

Forschungsfabrik Mikroelektronik Deutschland

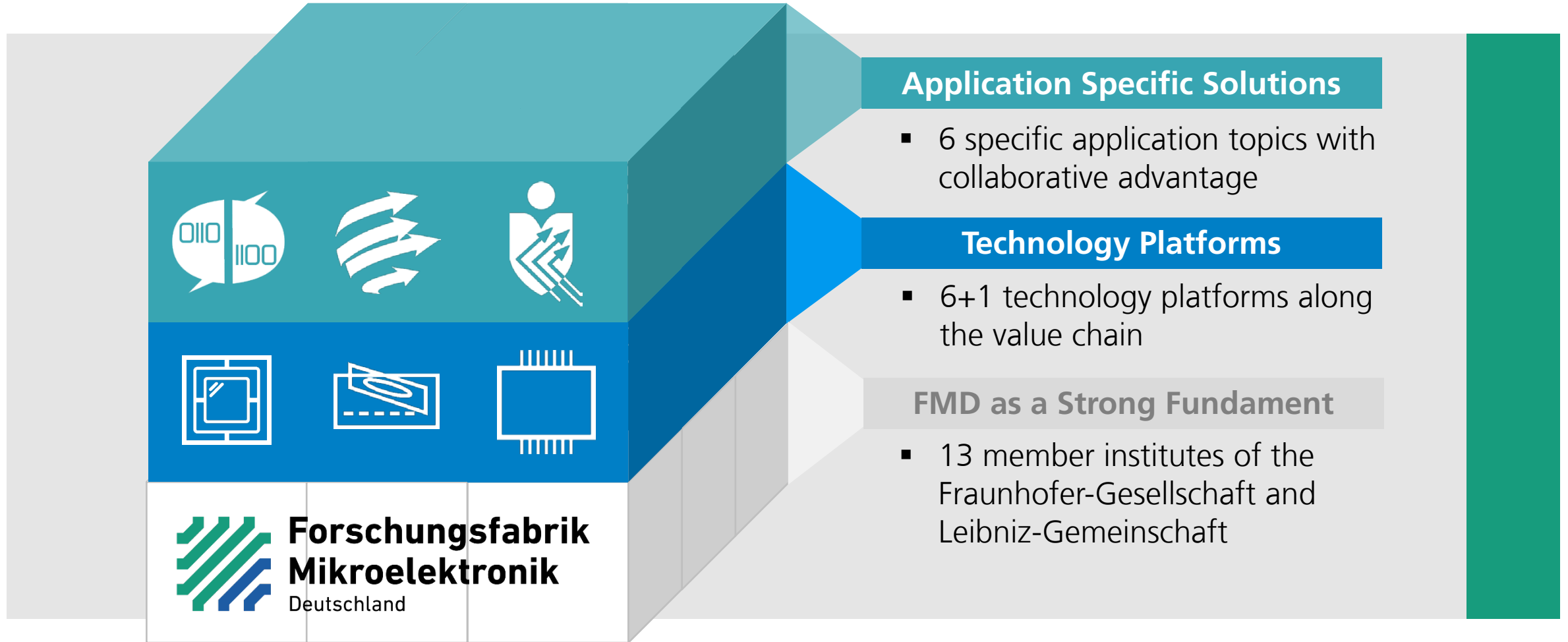
**Fraunhofer Group for Microelectronics in Cooperation with Leibniz
Institutes FBH and IHP**



LiDAR-Solutions for Automotive and Industrial Applications

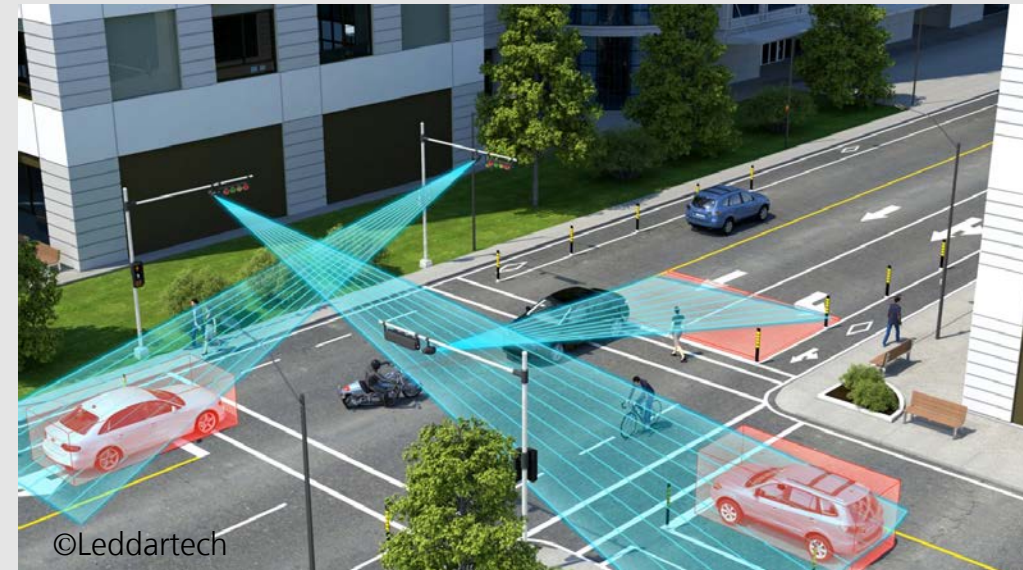
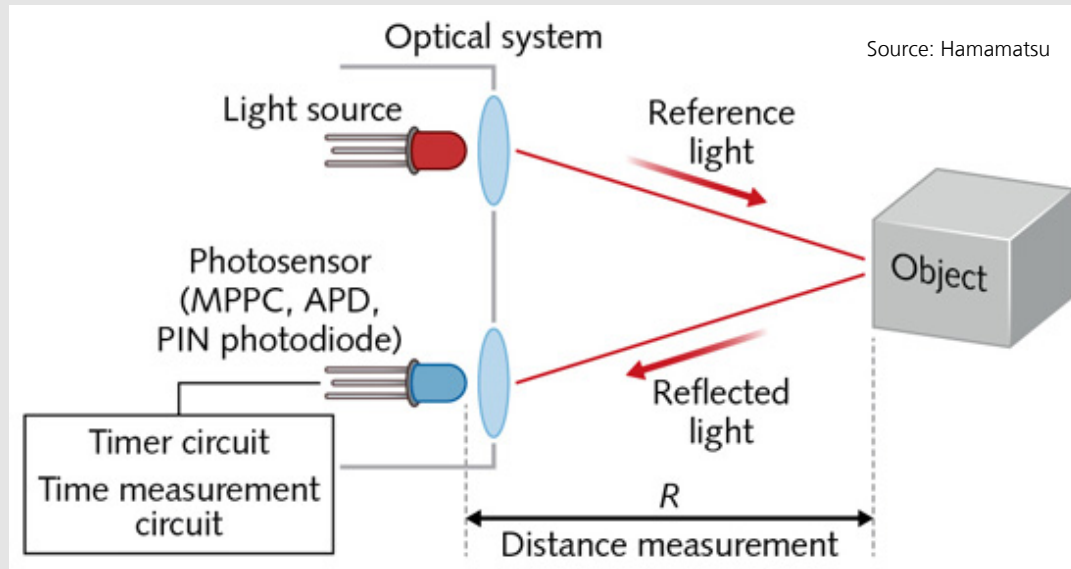
Jörg Amelung, Research Fab Microelectronics Germany

FMD Offer for Customers



LiDAR

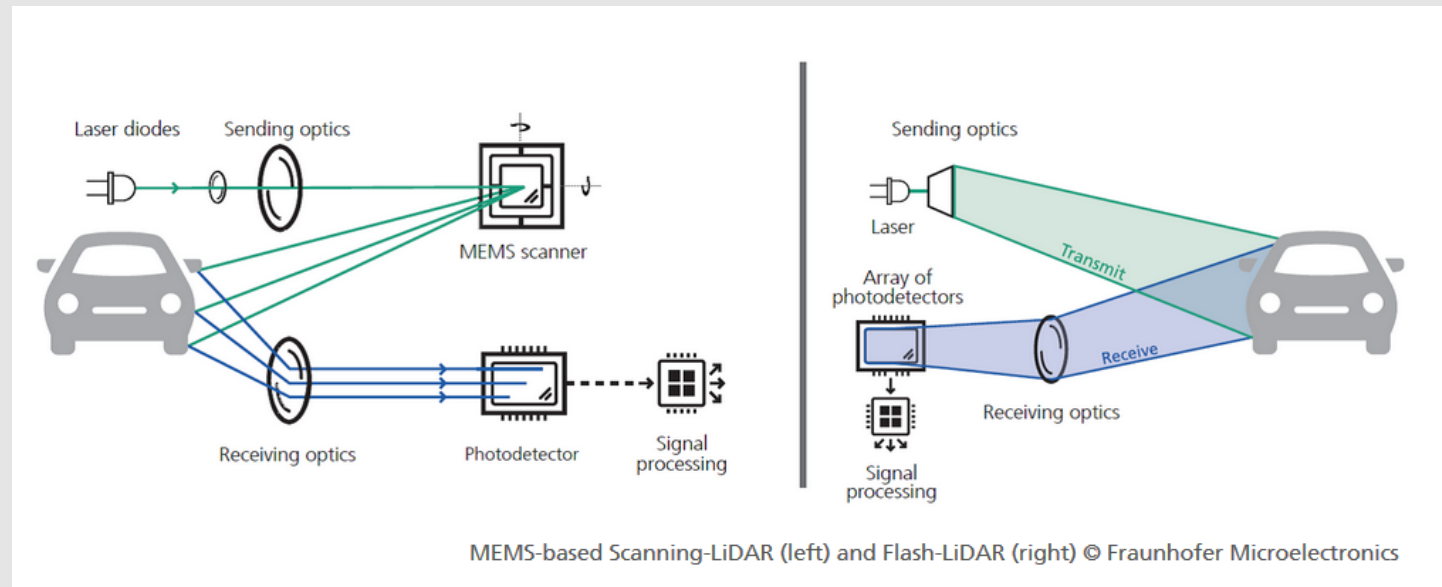
- LiDAR/LaDAR = Light/Laser Detection and Ranging
- Range determination by time-of-flight measurement



LiDAR

Expertise along the entire value chain

- Competencies along the entire value chain of a LiDAR system
 - Different LiDAR approaches
 - MEMS-based scanning LiDAR
 - Flash LiDAR
 - OPA
 - Different wavelengths
 - 905nm **as well as** 1550nm and others



LiDAR

Expertise along the components of the entire value chain



**Forschungsfabrik
Mikroelektronik**
Deutschland

laser source

sending optics

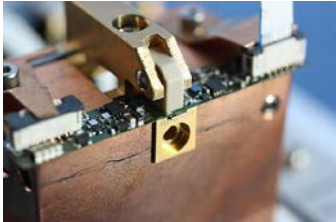
beam steering

receiving optics

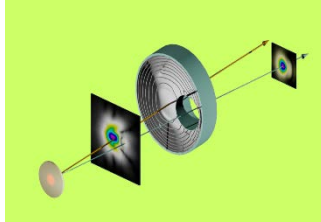
detection

*signal processing /
sensor data fusion*

FBH



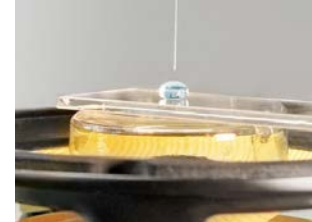
IOF



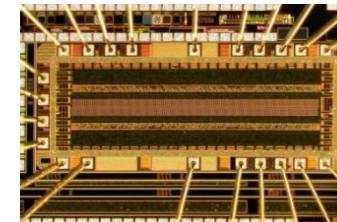
IPMS



IOF



IMS



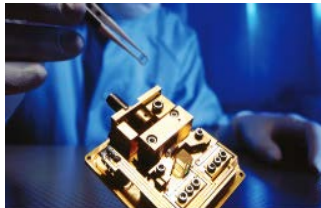
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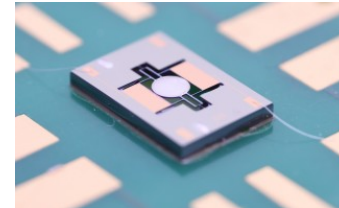
HHI



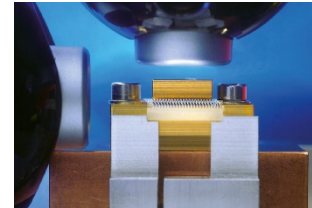
ILT



ISIT



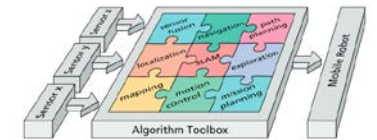
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IAF



IOSB

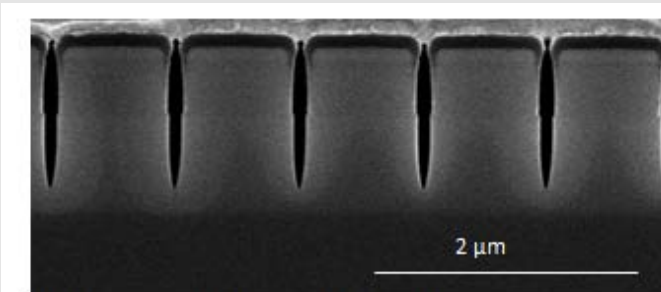
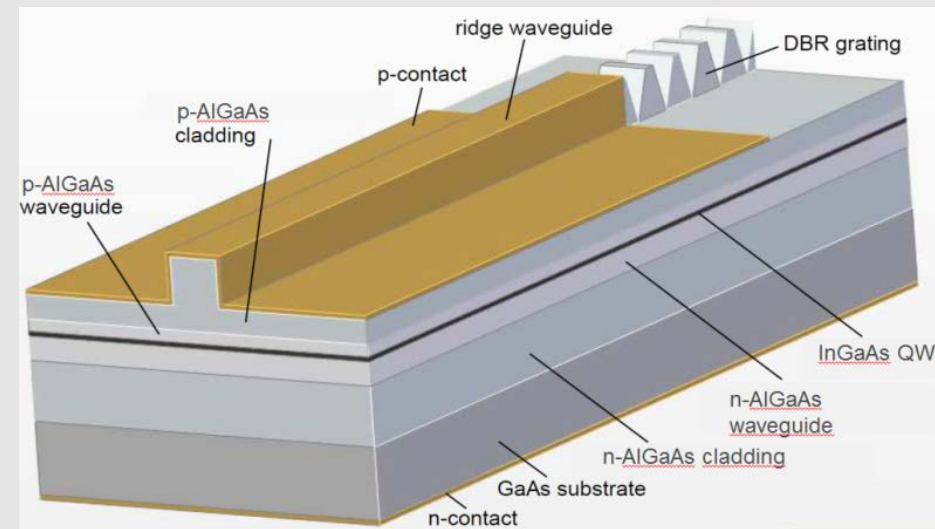


LiDAR - value chain for 905 nm and 1550 nm

Laser Source

Distributed Bragg Reflector (DBR) Broad Area (BA) Laser

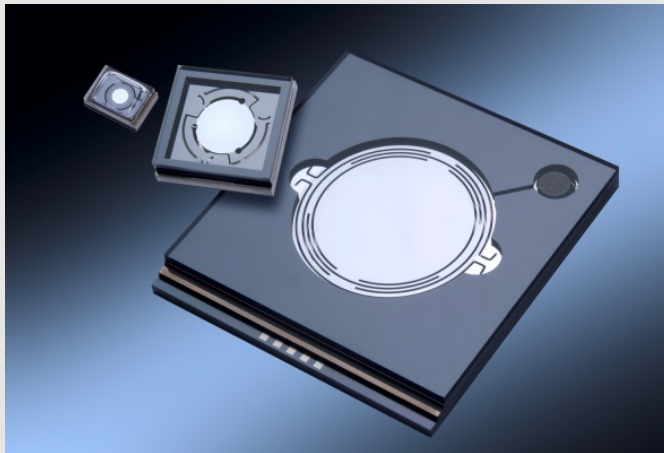
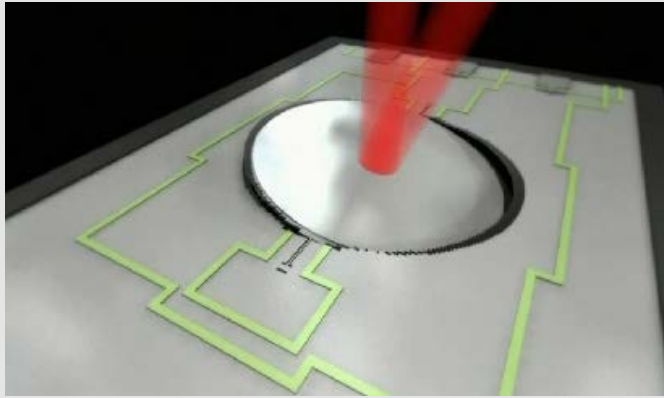
- GaAs-based
- Single-step MOVPE
- Emission wavelength near 905 nm at RT
- lateral optical and electrical confinement by dry-etched trenches
- Contact widths: $W = 30, 50, \text{ or } 100 \mu\text{m}$
- Total cavity length $L = 6 \text{ mm}$
- Higher-order surface Bragg grating integrated in the rear part of the cavity, $L(\text{DBR}) = 1 \text{ mm}$



SEM picture of cleaved DBR section

Beam Steering

MEMS based LiDAR Scanner Concept



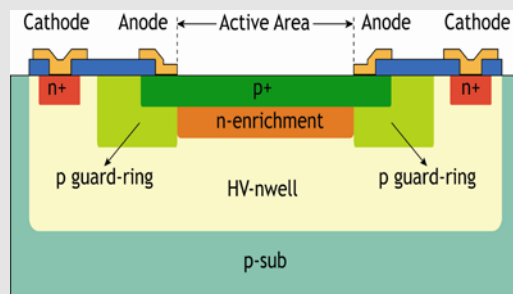
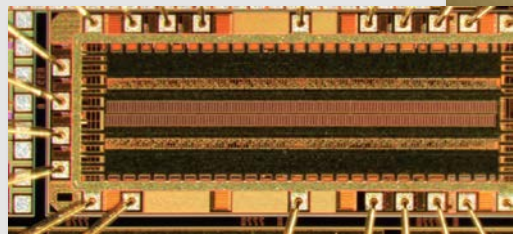
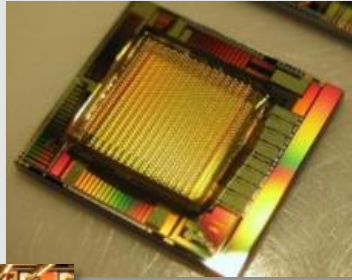
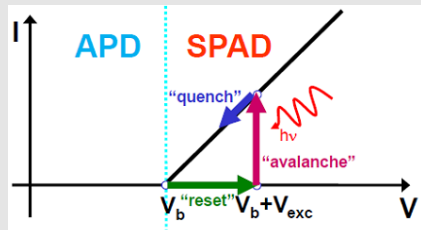
Distance Laser Scanner using MEMS

Advantages

- + fast scanning (no air bearings)
- + low weight, very robust
- + (potentially) low cost

Detection

Single-Photon-Avalanche-Diode (SPAD)



Single-Photon-Avalanche-Diode (SPAD)

- Avalanche photodiode operated above breakdown voltage (= Geiger-Mode)
- Very few photons can be detected
- CMOS integration allows for high spatial resolution and on-chip signal processing
- Fast operation with very good time resolution
- No analog signal processing needed

Conclusion

- LiDAR systems is one of the key component for future autonomous systems
- Inside the FMD cooperation the full value chain including system integration could be offered
- The FMD offers industrial contract research till pilot production and technology transfer to realize future MEMS based LiDAR systems

Your FMD Contact



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