Recent developments regarding Optical MEMS and their applications

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HISTORY
Fraunhofer IPMS

1992 Fraunhofer IPMS started as branch of the Fraunhofer Institute of Microelectronic Circuits and Systems

2003 Fraunhofer Institute for Photonic Microsystems (Fraunhofer IPMS) became an independent institute in Dresden

2005 Fraunhofer Center Nanoelectronic Technologies (Fraunhofer CNT) founded as Public Private Partnership with AMD & Infineon

2007 Modernization of the institute and opening of a new MEMS clean room

2013 Fraunhofer CNT became a department of Fraunhofer IPMS as business field IPMS-CNT

IPMS building


IPMS-CNT building

Fraunhofer IPMS clean rooms

150 mm MOMS/MEMS clean room

300 mm CNT clean room

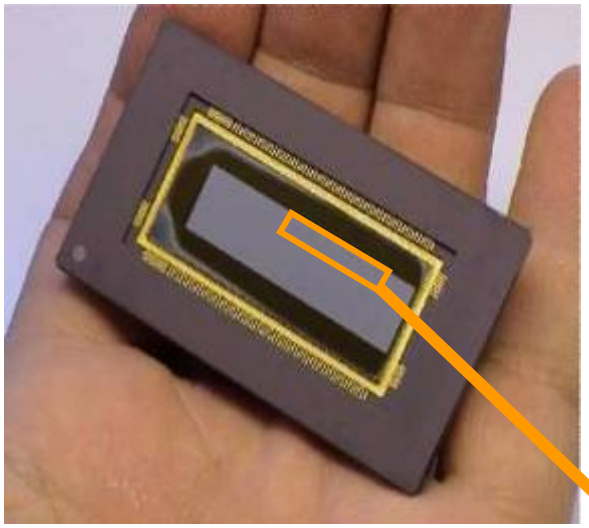
- 1500 m², class 10
- 150 mm (6”) Wafer line
- 3 shift preparation for R&D and pilot fabrication
- Technological parameter supervising system
- PPS based planning and documentation
- ISO 9001 certification

- 800 m² clean room, class 1000 & 200 m² laboratory area
- 40 Tools for Wafer Processing, Patterning, Metrology & Analytics
- Qualification of processes & materials on 300 mm industrial standard equipment
- Sub-nm characterization and verification
- Full integration into customer process flow in 28 nm technology and beyond

Fraunhofer IPMS Location in the „Silicon Saxony“

Sources: Google / Bing / Infineon / Globalfoundries

Spatial Light Modulators



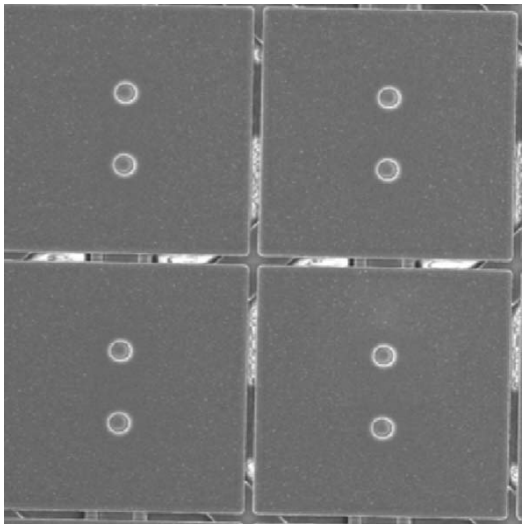
16 µm pitch

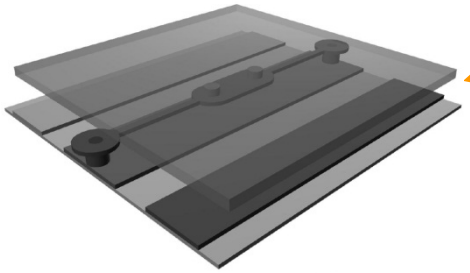
2048 x 512 pixel

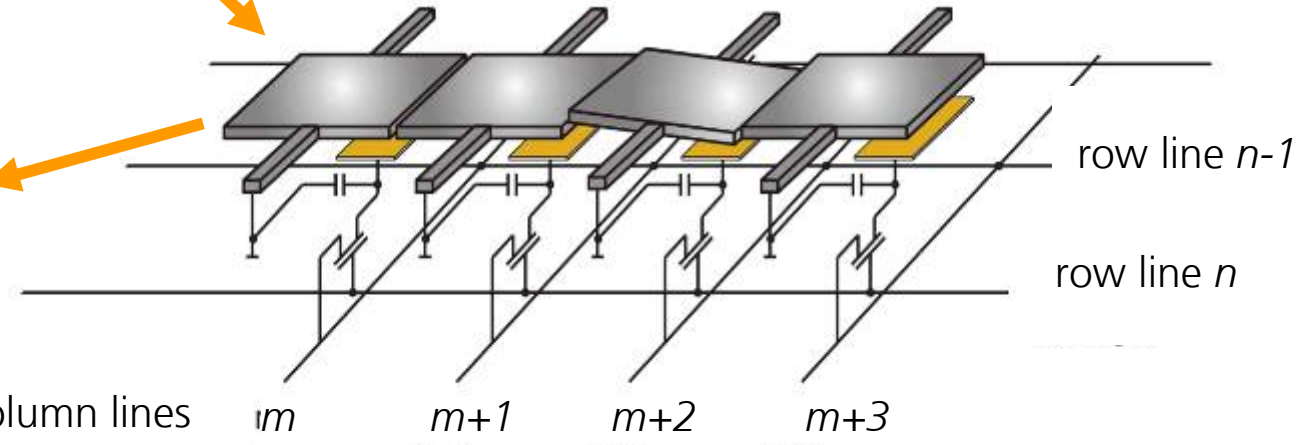
(1Mega-Pixel)

2 kHz frame rate

Operating wavelength 248nm



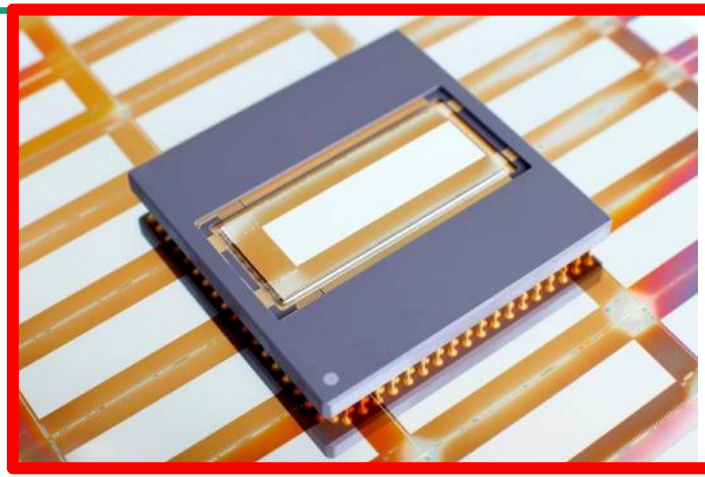




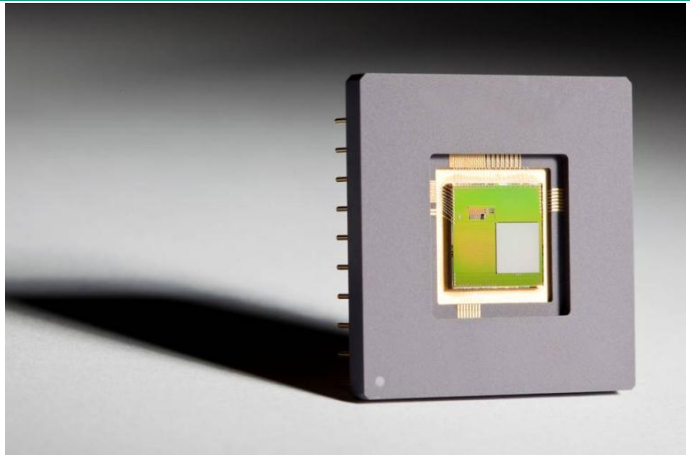
Custom-built SLM by Fraunhofer IPMS: Applications

Laser Direct Imaging

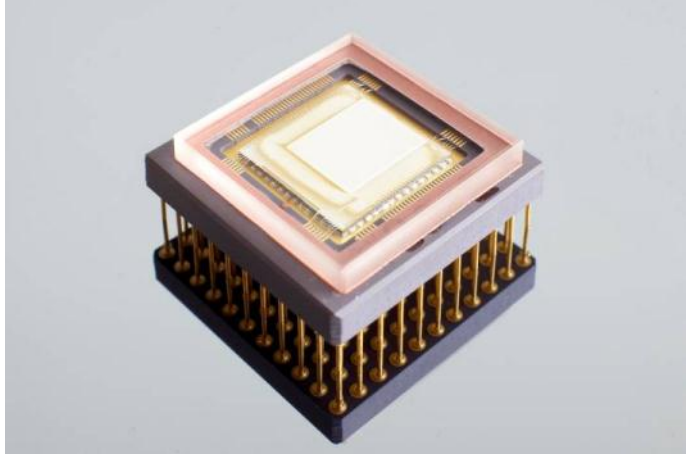
Mask Writing



Microscopy



Adaptive Optics



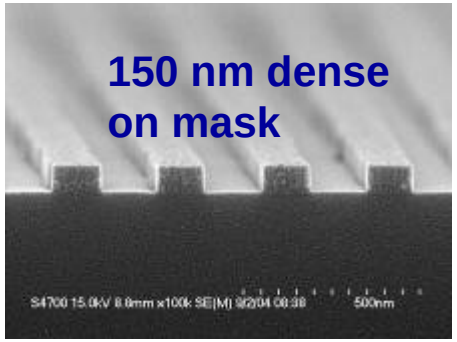
Fraunhofer IPMS

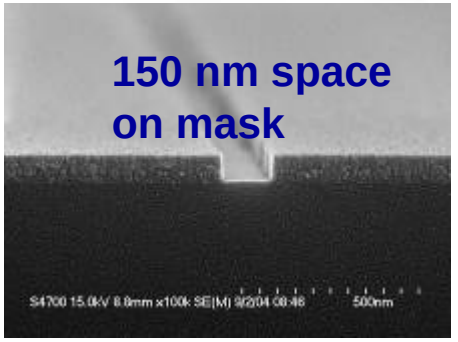
MICRONIC MYDATA's SIGMA 7700 Mask Writer

Application

- Quick turn-around and cost-effective production of reticles.
- Prints entire mask set at the 90nm technology node, and non-critical photomasks down to the 22nm node
- 3h per reticle (4-pass writing), ~1.5h (2-pass-writing)
- ideal solution for 2nd layer patterning of advanced PSM and well-suited for advanced image sensors

MICRONIC MYDATA



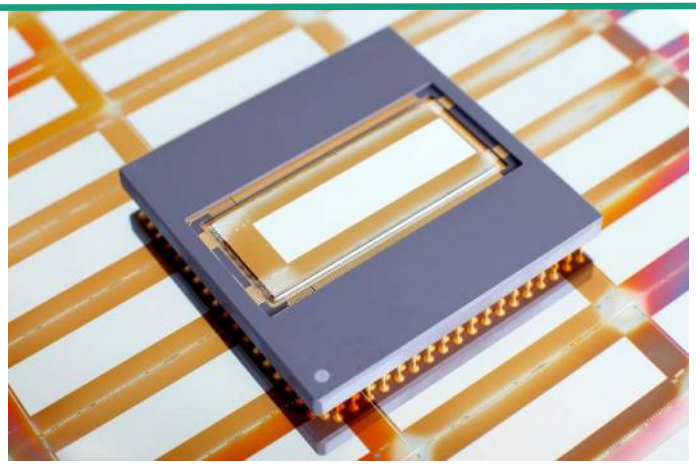


Status: Several systems in field

http://www.micronic-mydata.com/www/elements.nsf/(read)/CF594C5483A7D029C12578C4002781F2/$file/ab05547_sigma7700_product_sheet_b.pdf

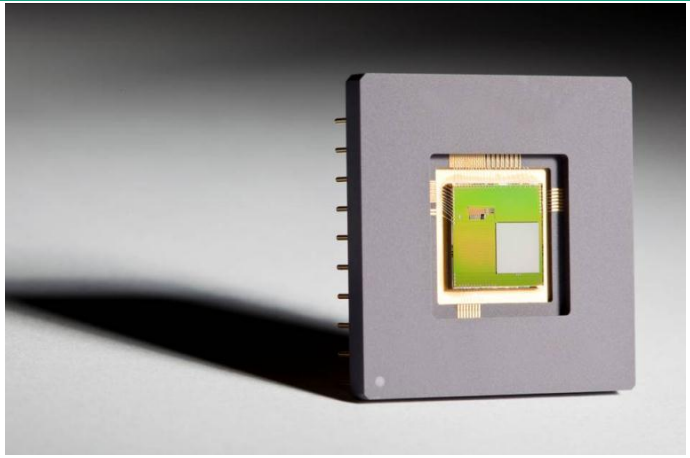
Custom-built SLM by Fraunhofer IPMS: Applications

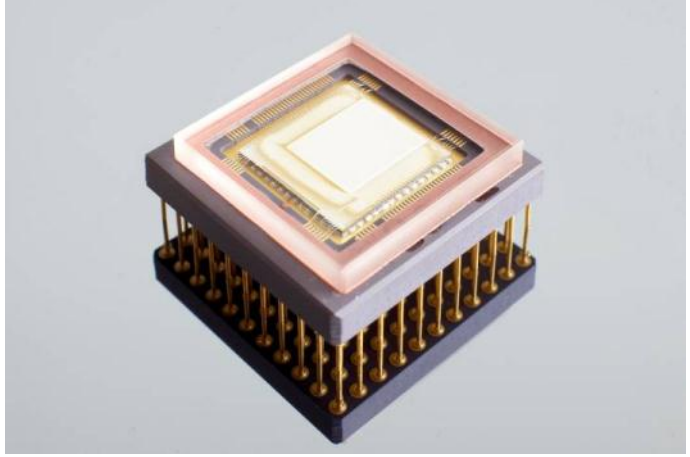
Laser Direct Imaging



Mask Writing

Microscopy

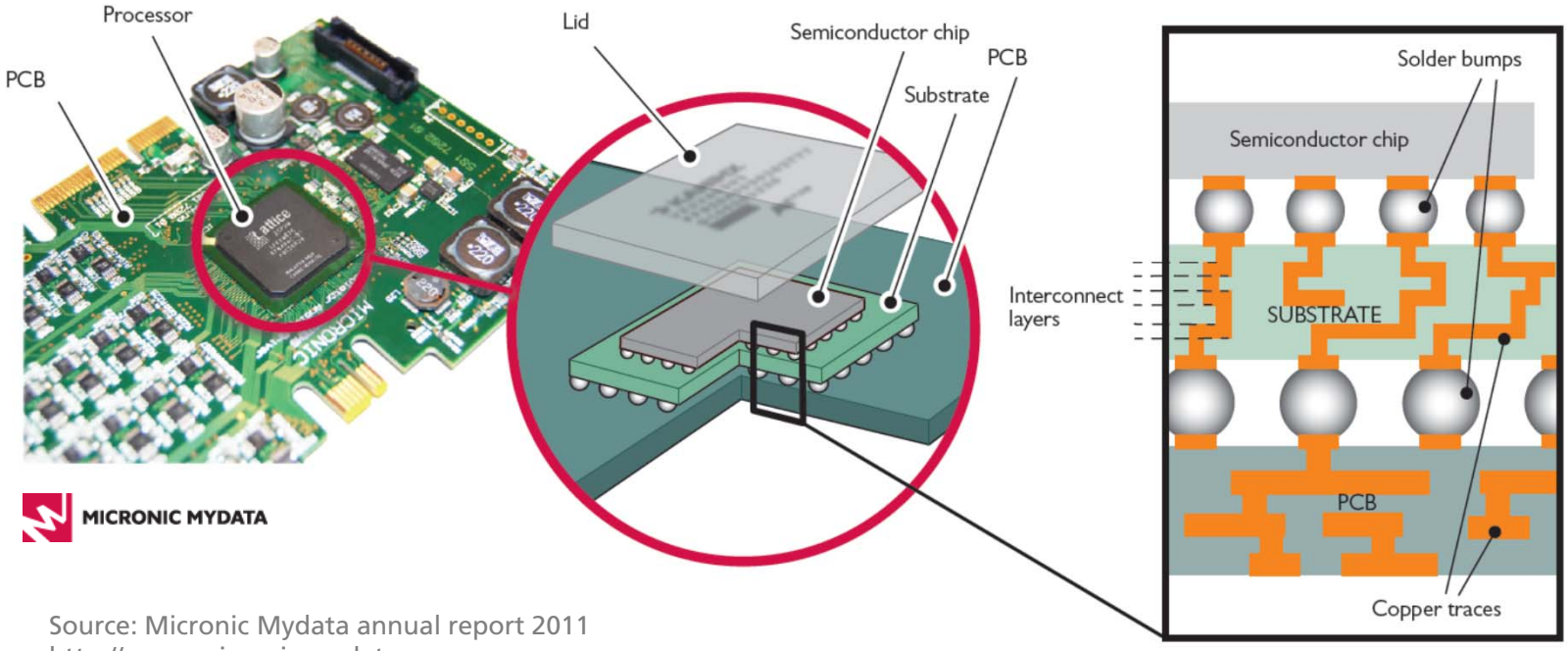




Adaptive Optics

Introduction: Laser direct imaging in substrate industry

- In semiconductor packages, interposers and substrates interface chips to the outside world. Advanced packages require a LS resolution down to 10 µm.
- Cost-effective substrates are produced from organic (plastic film) material. They are processed in form of large panels (e.g. 51cm x 51.5cm).



Source: Micronic Mydata annual report 2011
http://www.micronic-mydata.com

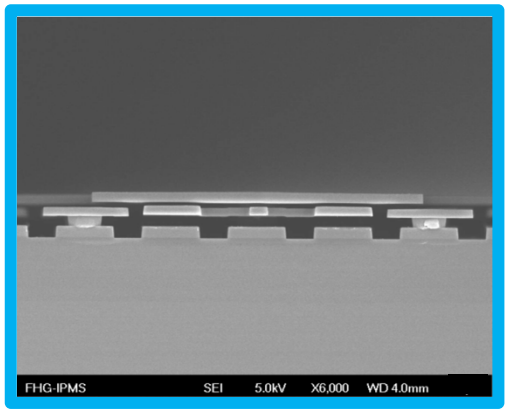
Introduction: Laser direct imaging in substrate industry

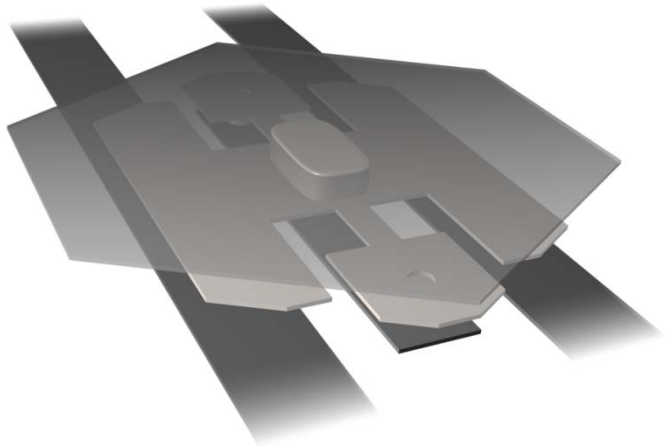
- Micronic Mydata's new LDI5sp system acounts for shape changes: high resolution and pattern overlay without loss of productivity.
- Fraunhofer IPMS contributed spatial light modulator (SLM) to the system.

Micronic Mydatas LDI5sp exposure system

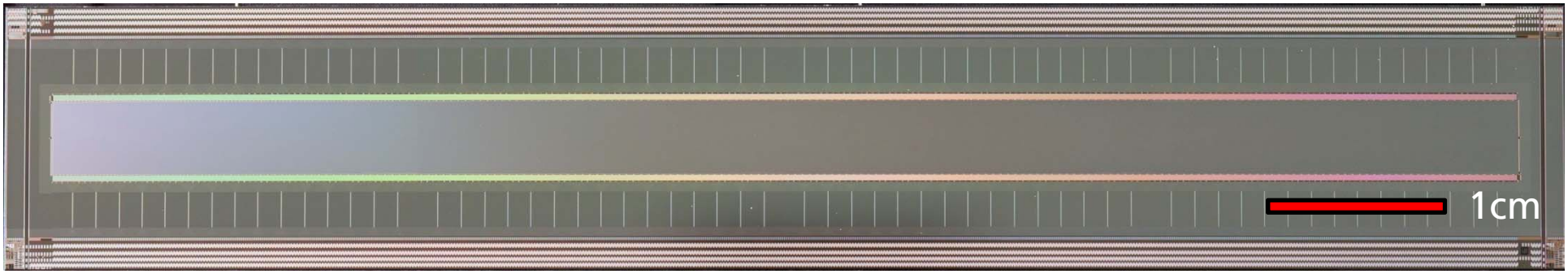
Fast one-dimensional analog SLM, 8192 Pixel

SLM features

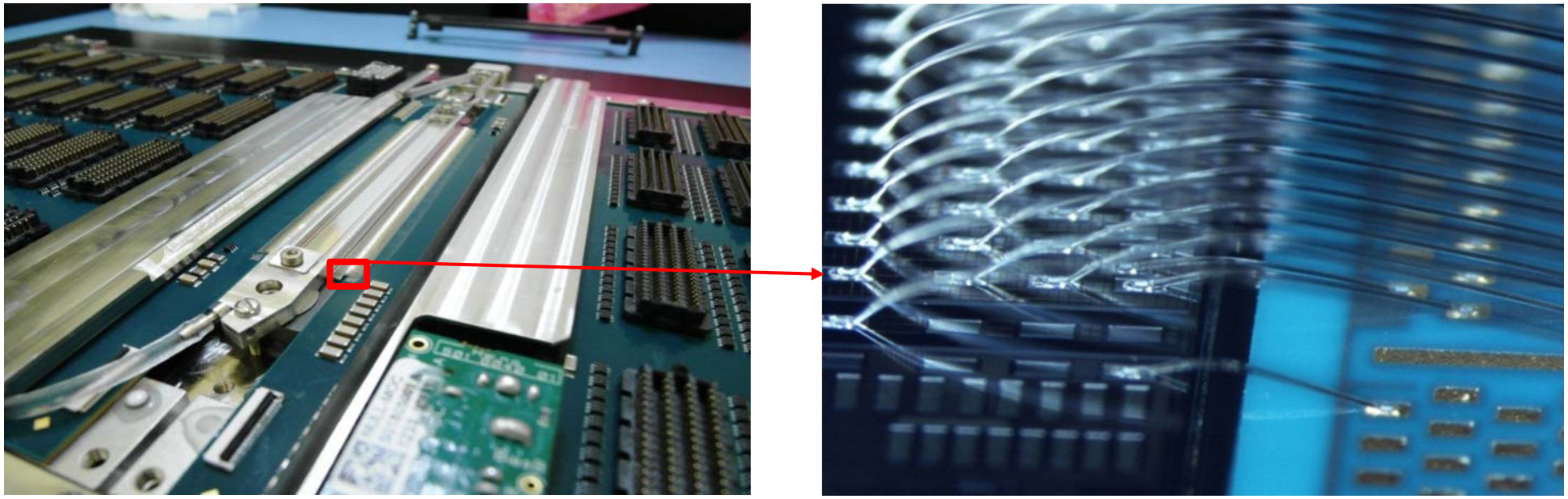




LDI SLM Parameter	Value
Chip dimensions [mm]	15 x 88
Dimensions of pixel area [mm]	4 x 82
Fill grade of active area [%]	> 90
Number of optical pixels	8192
Mirrors per optical pixel	268
Mirror material	Al-alloy
Operating wavelength [nm]	355
Mirror reflectance at 355nm [%]	> 85
Pixel resonance frequency [MHz]	> 1.3
Achieved contrast	Up to 1000



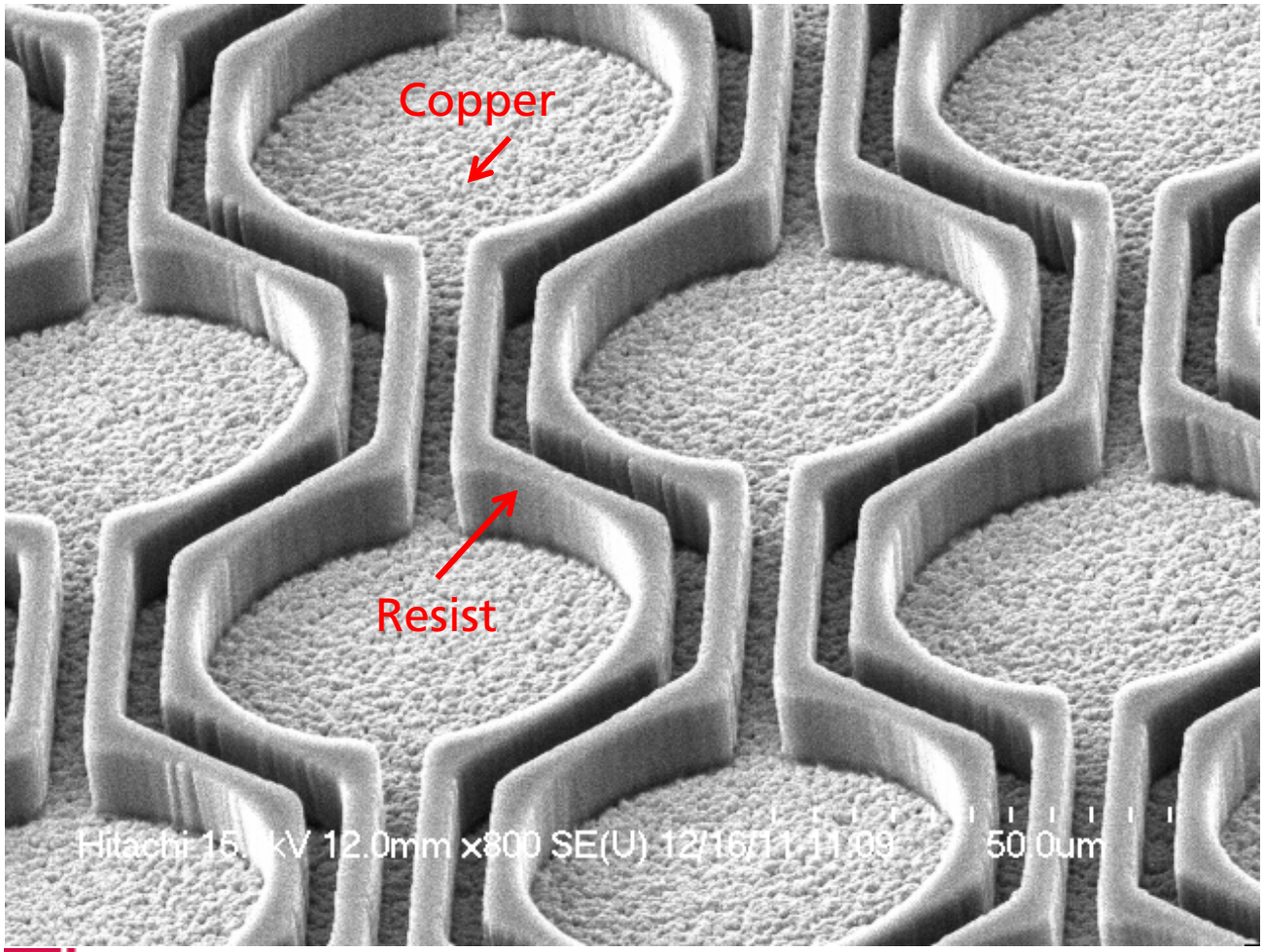
Assembly of SLM chip



- SLM electrodes are hard wired to external data path.
- This enables a high-rate parallel update of all pixels.

SLM performance in exposure system: Exposure results

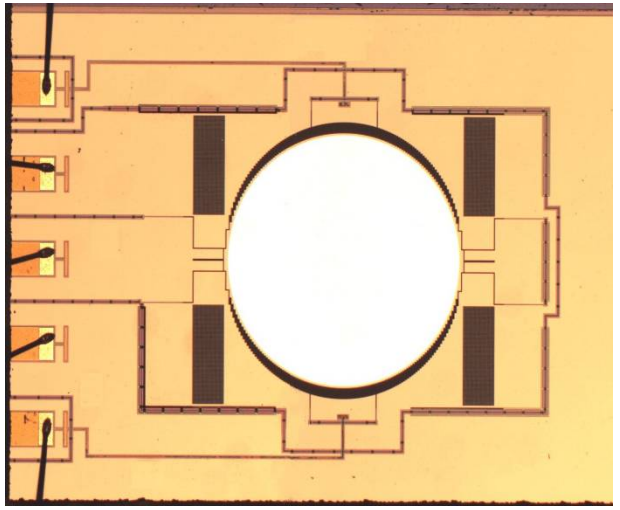
- 15 um DFR on Cu seed layer, patterned with a micro-VIA interconnect test pattern. Minimum line/space feature size is 6 um.

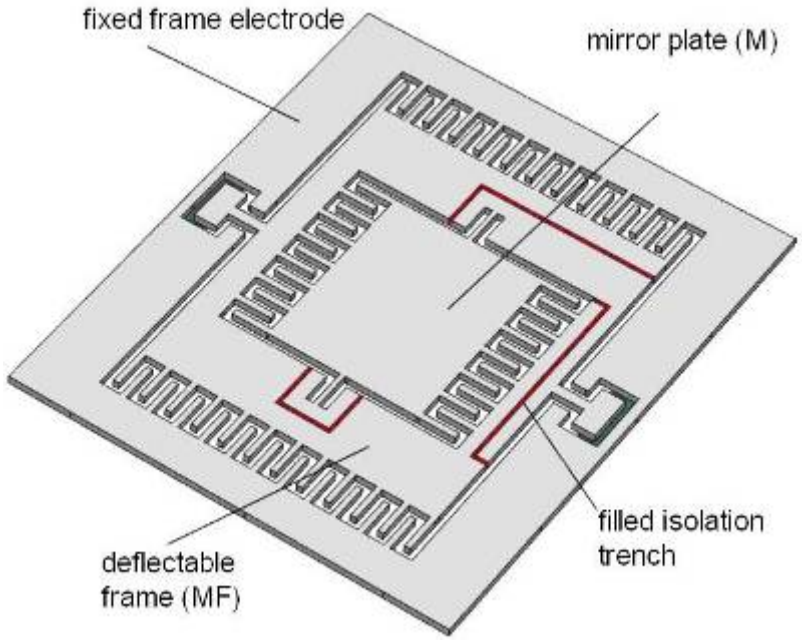


MICRONIC MYDATA

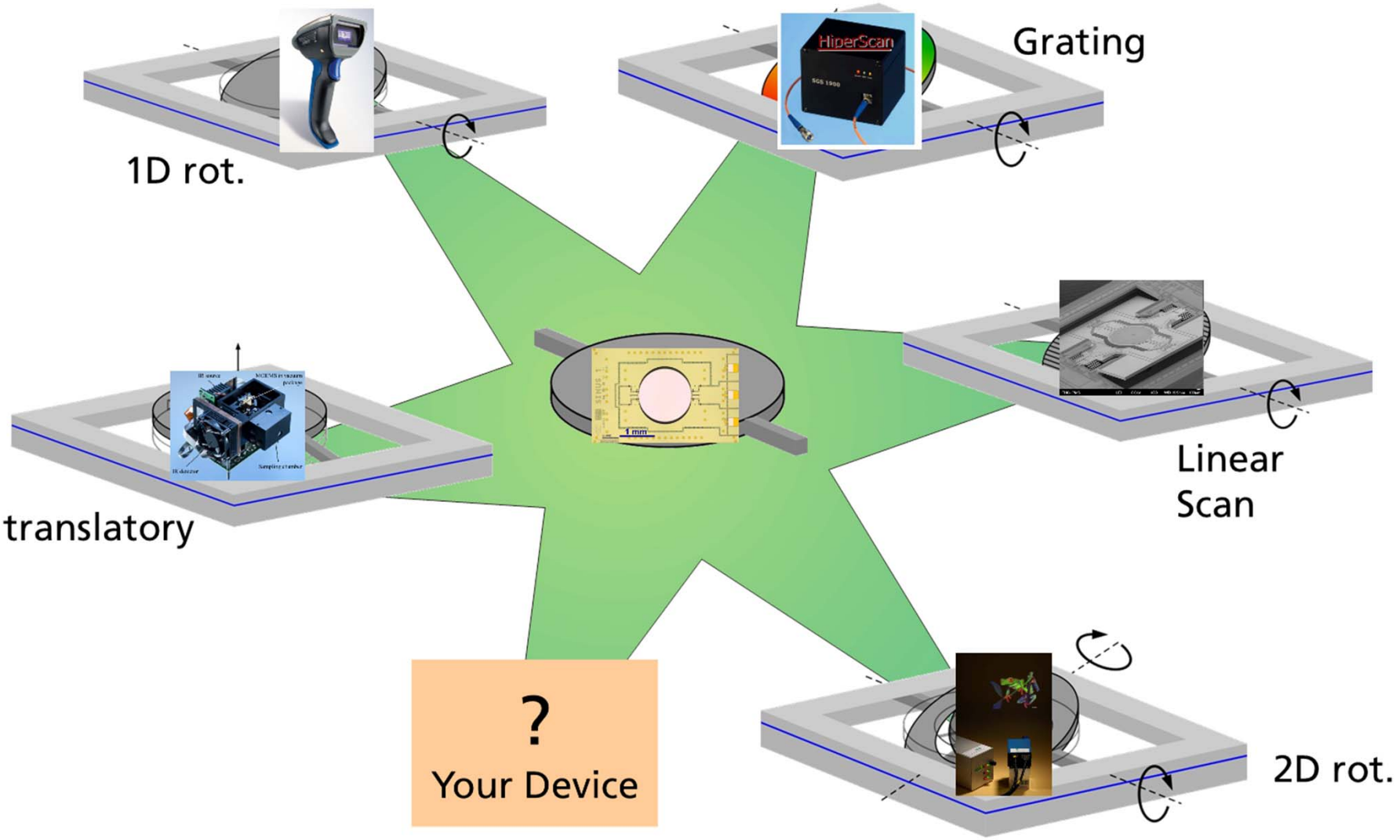
Micro Scanning Mirrors

- Technology
  - Bulk micromachining
  - 1D-Scanner
  - Frequency: 250 Hz
  - Diameter: 1.5 mm
  - Deflection angle: up to +/- 34° (136° optical scan range)



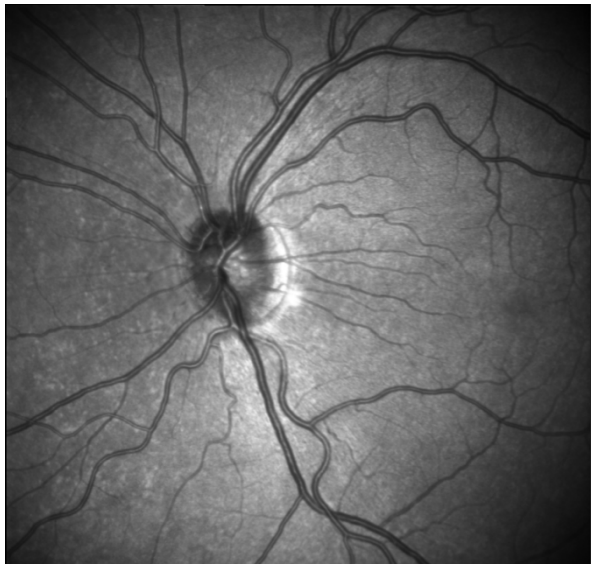


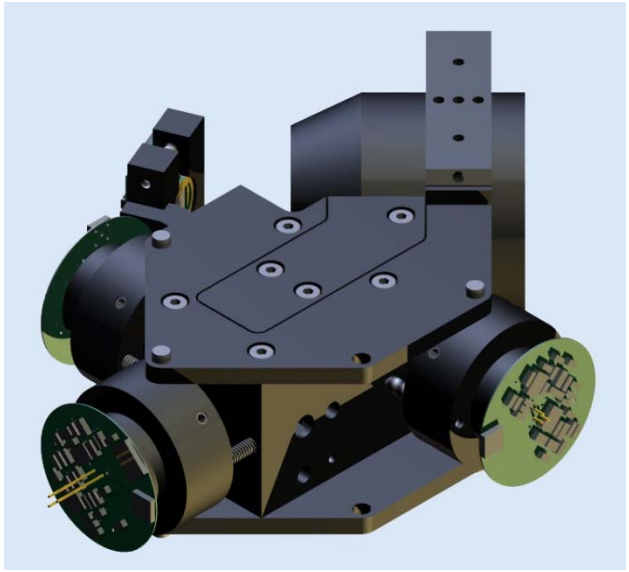
Micro Scanning Mirror Variants and Applications

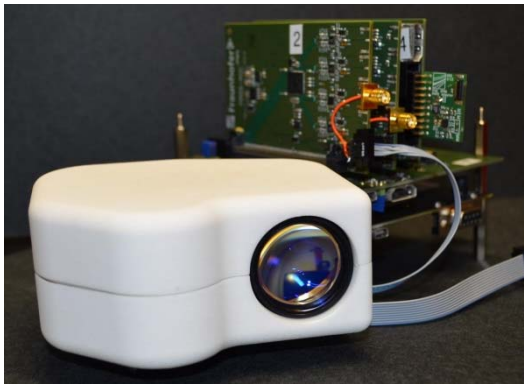


Application: Biometry

MARS: Mobile Authentification by Retina Scanning







GEFÖRDERT VOM

Bundesministerium
für Bildung
und Forschung

VDI Technologiezentrum

Fraunhofer IPMS
Fraunhofer ISI

IMM pitcom

IMMS

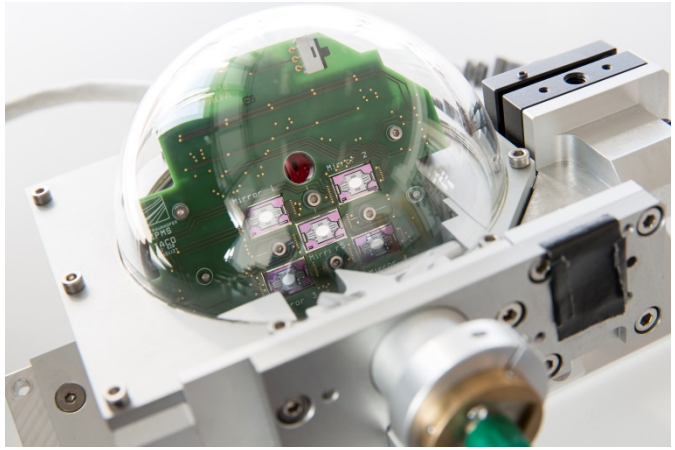
LOXI GMBH

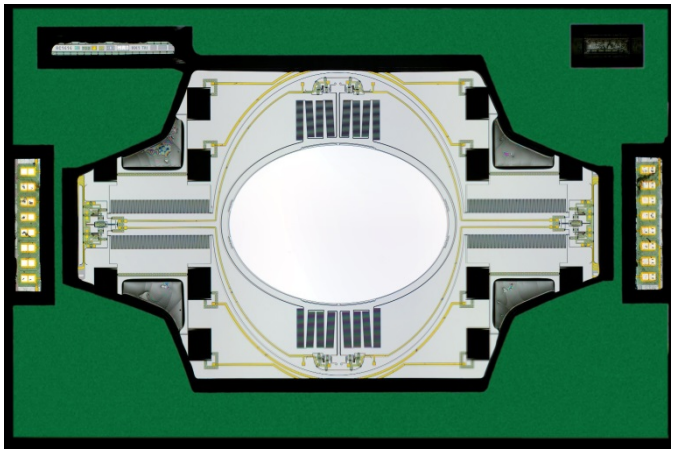
DERMALOG

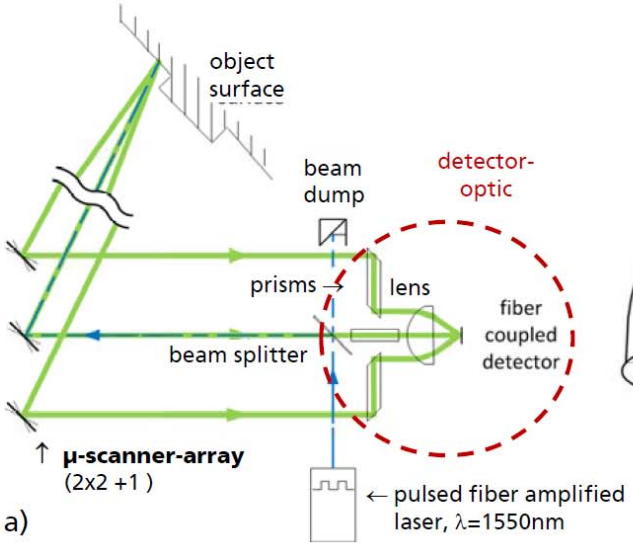
SECURITAS

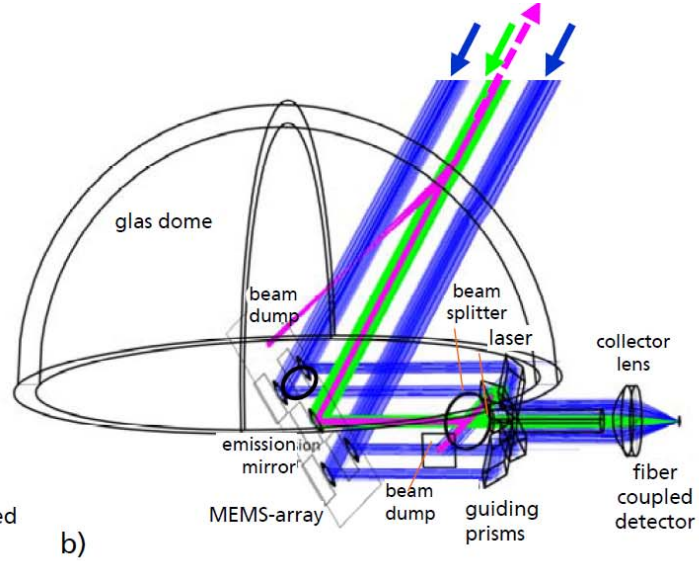
P3N Partner Projekte Prozesse im Netzwerk

Application: 3D Camera



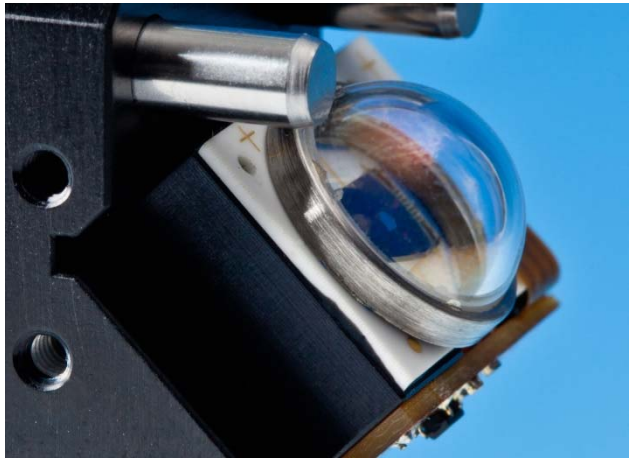






Application: Biomedical Imaging

ZEISS light sheet fluorescence microscope system Lightsheet Z.1



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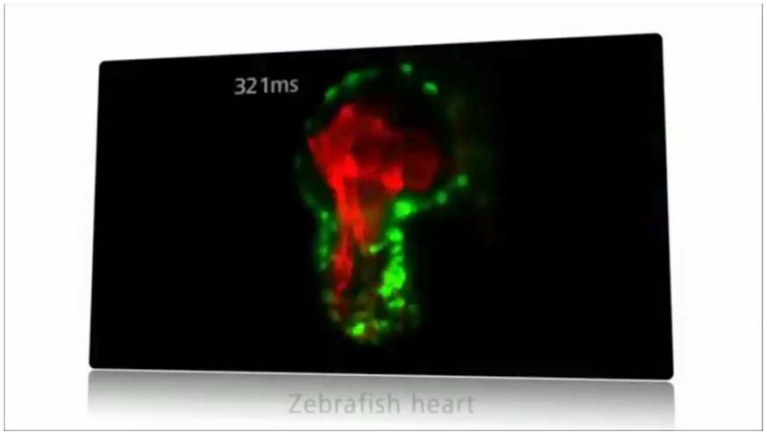

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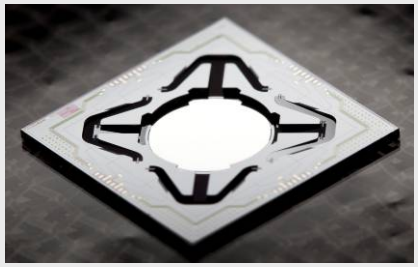
Technology Toolset at Fraunhofer IPMS

MEMS/ MOEMS

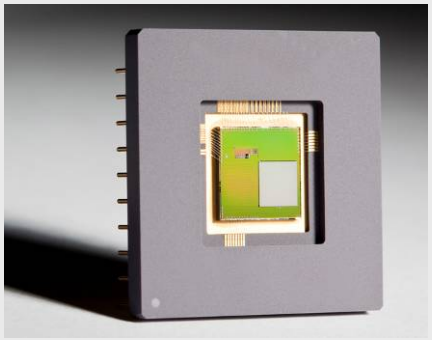
Bulk MEMS

- 3- dim. Structures in Silicon
- Applications:
  - MEMS Scanner
  - Pressure Sensor



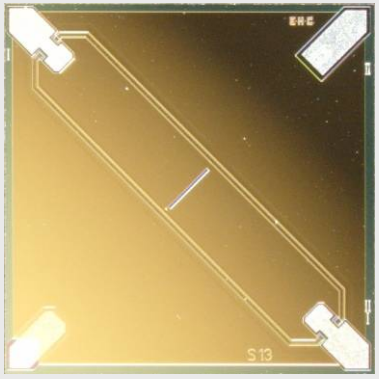
Surface MEMS

- Thin film surface MEMS
- MEMS on CMOS
- Applications:
  - Spatial Light Modulator
  - CMUTs



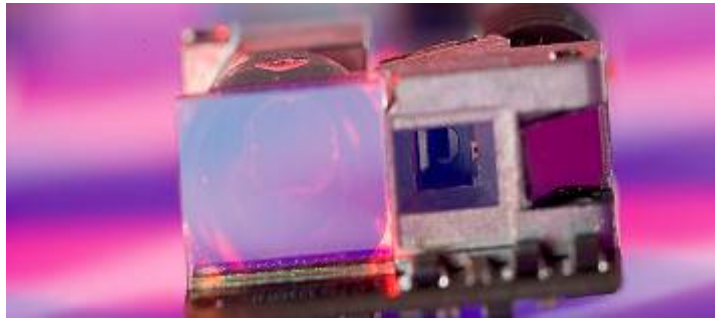
CMOS & „active“ Silicon

- High Voltage CMOS
- Photodiodes
- pH- Sensor



PILOT / LOW-VOLUME FABRICATION

Barcode reading systems based on micro scanning mirrors

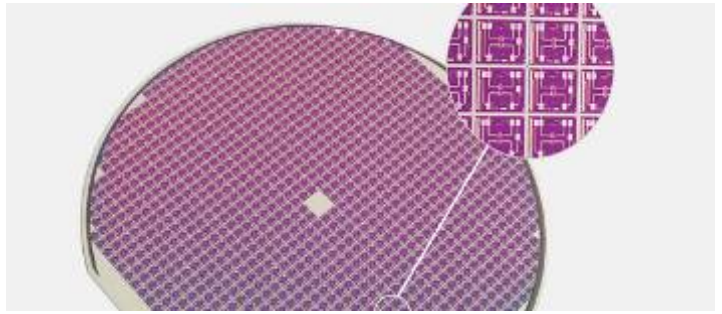


Intermec

PIN-Diodes for high precision optical measurement and positioning

N.N.

Piezo resistive pressure sensors for automotive applications



SAGEM

THANK YOU FOR YOUR ATTENTION!

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