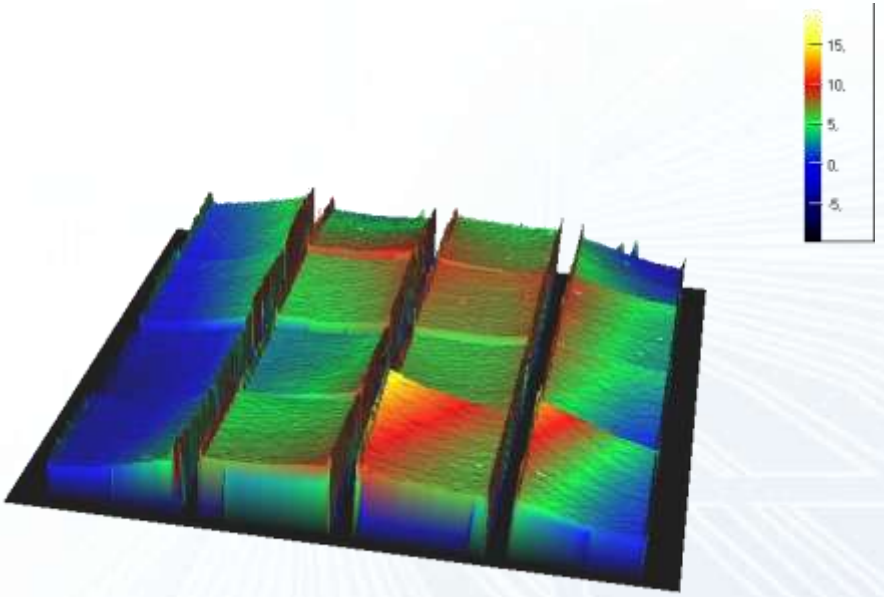


Krümmung max 95 µm; konvex

Chipbonden

- Modulkrümmung nach Chipbonden optimiert (Curing)

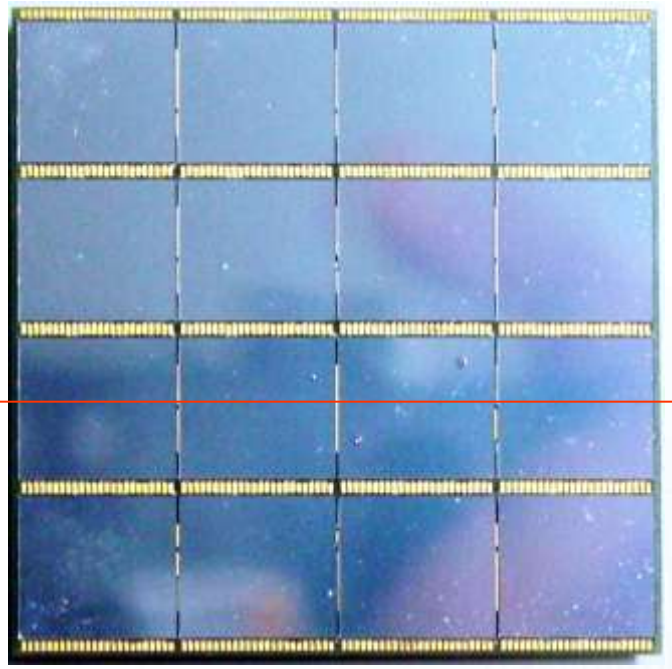




Krümmung: max 15 µm; leicht konvex

Chipbonden

- Chipkrümmung

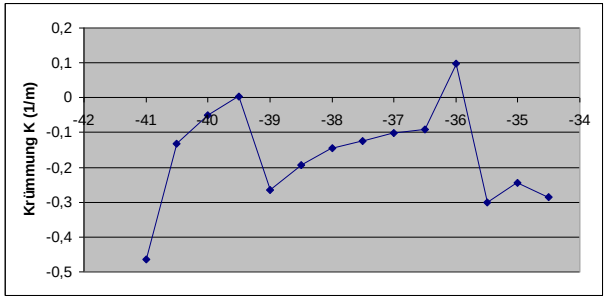


Messlinie für Chipkrümmung

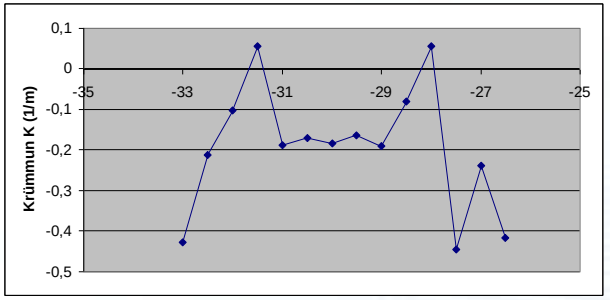
Laserfokusmessung und röntgenograph. Spannungsmessung

Chipbonden

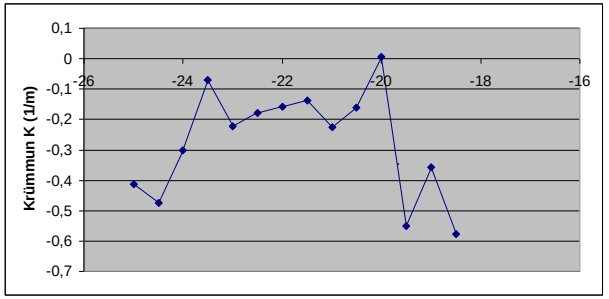
- Chipkrümmung



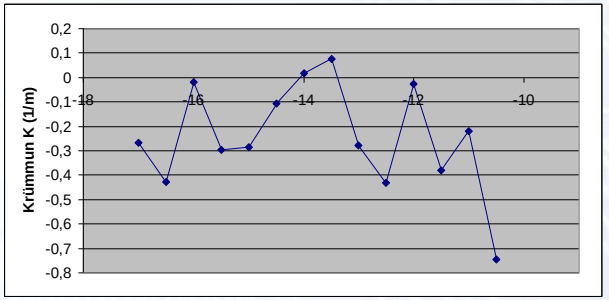
Chip 1



Chip 2



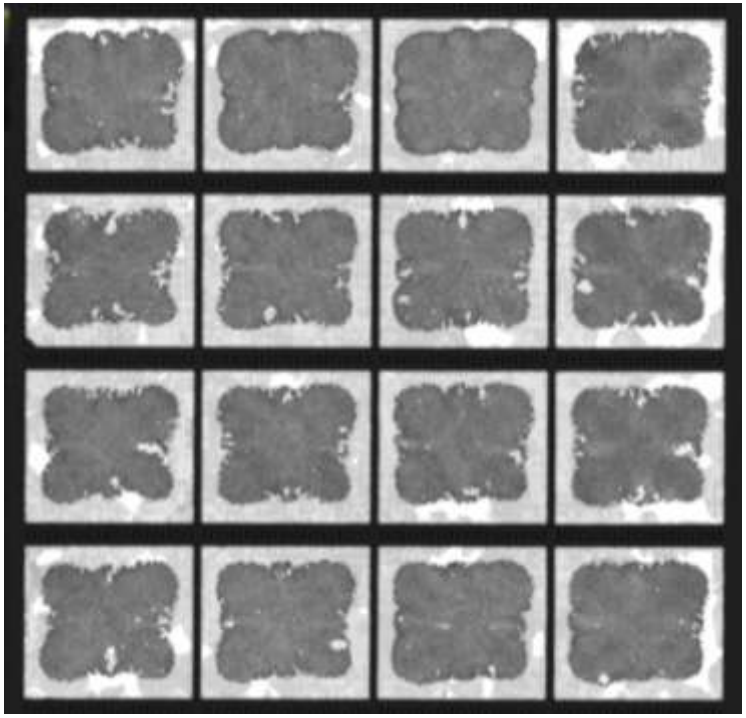
Chip 3



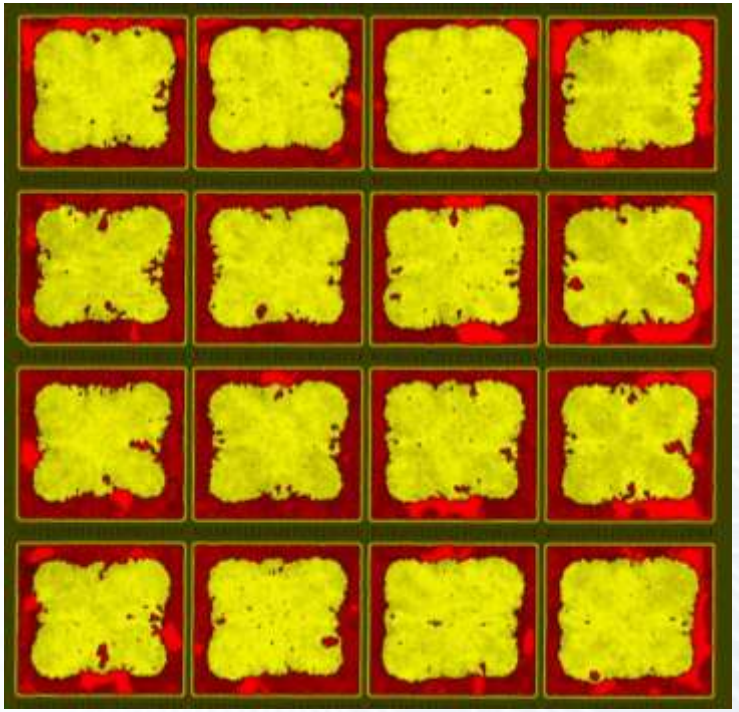
Chip 4

Chipbonden

- Klebstoffbild



X - Ray



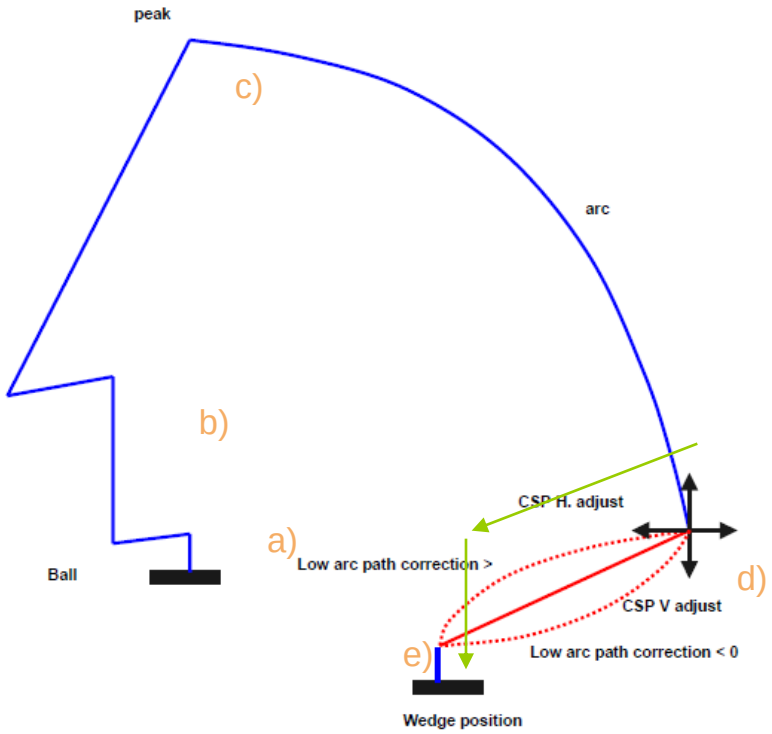
Ultraschallbild

Drahtbonden

- Drahtbonden
  - US-Bondverfahren
    - AlSi-Draht Ø 25 µm
    - Metallisierung Bondpad „Standard“ ENIG (NiAu)
    - Chipdicke **250 µm**
  - TS-Bondverfahren
    - Au-Draht Ø 25 µm
    - Metallisierung Bondpad ENIPIG / ENEPIG (NiPdAu)
    - Substrattemperatur > 120 °C
    - Chipdicke **750 µm**
  - Bondgeometrie (Bondloop)
    - Verfahrensoptimierung
    - Bondwerkzeug

Drahtbonden

- Bondloop Optimierung
  - Theoretischer Ablauf für Bondlooperzeugung



a) 1. Kontakt erzeugen

b) Anzahl der „Knicke“ 1) für Bondloop festlegen

c) Drahtlänge für den Bondloop festlegen

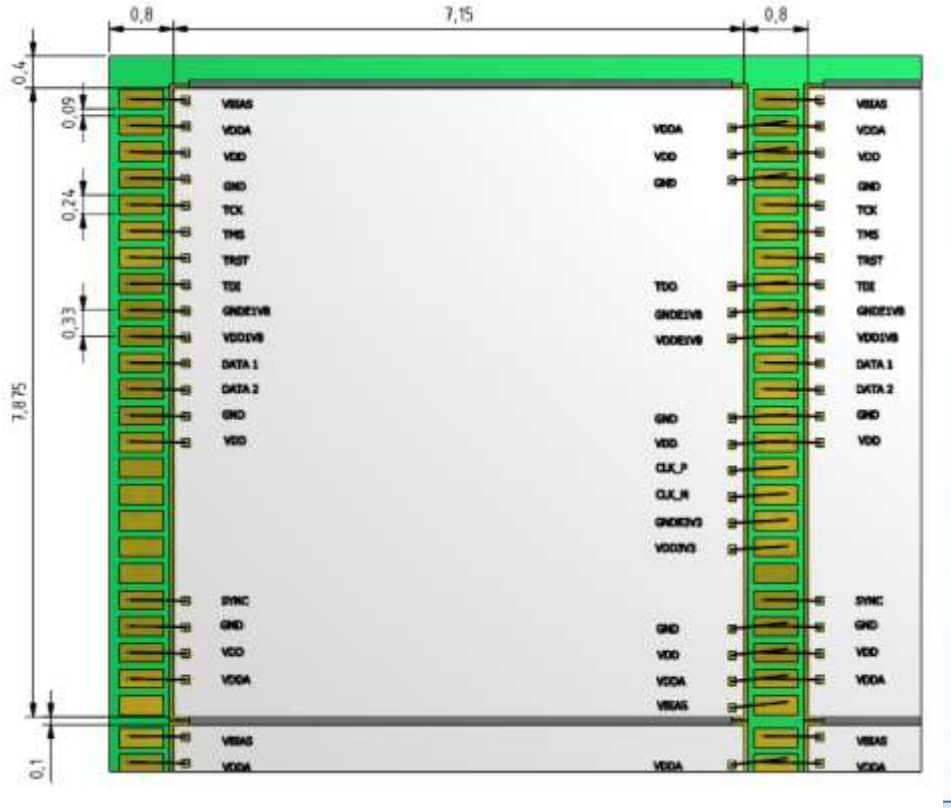
d) In Richtung 2. Kontakt fahren

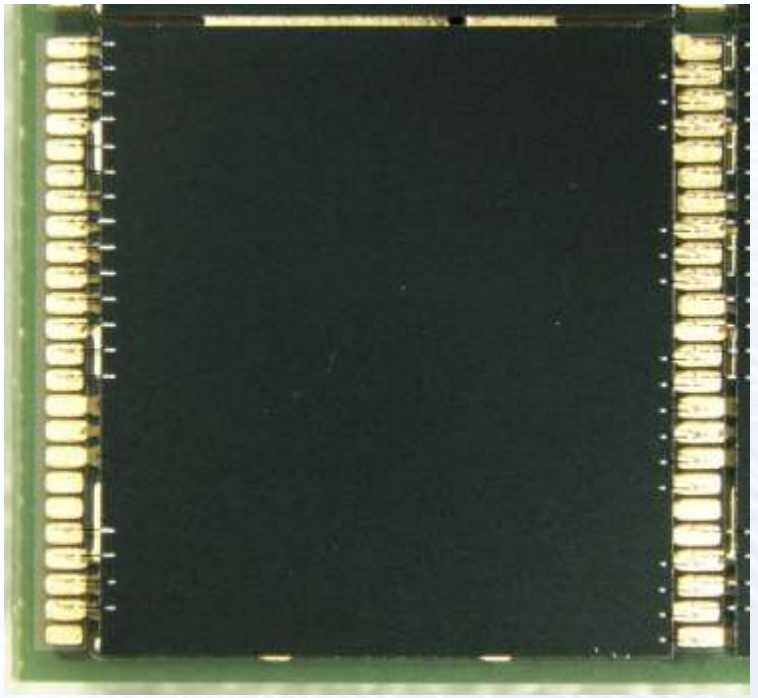
e) 2. Kontakt erzeugen

(1) Knick definiert die Biegung im Bondloop)

Drahtbonden

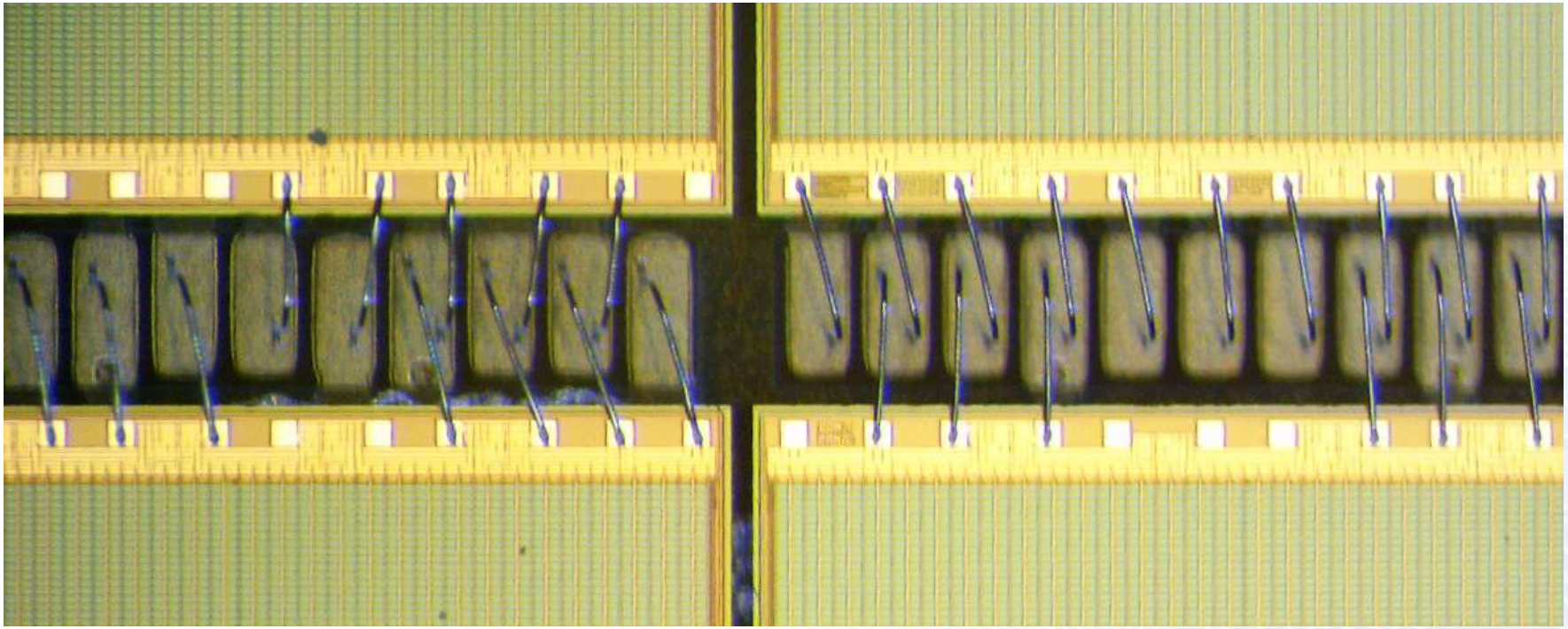
- Bondlayout





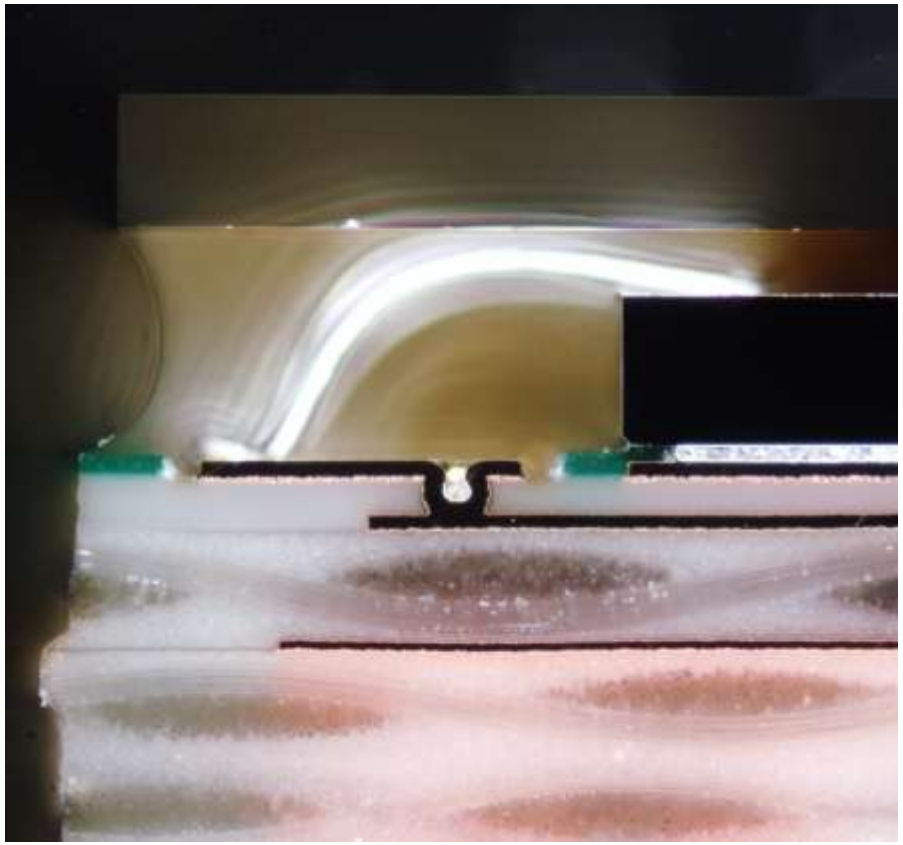
Drahtbonden

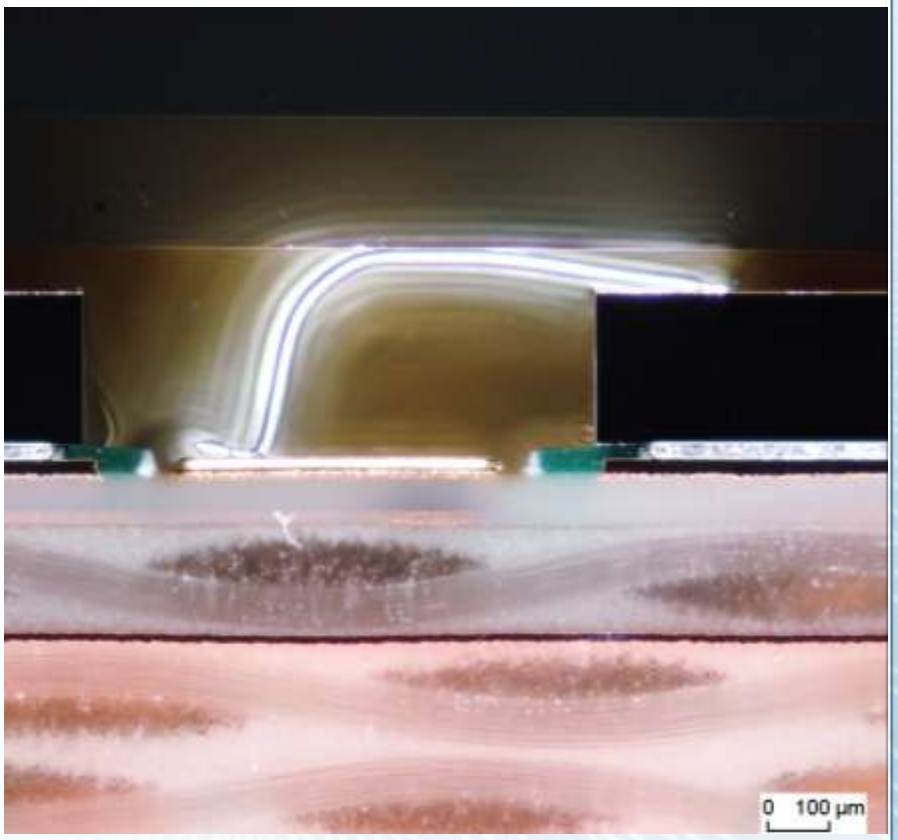
- US - Wedge / Wedge Bonden mit AlSi 1 –Draht / Bondrichtung



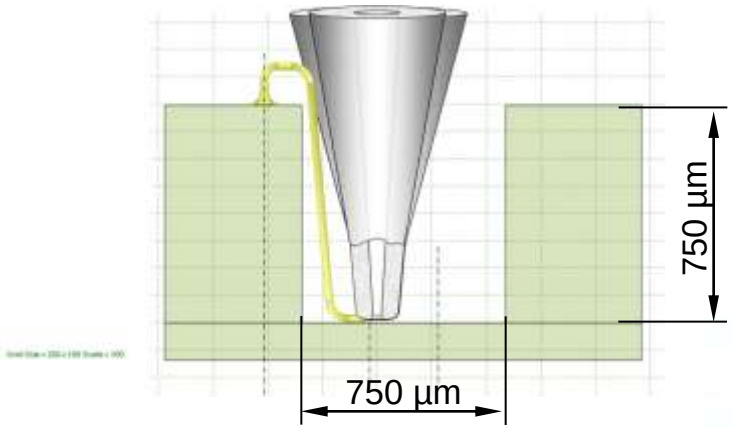
Drahtbonden

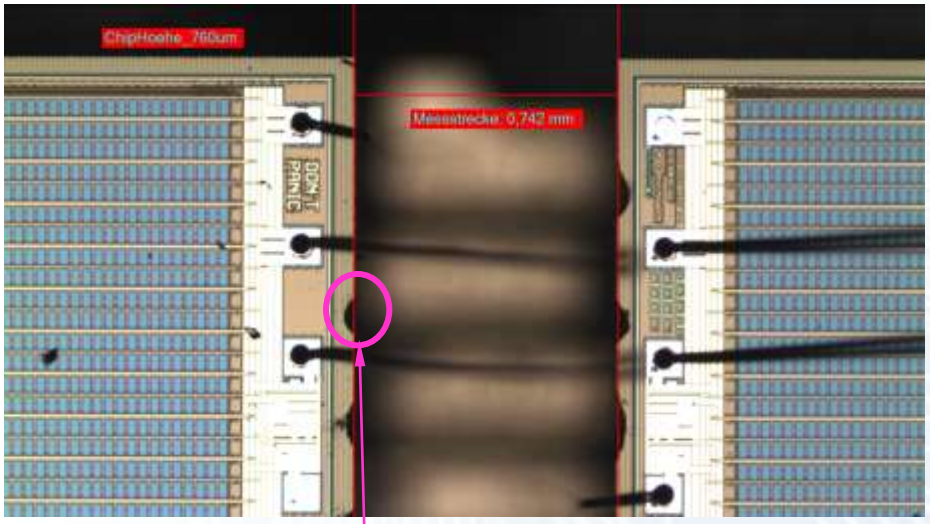
- Bondloop AlSi 1-Draht nach Glasmontage





- Thermosonic – Bonden mit Au - Draht
  - Geometrische Verhältnisse / Bondrichtung

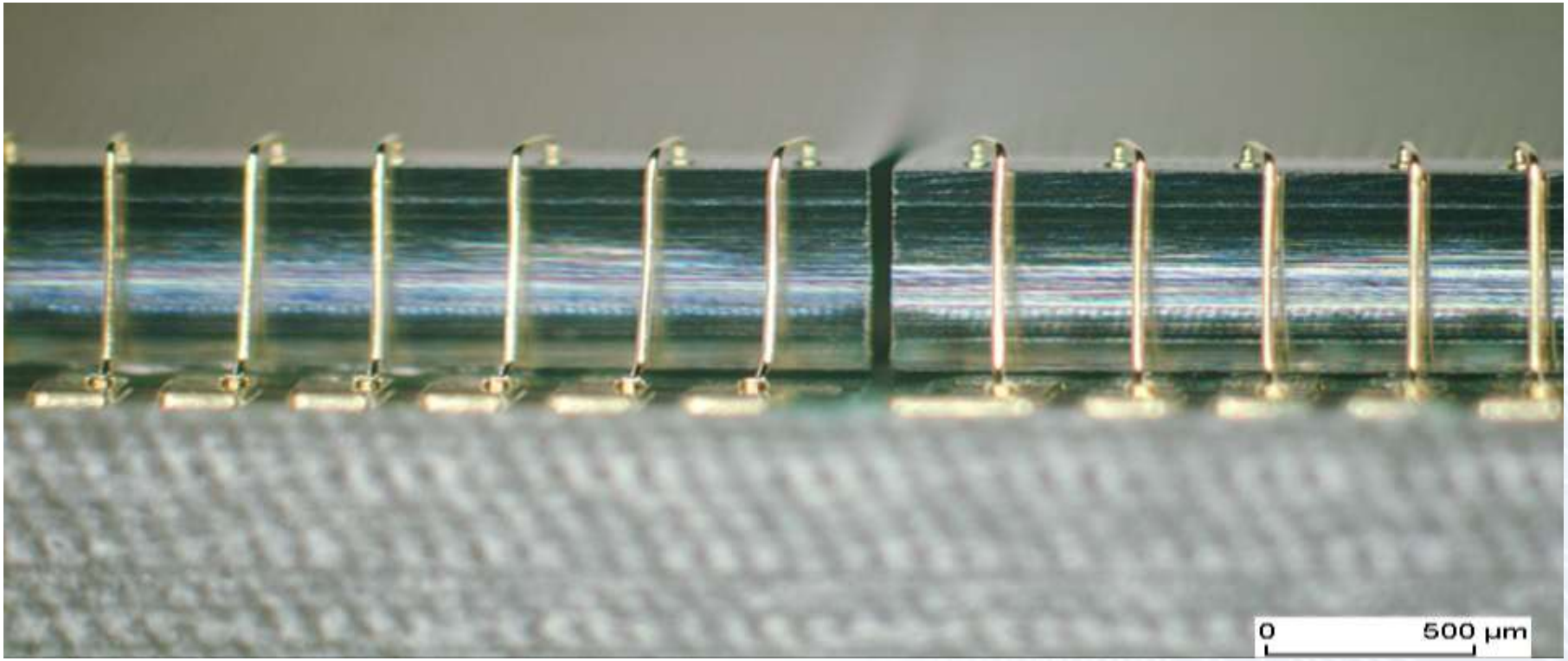




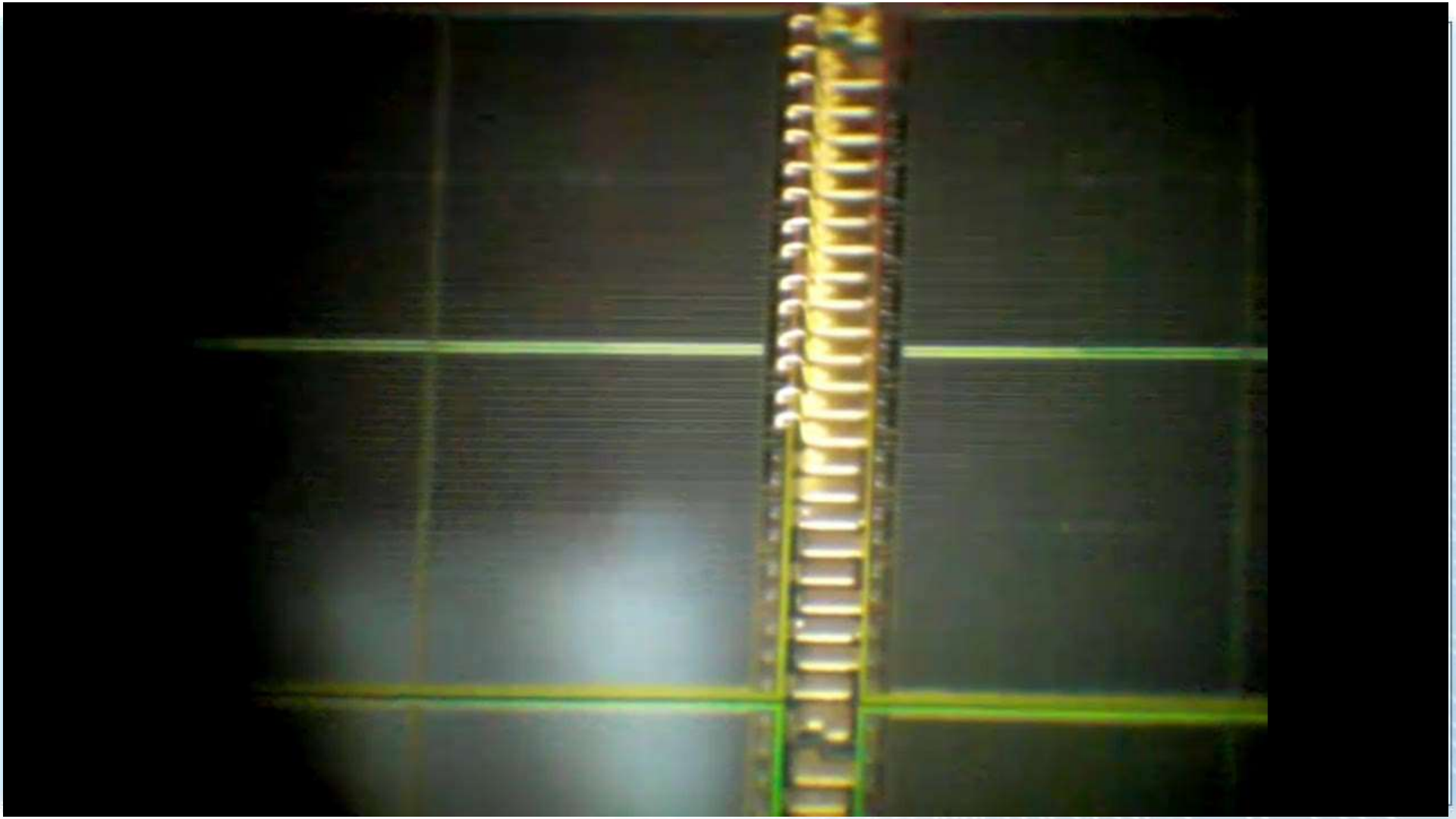
Kantenausbruch

Drahtbonden

- TS Au-Draht Bondungen



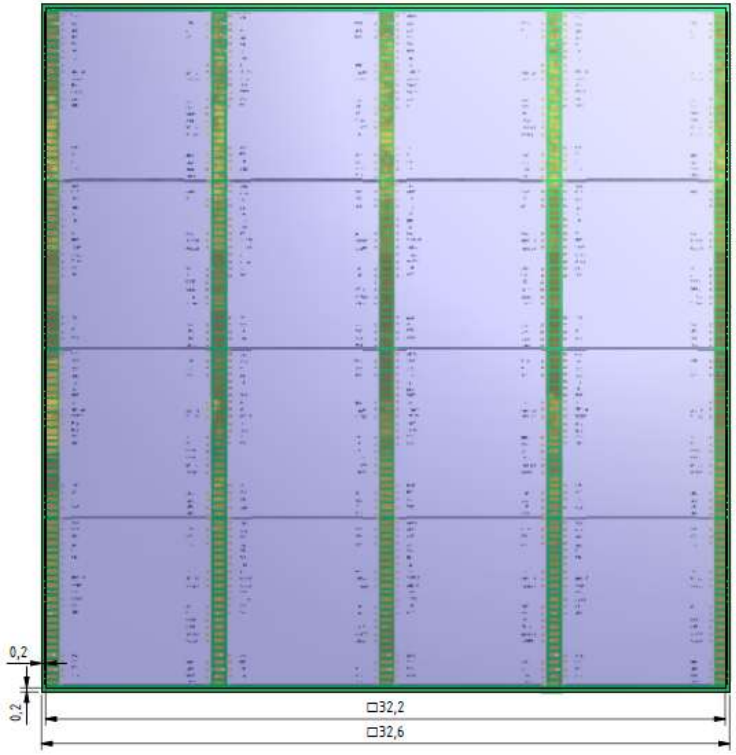
Drahtbonden



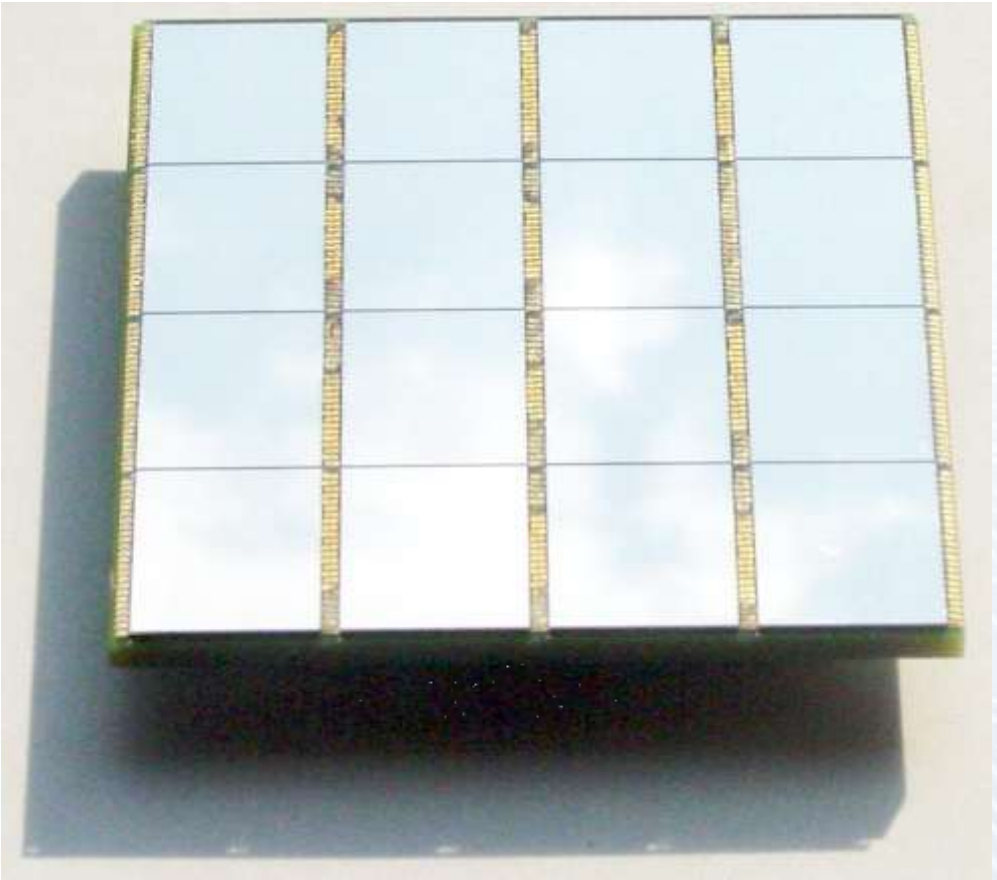
- Glasmontage
  - Glasdicke 0,2 mm ⇨ 0,1 mm
    Handling!
  - Abdeckung der 16 Chips mit einer Glasplatte
  - Geometrie nach Vorgabe
  - Technologie stressarm
  - Klebung blasenarm; optischer Klebstoff

Glasmontage

- Glasmontage

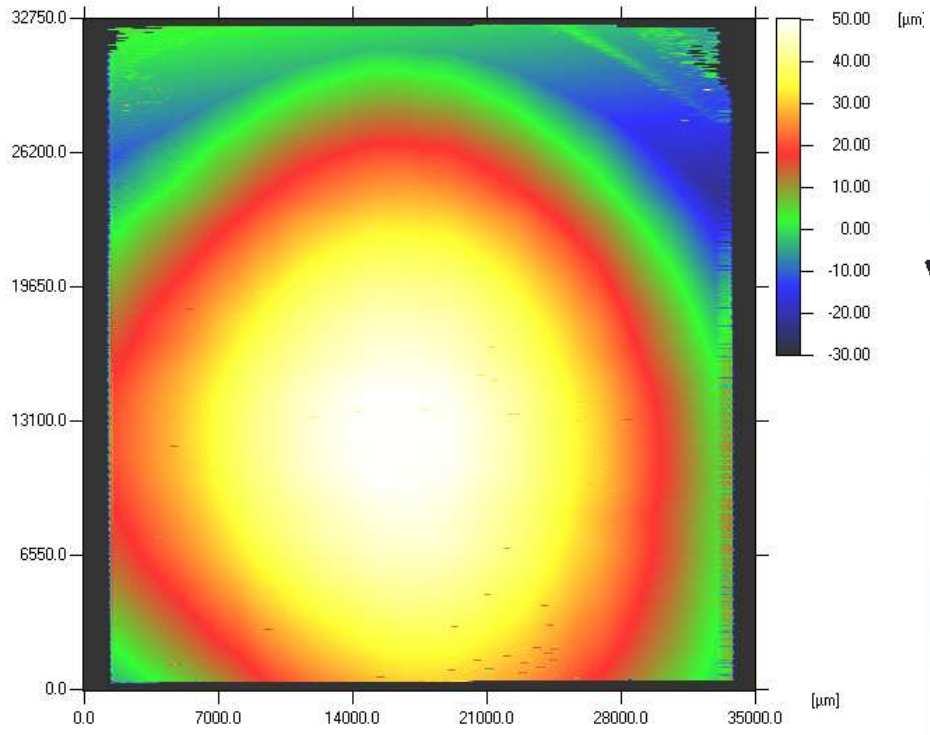


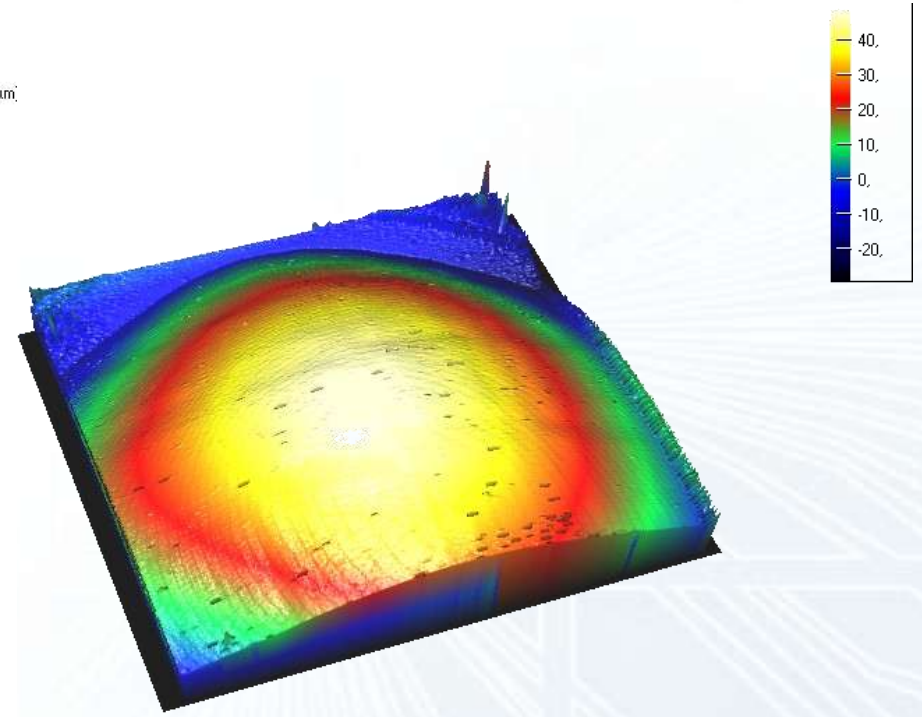
Glasgröße: 32,2 x 32,2 mm²
Glasdicke: 0,1 mm



Glasmontage

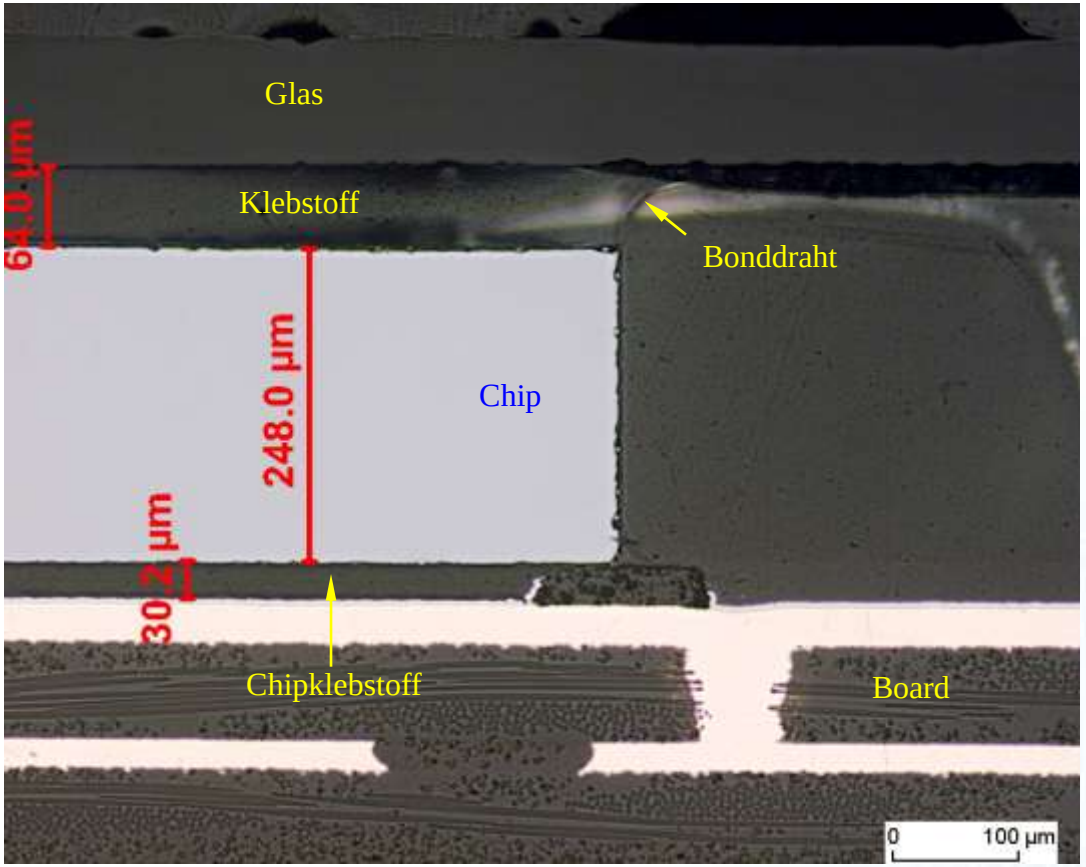
- Modulkrümmung nach Glasmontage





Modulkrümmung max 46 µm, konvex

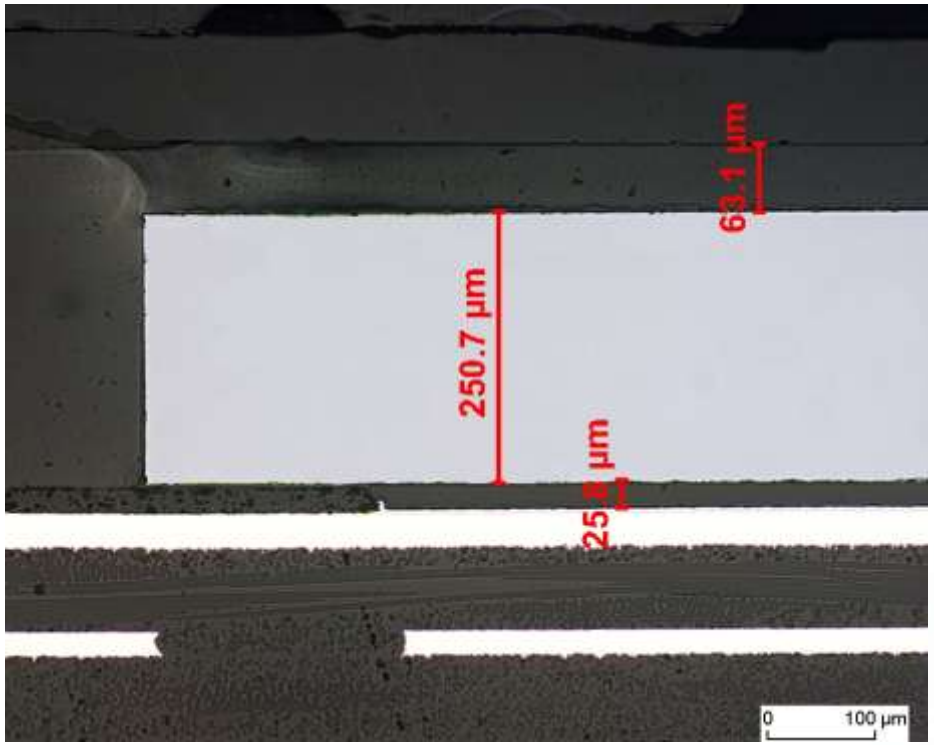
- Gesamtaufbau im Querschliff

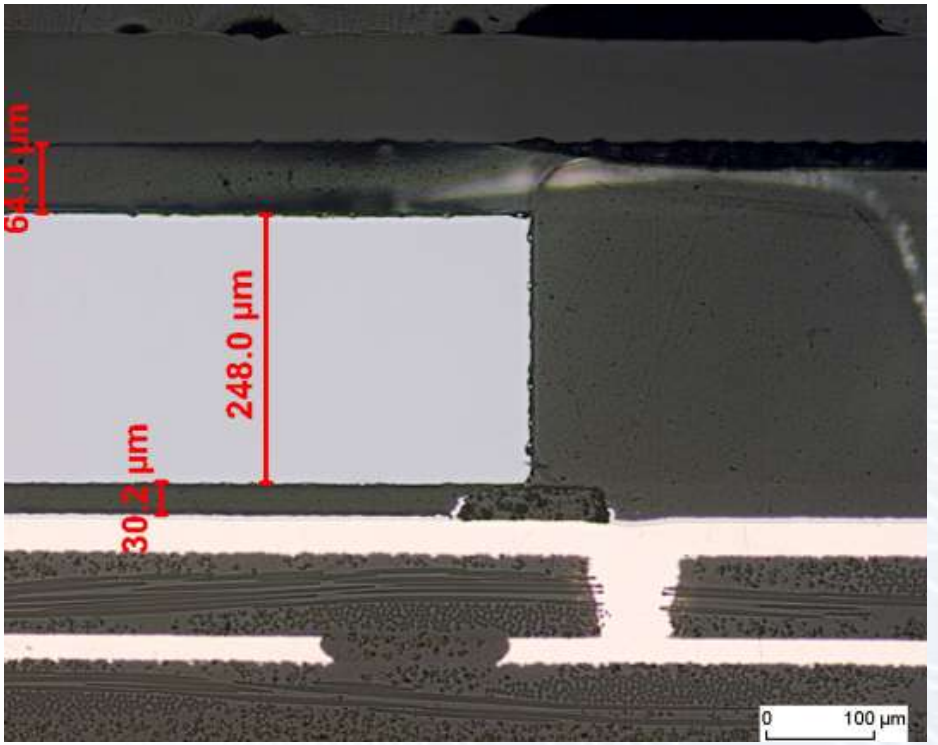


Chip 1 rechts

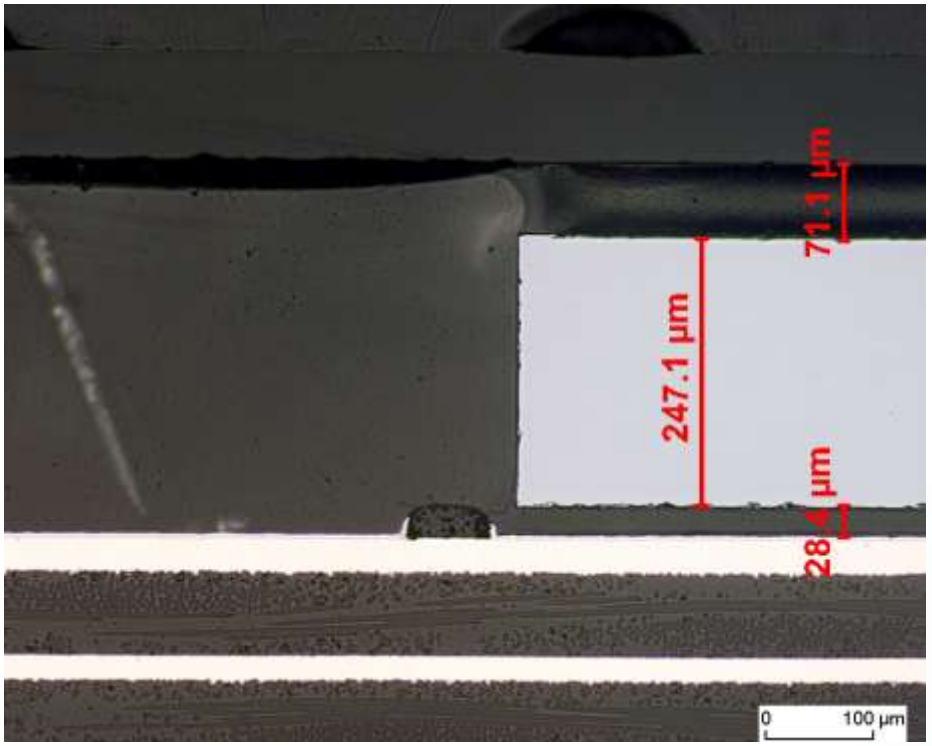
Modul

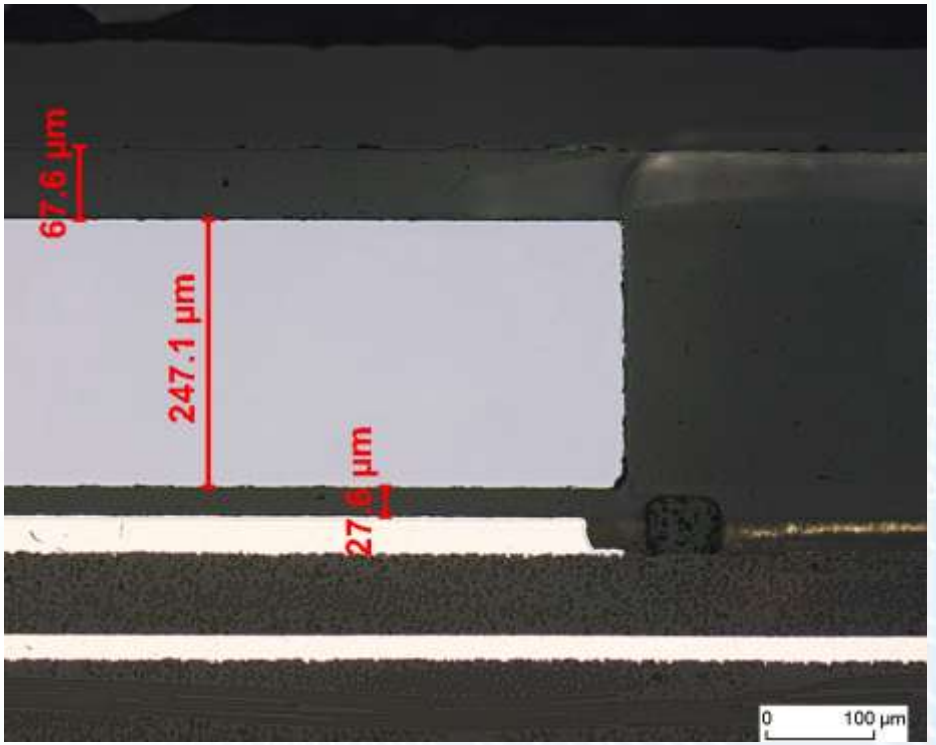
- Chip 1



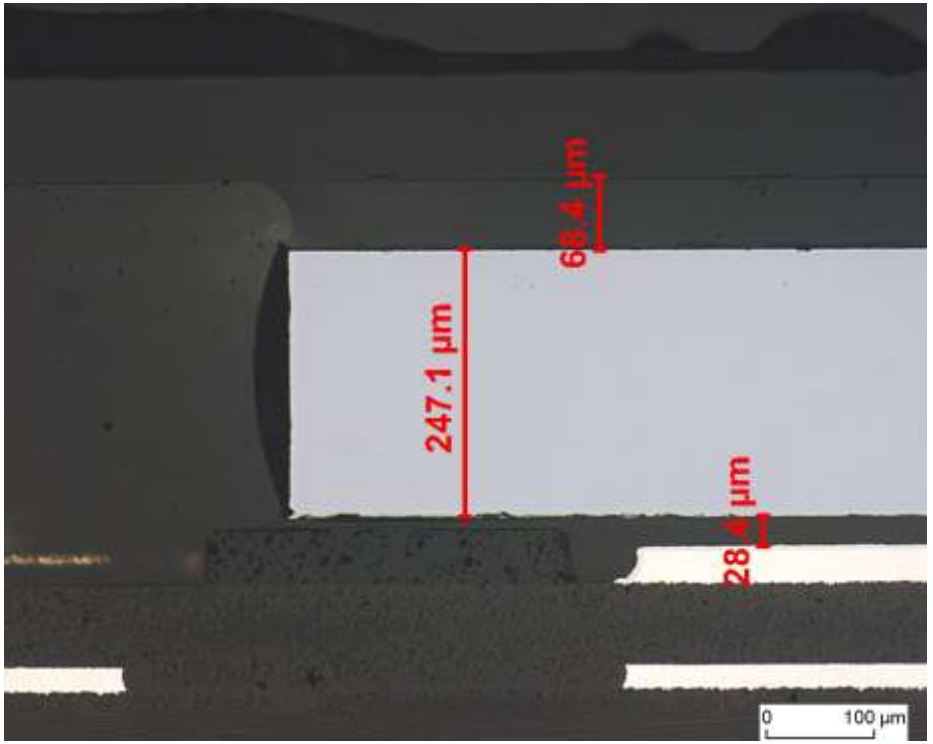


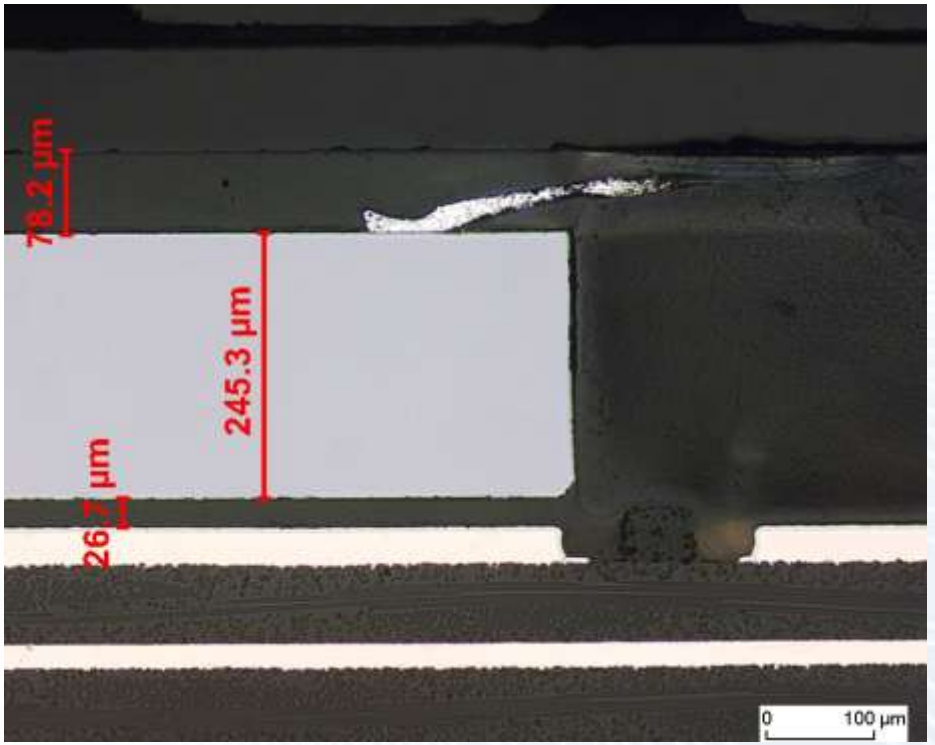
- Chip 2



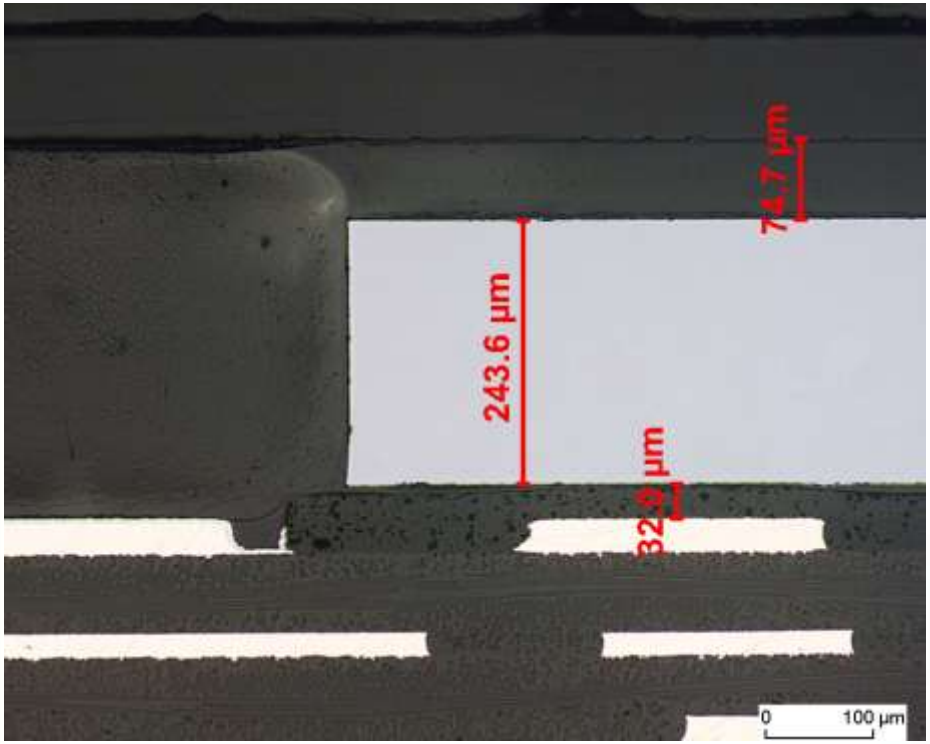


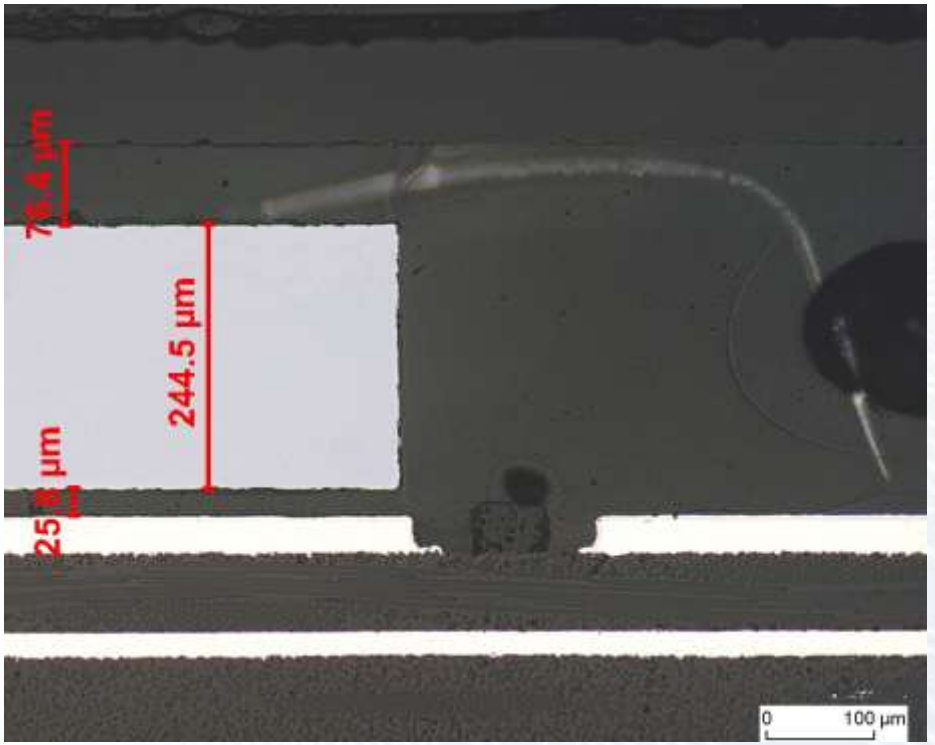
- Chip 3





- Chip 4





Zusammenfassung

- Zusammenfassung
  - Komplexer Aufbau
  - Stressarme Technologien notwendig
  - Zielstellung konnte erreicht werden
  - Entwicklung nur erfolgreich durch gemeinsame Leistung der Produkt- und AVT-Entwickler