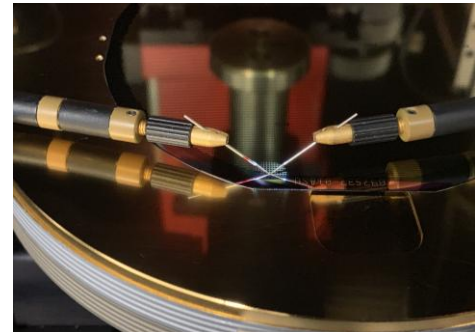


# 1.6T/3.2Tbps Applications: Next-Gen Photodiode Innovations

Dr. Tudor Olariu

Product leader, Albis Optoelectronics AG, Switzerland

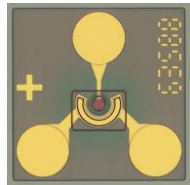
- 20 years of excellence in III-V photodiode fabrication with **over 40 million III-V photodiodes sold to date.**
- Designer, developer and manufacturer of high-speed InP and GaAs **photodiodes and avalanche photodiodes.**
- Own **clean room production facilities:**
  - In-house front-end to back-end wafer processing and testing.
  - Flip-chip mounting and packaging infrastructure.



# Product Highlights – Booth #2145

## High speed III-V photodiodes

- Long wavelength lensed 28/56/112 GBd PD.
- Large PD array – AOC 800GBASE-DR8.
- 70 GHz PD – 128 GBd coherent receivers.
- 56G/100G GaAs PD – 400GBASE-SR4.



## Long wavelength APD

- FTTX 10G/28G ROSA.
- Burst mode APD – 25G/50G PON.
- 28G APD ROSA.

## Packaged photodiode solutions

- High QE PD for quantum technology.
- Quadrant PD/APD for positioning.
- High power, packaged RF PD 10GHz / 20GHz.
- Battery powered photodiode modules.



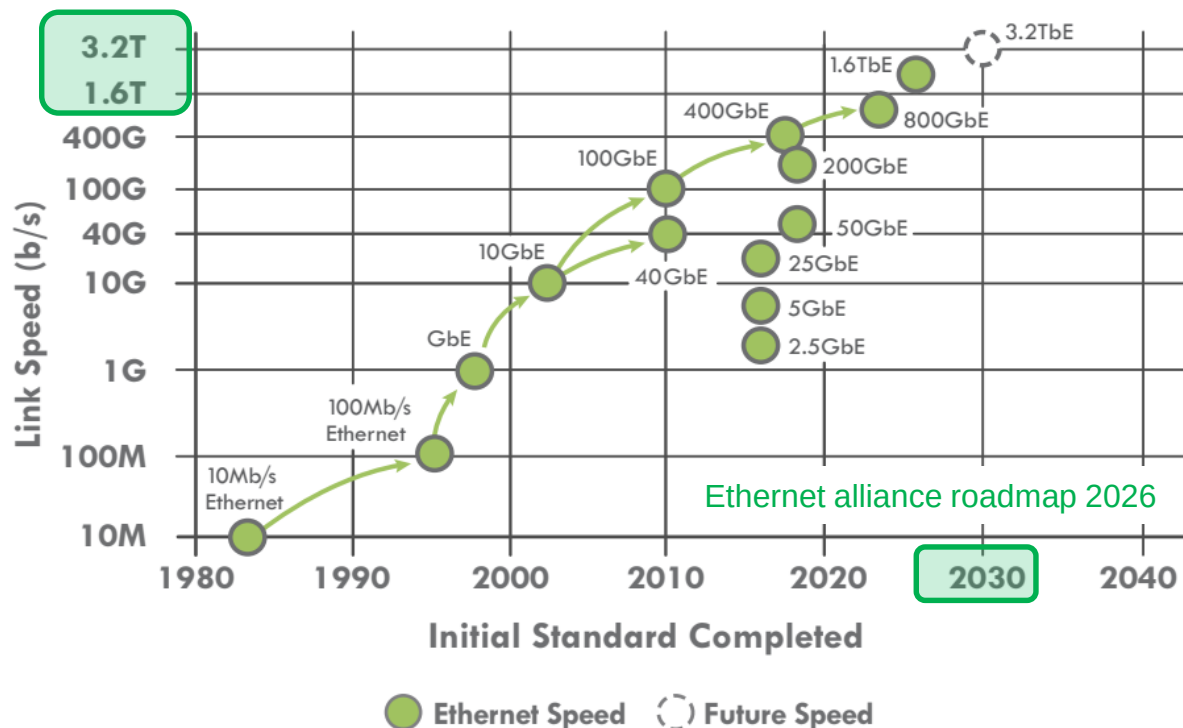
# Next steps in datacom : towards 3.2T

Data traffic drivers : AI/ML, VoD, Cloud computing, IoT ...

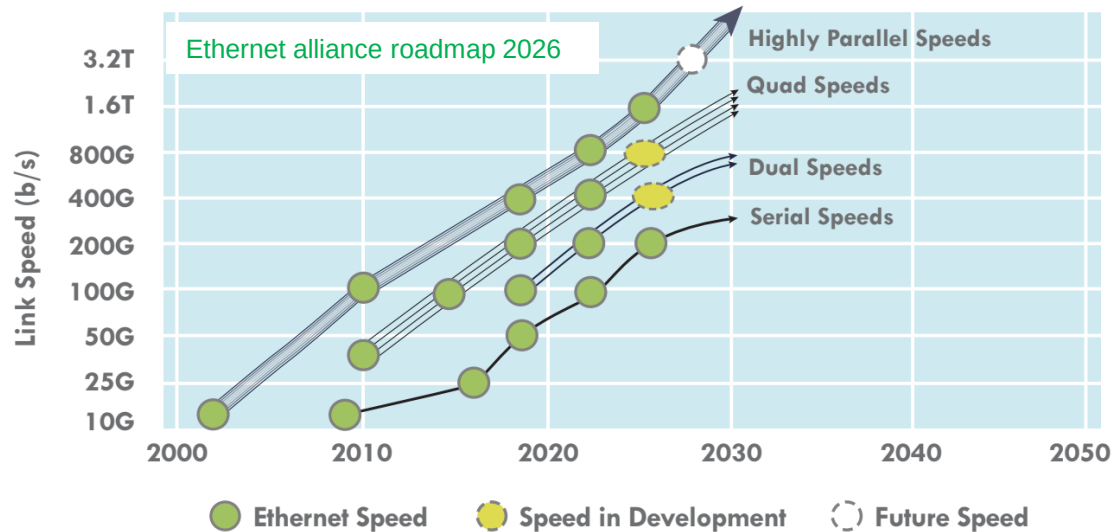
Roadmap of the next 5-8 years → 800G / 1.6T / 3.2T

Drive towards higher component speeds

## ETHERNET SPEEDS

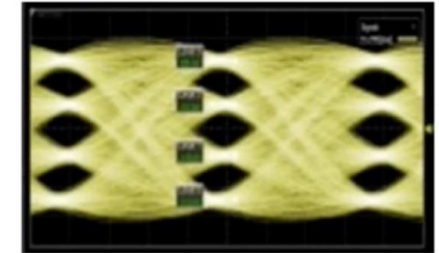


# Near term implementation



## PAM4 Modulation

106Gb/s PAM4 TIA Output



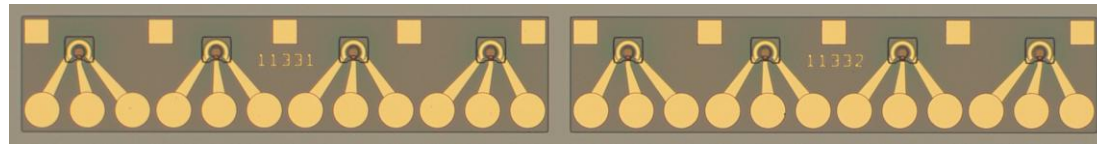
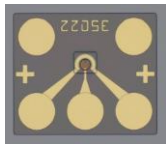
[H. Li ISSCC 2021]

| Link Speed (Gb/s) | Channel rate (Gb/s) | Channels (#) | Channel rate (Gbaud) | Modulation | Remarks     |
|-------------------|---------------------|--------------|----------------------|------------|-------------|
| <b>800G</b>       | 100G                | 8            | 56                   | PAM4       | deployed    |
|                   | 200G                | 4            | 112                  | PAM4       | deployed    |
| <b>1.6T</b>       | 100G                | 16           | 56                   | PAM4       | deployed    |
|                   | 200G                | 8            | 112                  | PAM4       | ready       |
|                   | 400G                | 4            | 224                  | PAM4       | exploratory |
| <b>3.2T</b>       | 200G                | 16           | 112                  | PAM4       | ready       |
|                   | 400G                | 8            | 224                  | PAM4       | exploratory |

# Photodiode technology is evolving

Although the component speeds for individual channels supporting links up to 3.2 T are well-defined (100G/200G), the integration process continues to evolve.

The choice between photodiode single channels and monolithic arrays remains customer specific, largely driven by electronics form factor (TIAs)



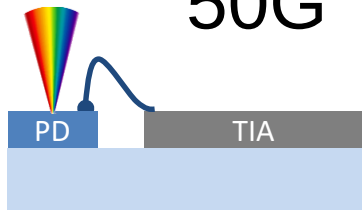
On the photodiode side advancements are focused on **optimizing optical coupling methods and improving electrical interfaces**

# Albis PD

High speed

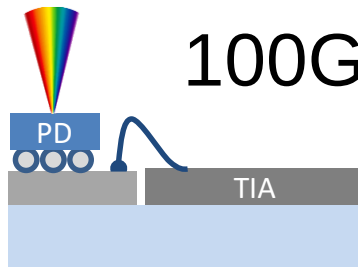


## Standard PD 50G



PD wire bond to TIA

## 100G



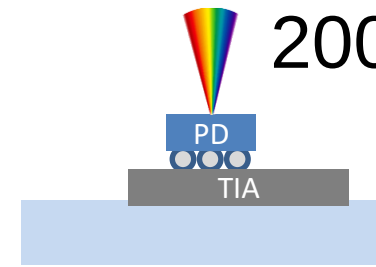
AuSn solder PD on carrier  
Wire bond to TIA

## 200G



SAC solder PD & TIA  
onto PCB

## 200G

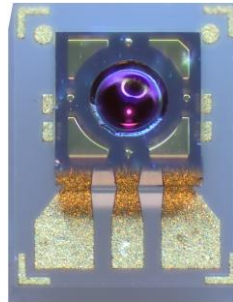


AuSn or SAC solder PD  
onto TIA

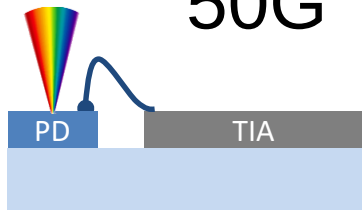
# Albis PD

High speed

High speed+  
Backside lens

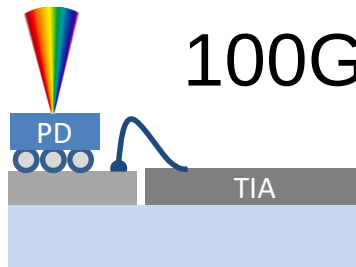


Standard PD  
50G



PD wire bond to TIA

100G



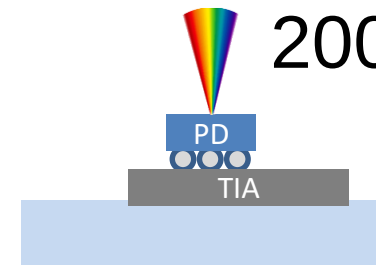
AuSn solder PD on carrier  
Wire bond to TIA

200G



SAC solder PD & TIA  
onto PCB

200G



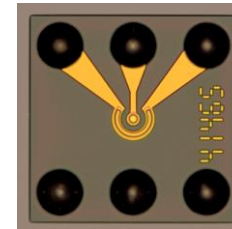
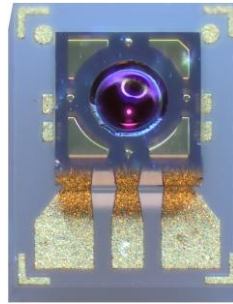
AuSn or SAC solder PD  
onto TIA

# Albis PD

High speed

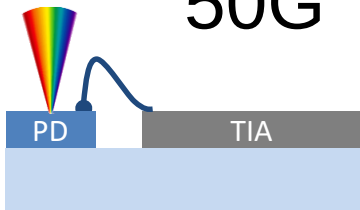
High speed+  
Backside lens

High speed++  
Backside lens  
Electrical interfaces



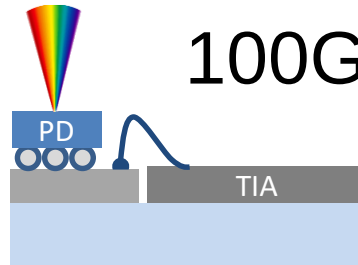
## Standard PD

50G



PD wire bond to TIA

100G



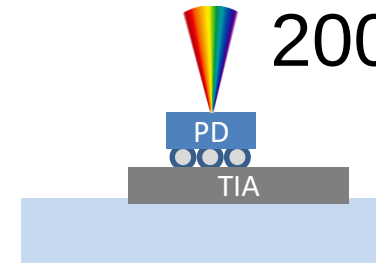
AuSn solder PD on carrier  
Wire bond to TIA

200G



SAC solder PD & TIA  
onto PCB

200G

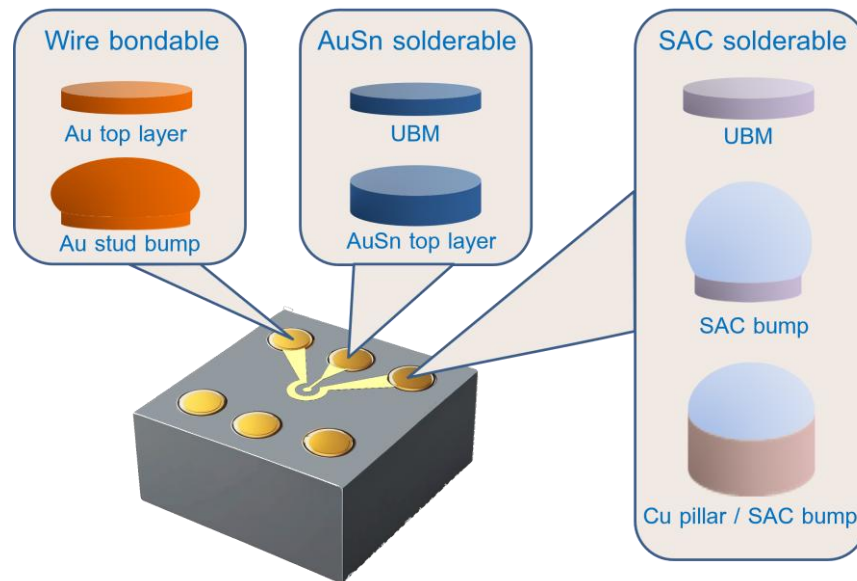
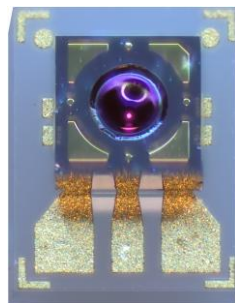


AuSn or SAC solder PD  
onto TIA

# Albis PD

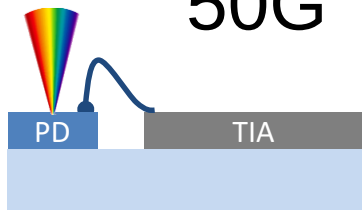
High speed

High speed+  
Backside lens



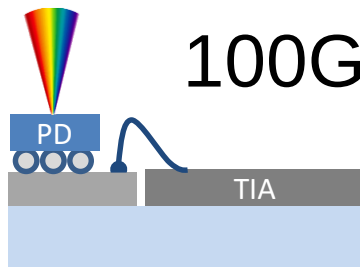
Standard PD

50G



PD wire bond to TIA

100G



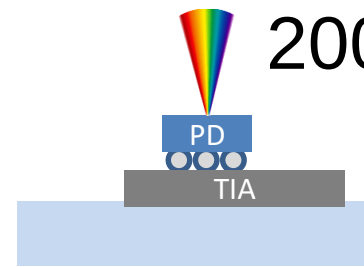
AuSn solder PD on carrier  
Wire bond to TIA

200G



SAC solder PD & TIA  
onto PCB

200G

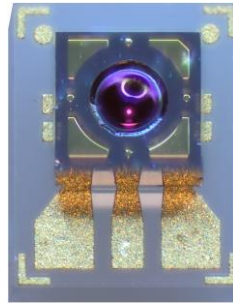


AuSn or SAC solder PD  
onto TIA

High speed

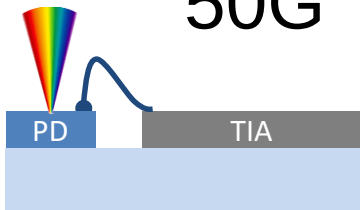
High speed+  
Backside lens

High speed++  
Backside lens  
Electrical interfaces  
Epitaxy design / low parasitics



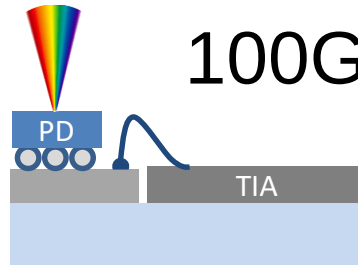
Standard PD

50G



PD wire bond to TIA

100G



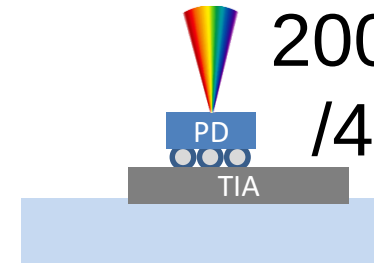
AuSn solder PD on carrier  
Wire bond to TIA

200G



SAC solder PD & TIA  
onto PCB

200G  
/400G



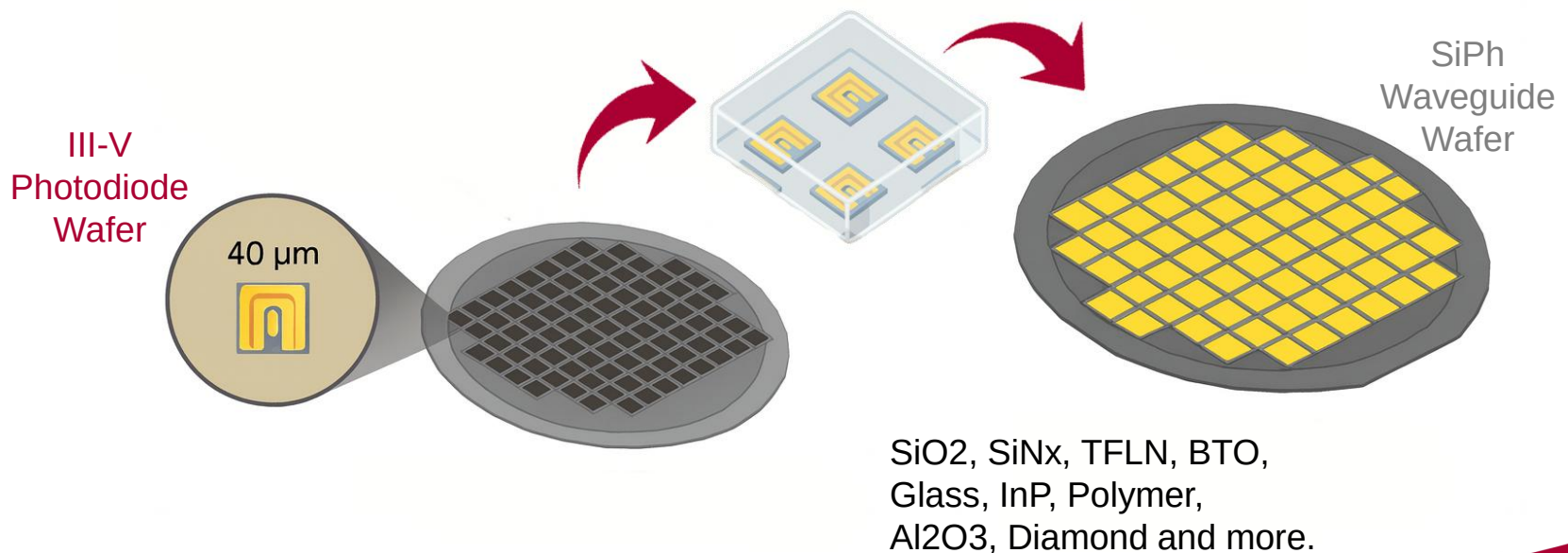
AuSn or SAC solder PD  
onto TIA

# Alternative path – Mass Transfer

Assembly technique where components from multiple source wafers are transplanted to a single target silicon photonics wafer via mass transfer: a highly parallelized pick-and-place process, e.g. micro-transfer printing ( $\mu$ TP)

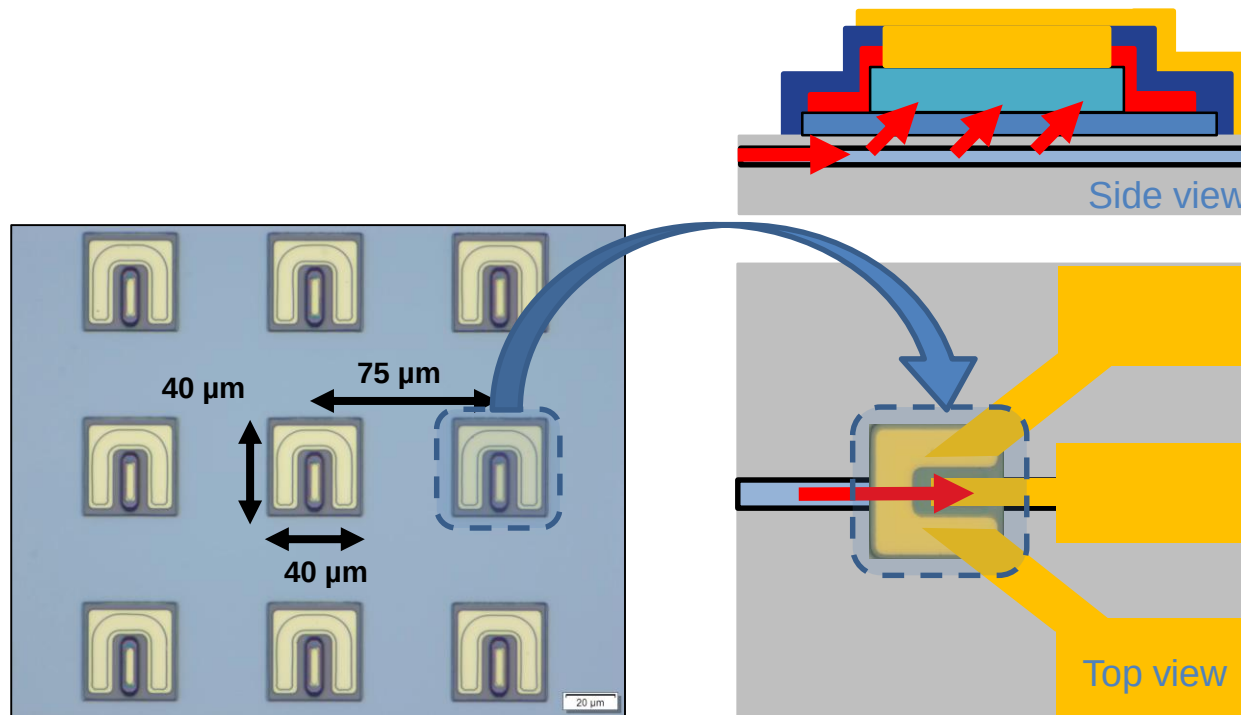
Advantages:

- **Increase functionality** by heterogenous, dense integration of optimized components.
- **High throughput** by simultaneous transfer of multiple components.
- **High alignment precision** – time for precision alignment.



# Mass Transfer - advantages

Heterogenous integration of PD on PIC platform (SiN, Glass, Polymer, TFNL)  
Cost efficient electrical interconnects on wafer level (no wire bond or soldering)



Enables evanescent / grating coupler

→ Higher PD speed with high responsivity (UTC)

→ Path towards 400G PDs

# Conclusion

Albis Optoelectronics provides **detector solutions**:

Datacom, telecom, sensing, positioning, laser monitoring and LIDAR

Albis Optoelectronics **offering for future 1.6T/3.2T products**

High speed

High responsivity

Single / Arrays

Scalability

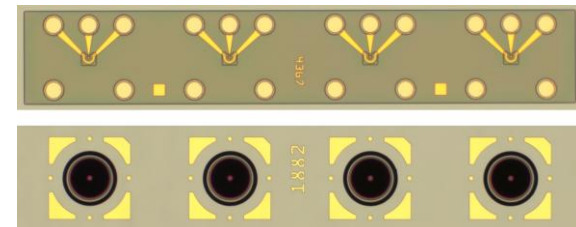
Chip / Chip-on-carrier

Easy optical coupling through backside integrated lens

Pad interfaces matching various platform

Mass transfer photodiodes

And more.....



# Thank you!

**Albis Optoelectronics AG**  
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## Albis Optoelectronics – Detecting Solutions

### Visit us at booth #2145

