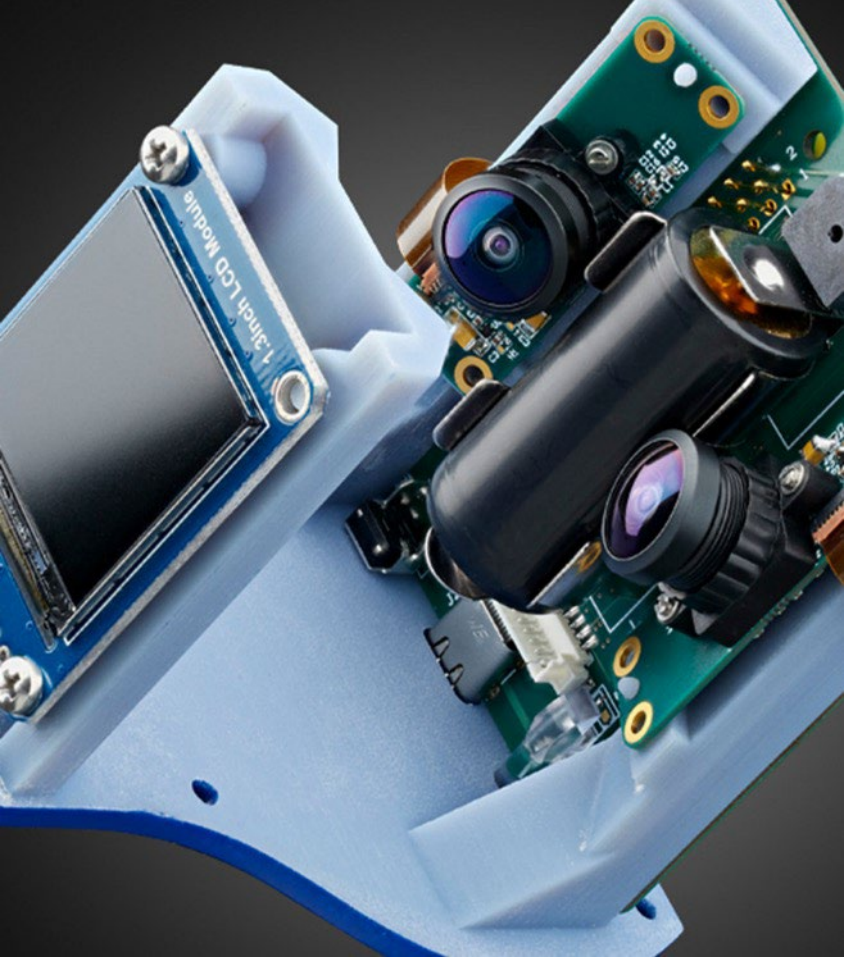

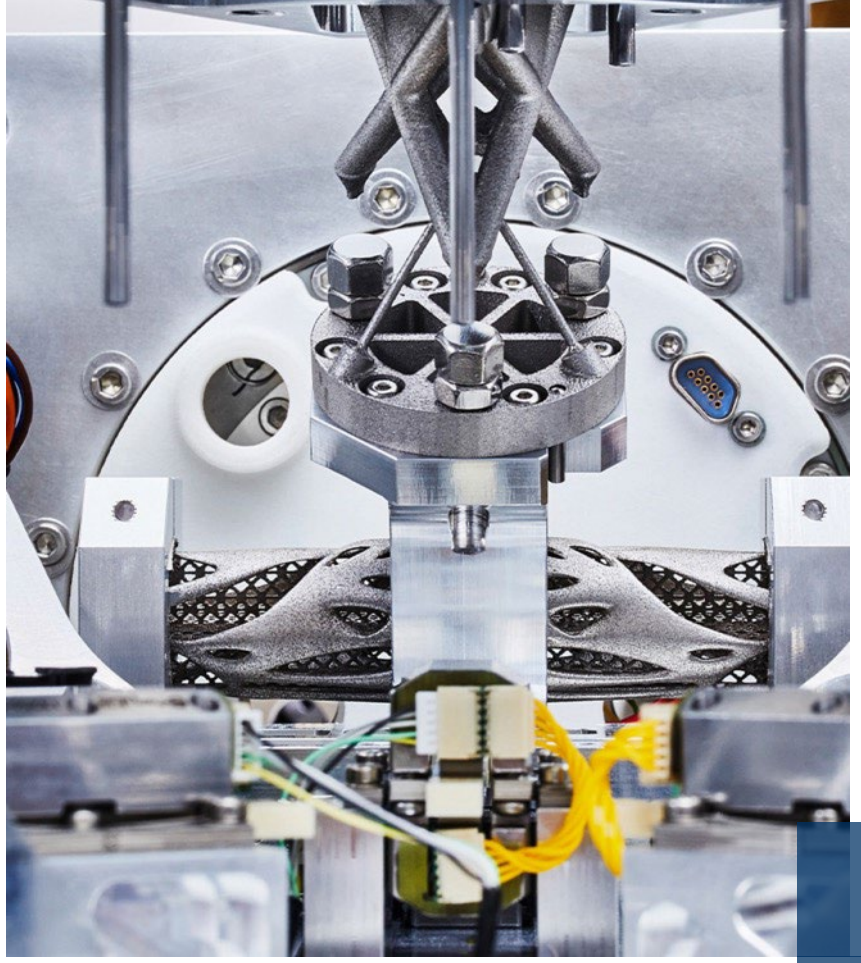

Daniele Brunazzo, PhD
Business Development Manager

2nd December 2024

MICRO- AND NANO-OPTICS: FROM LAB TO FAB

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40 YEARS OF INNOVATION

CSEM AT A GLANCE

CSEM AT A GLANCE

We are a public-private, non-profit Swiss **technology innovation center**

We enable competitiveness by **developing and transferring world-class technologies to the industrial sector**

We fuel the innovation of **more than 200 industrial partners every year**.

1984
FOUNDED

650
SPECIALISTS

107.6
M TURNOVER in 2023

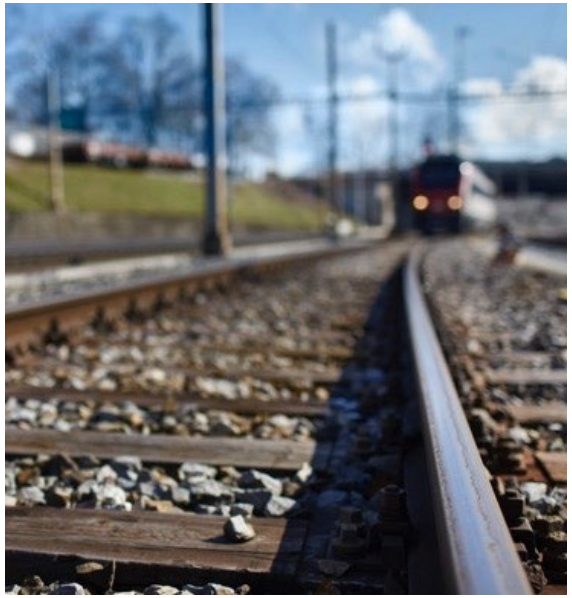
177
PATENT FAMILIES

1100
INDUSTRIAL CLIENTS SINCE 2018

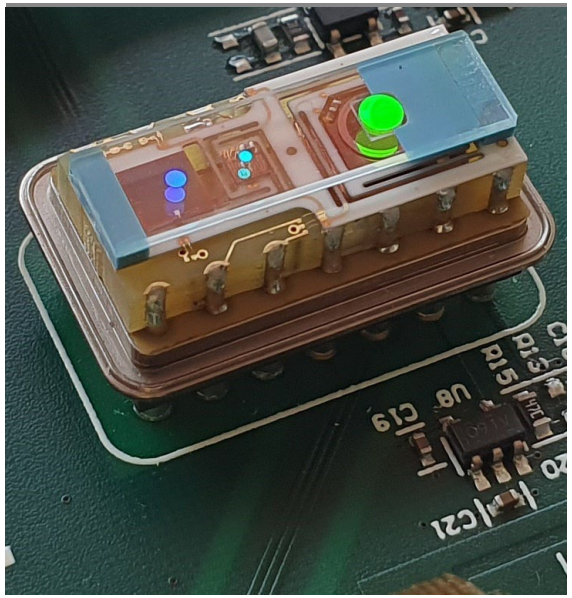
csem

IMPACT THROUGH INDUSTRY PROJECTS, WITH START-UPS, SMEs AND BIG COMPANIES

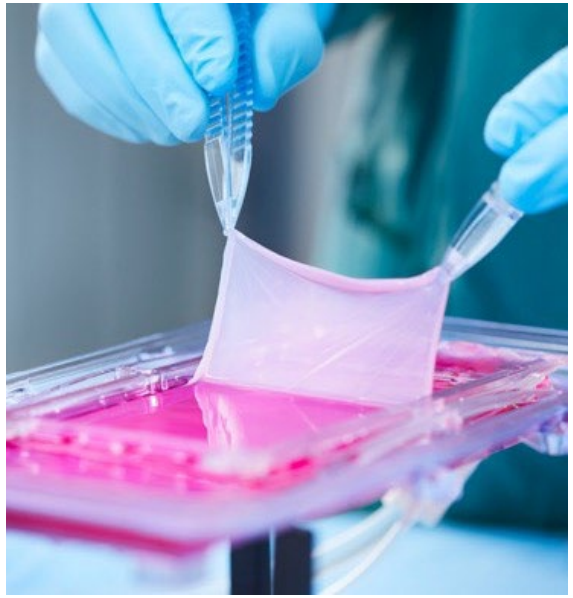
T-Touch Connect Sport: connected, secured, autonomous, and long-lasting



AI platform for diagnostic trains to determine and plan track maintenance



Miniaturized atomic clocks for precise time measurement with unparalleled low power consumption



Automated machine to bioengineer personalized skin

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WE ARE INDUSTRY-ORIENTED

92%
HAPPY CUSTOMERS

Staff with industry experience

Long-term support
(80% of staff on permanent contracts)

Processes with built-in confidentiality

Industrial equipment
(clean rooms, characterization labs)

Proven project management methodology
(300 projects/year)

QMS & certifications
(ISO 9001 and 14001,
ISO 13485: Medical devices)

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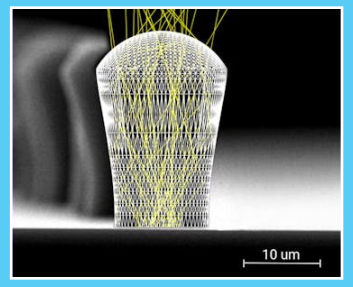
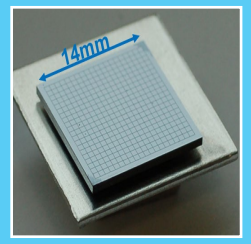
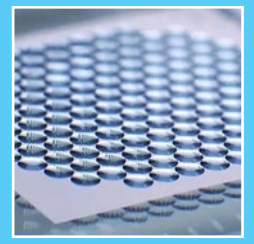
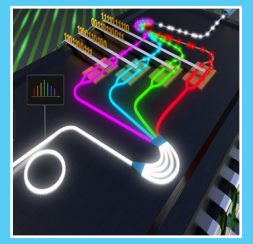
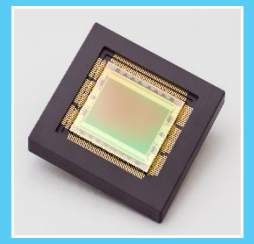
CSEM EXPERTISE IN OPTICS AND PHOTONICS



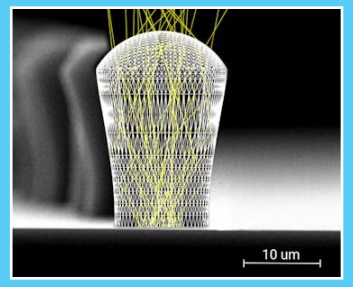


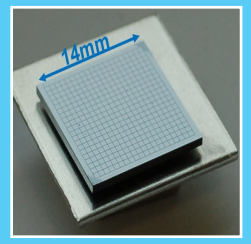




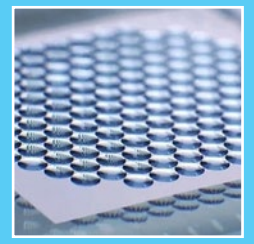
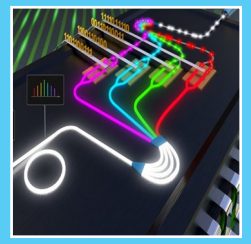
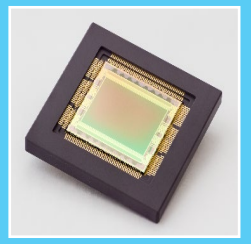
Components:

- MOEMS
- Micro- and Nano-Optics
- Photonics Integrated Circuits (PICs)
- Imaging sensors

CSEM EXPERTISE IN OPTICS AND PHOTONICS





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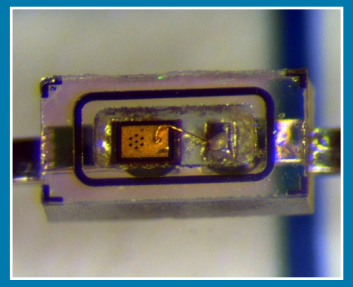
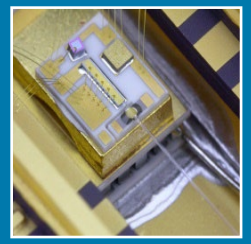
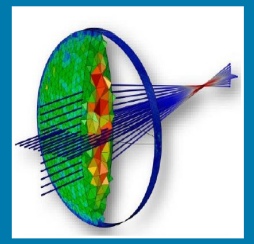
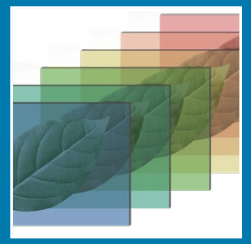
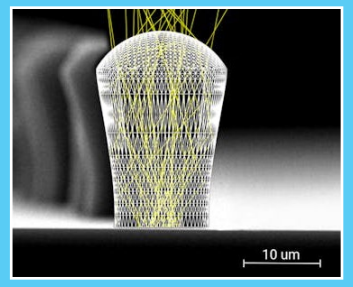
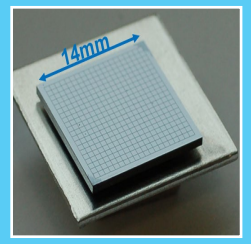





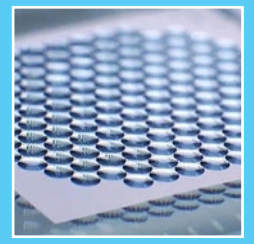
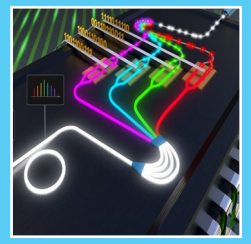
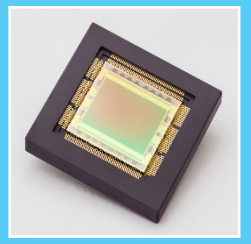

Technologies:

- PICs design, testing, consulting
- Optical design: Zemax, Comsol, etc.
- Multi-spectral imaging
- ML & AI

CSEM EXPERTISE IN OPTICS AND PHOTONICS





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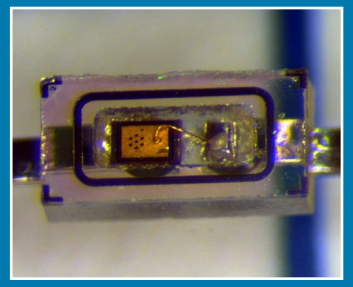
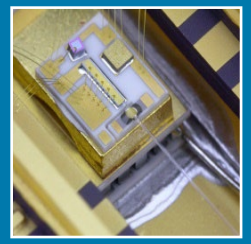
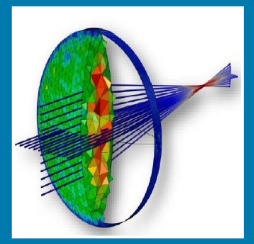
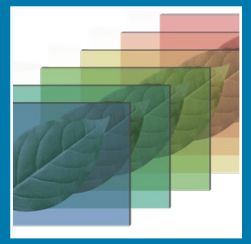


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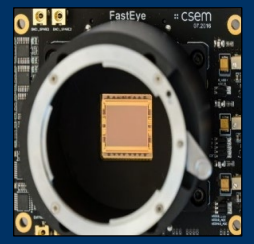


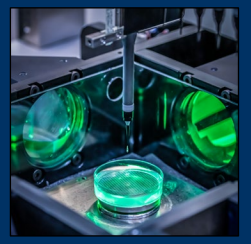

Systems:

- Lasers
- Cameras
- LIDARs
- Sensing systems & readout modules

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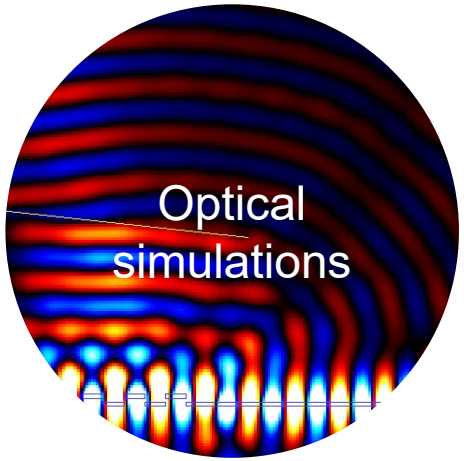
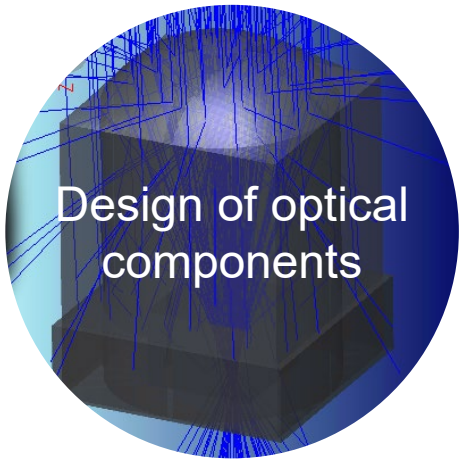
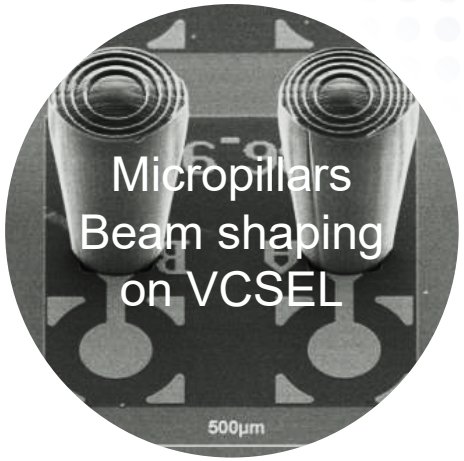
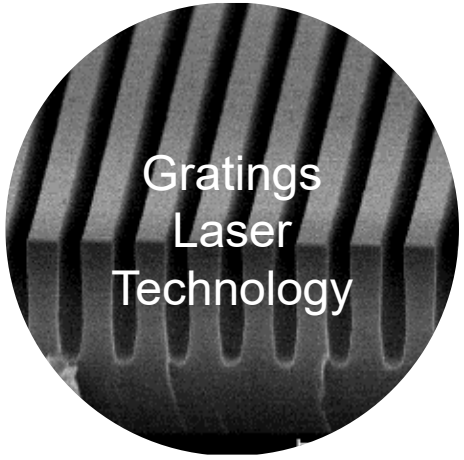
MICRO- AND NANO-OPTICS

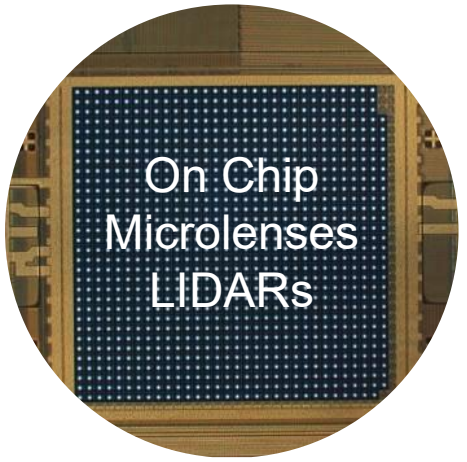
TECHNOLOGY BLOCKS AND VALUE PROPOSITION











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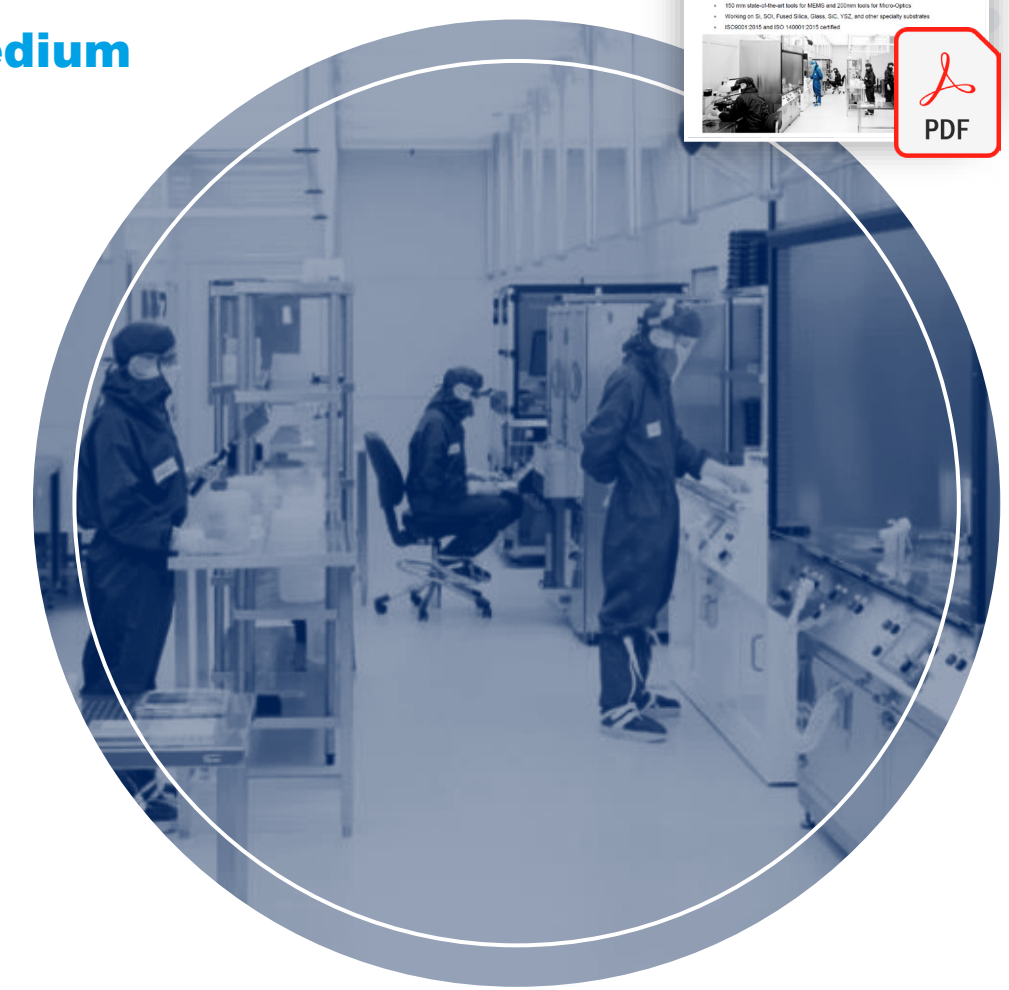
FROM LAB TO FAB

From concept development projects to small and medium series production



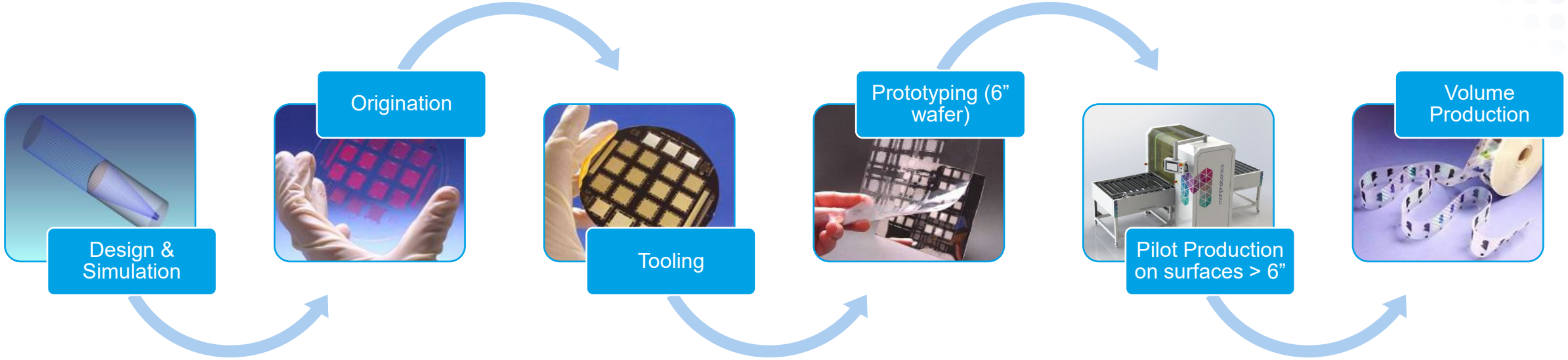
CSEM Micro-Systems Cleanroom:

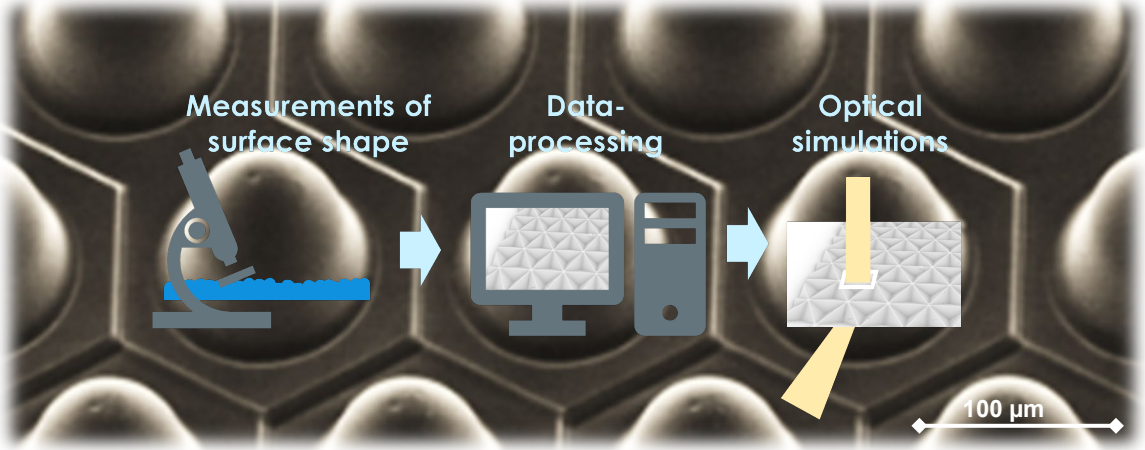
- 800 m^2 – ISO5 to ISO6 areas (+300 m^2 in 2027)
- Wafers up to 8”
- Permanent staff of experienced engineers
- ISO9001 and 14001 certified
- Extension to full 200 mm capability planned in 2027

Preferential access to extended foundry network

https://www.csem.ch/en/tailored-services/mla-foundry-services/

MICRO & NANO-OPTICS PROCESS FLOWS





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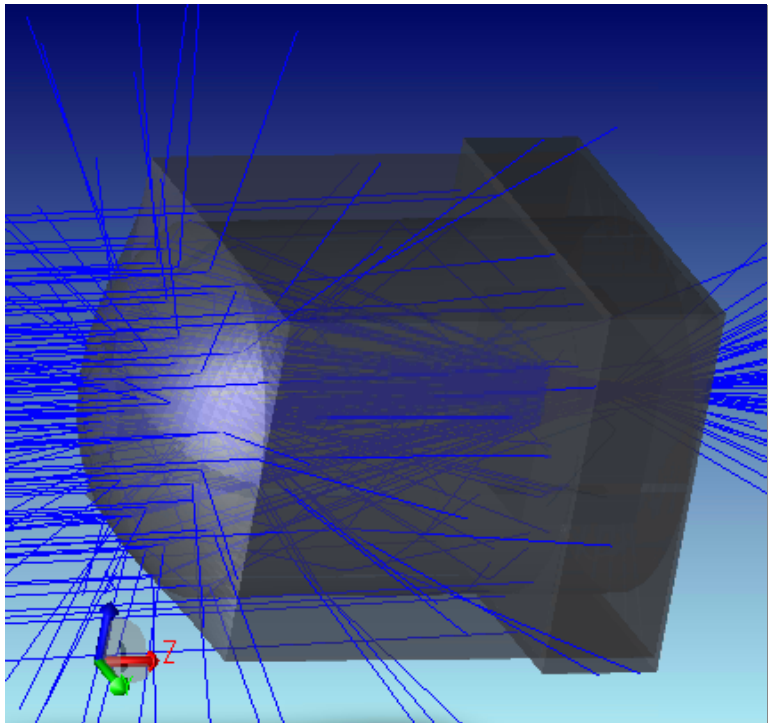
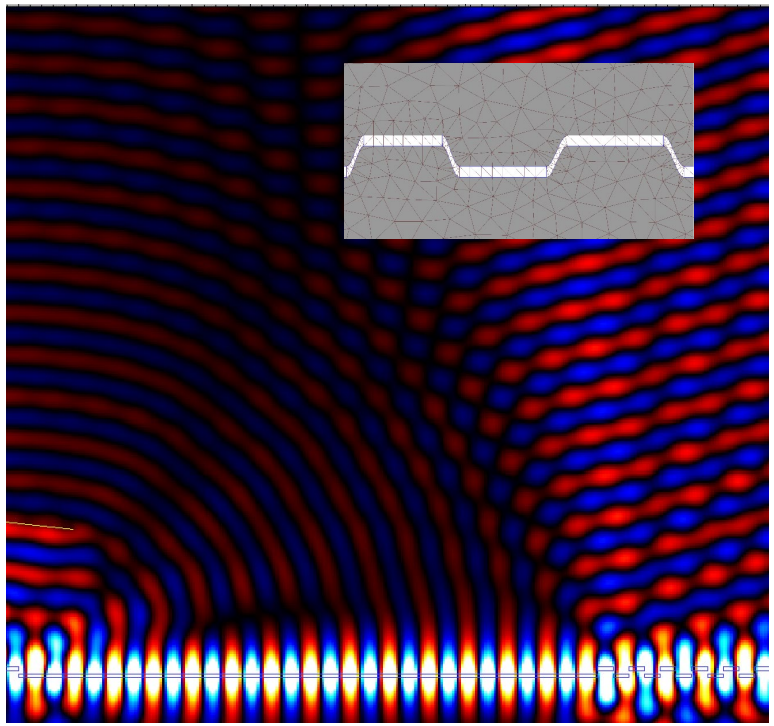
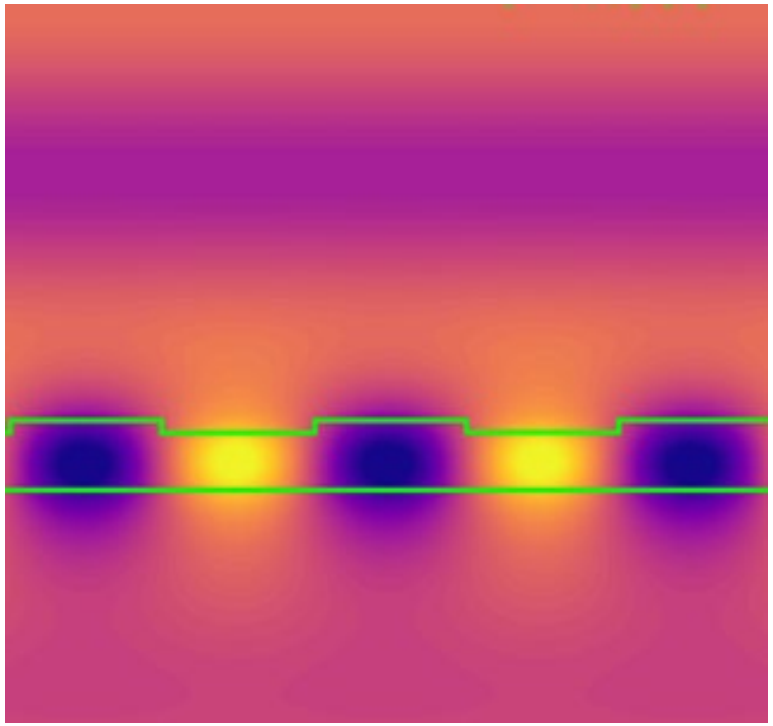
OPTICAL SIMULATION TOOLS



- **Ray Tracing:**
  - **Tools:** Zemax, LightTools with SolidWorks, in-house software
  - **Applications:** illumination, imaging



- **Wave Optics:**
  - **Tools:** FDTD, FEM
  - **Applications:** waveguides, resonant structures



- **NanoOptics:**
  - **Tools:** Rigorous Coupled-Wave Analysis
  - **Applications:** photonic crystals, diffraction gratings, plasmonics

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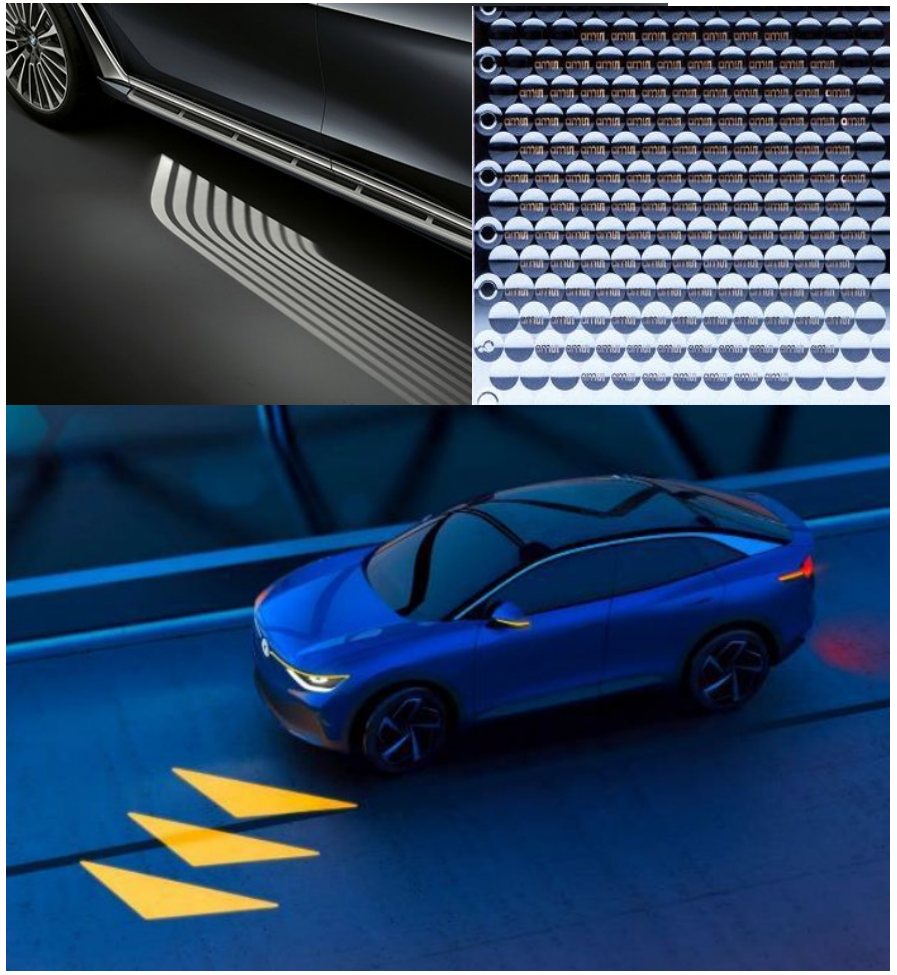
APPLICATIONS

MICRO-LENSES ARRAY IN AUTOMOTIVE LIGHTING

- Partner: Focuslight (ex-Suss MicroOptics)
- Microlenses from 2 to 500 microns
- Arbitrary microlens shape design: square, rectangle, round, cylindrical, etc.
- From wafer scale to large area format
- Car lighting, scientific instrumentation, sensors, functional and decorative surfaces



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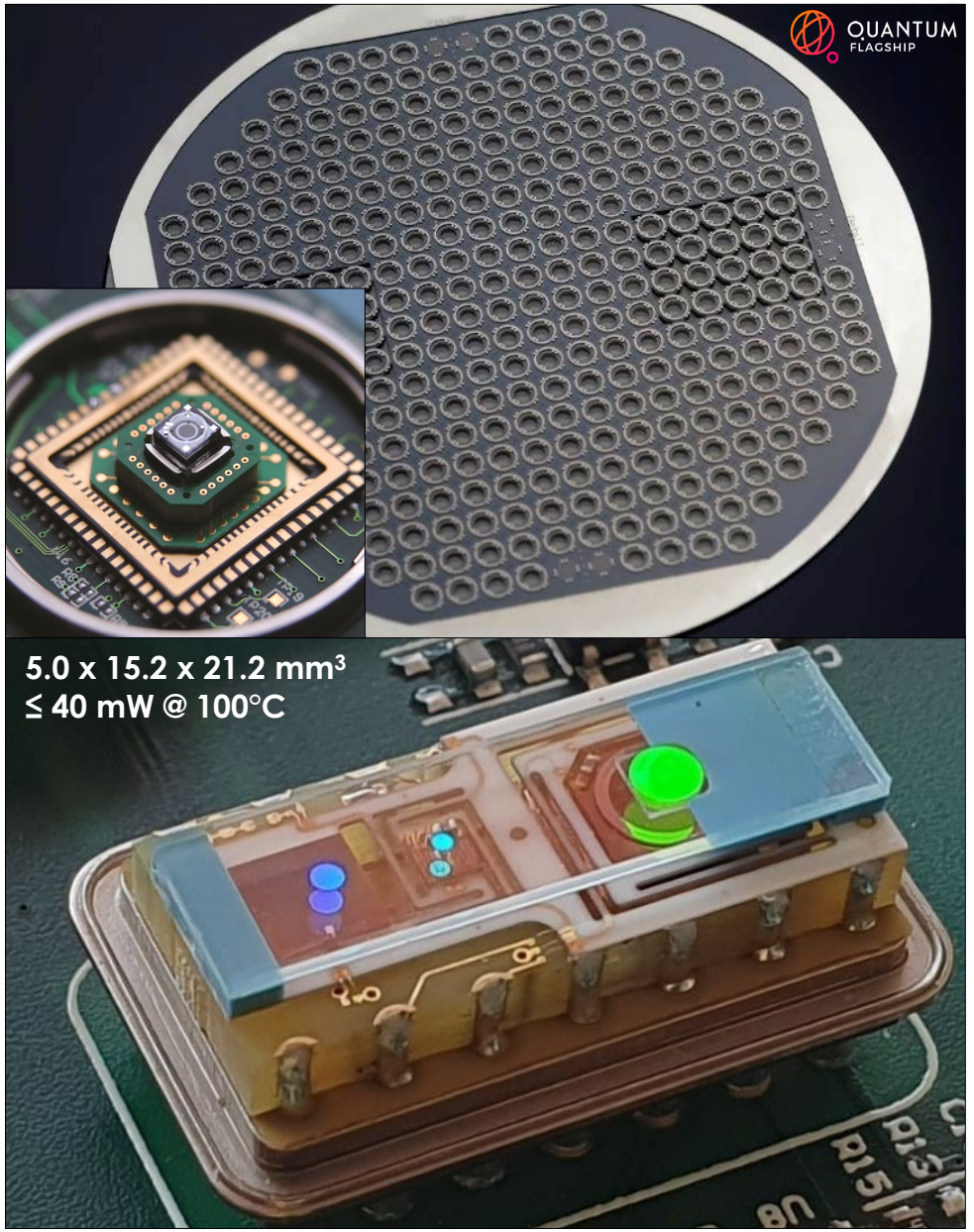
DIFFRACTIVE WAVEGUIDE IN CHIP-SCALE ATOMIC CLOCK

- MEMS-based ion-trapping atomic clock with unprecedented precision



SAFRAN

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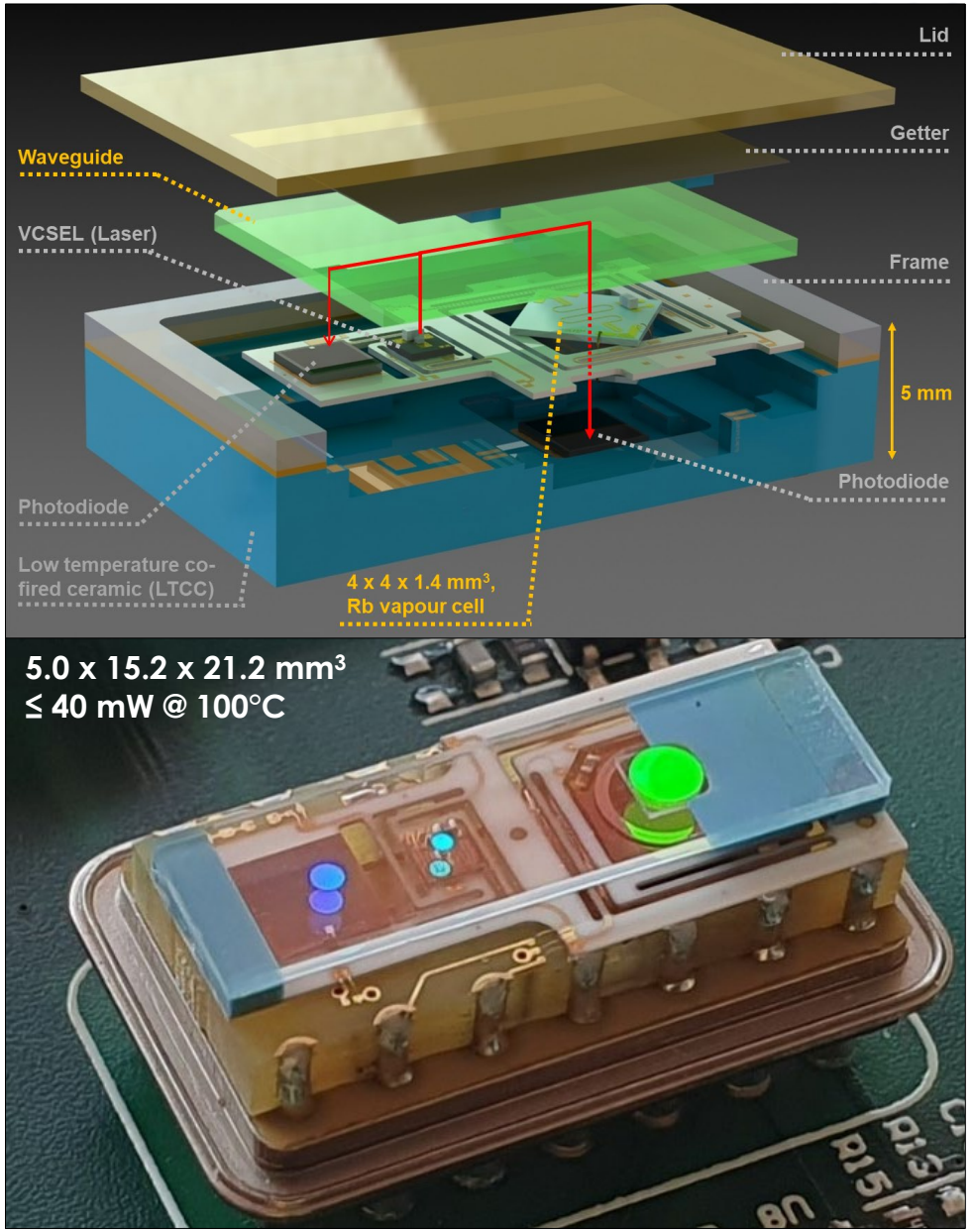
DIFFRACTIVE WAVEGUIDE IN CHIP-SCALE ATOMIC CLOCK

- MEMS-based ion-trapping atomic clock with unprecedented precision
- Diffractive waveguide:
  - Wafer-scale manufacturing
  - Compact light transport
  - Beam expansion
  - Efficient coupling



SAFRAN

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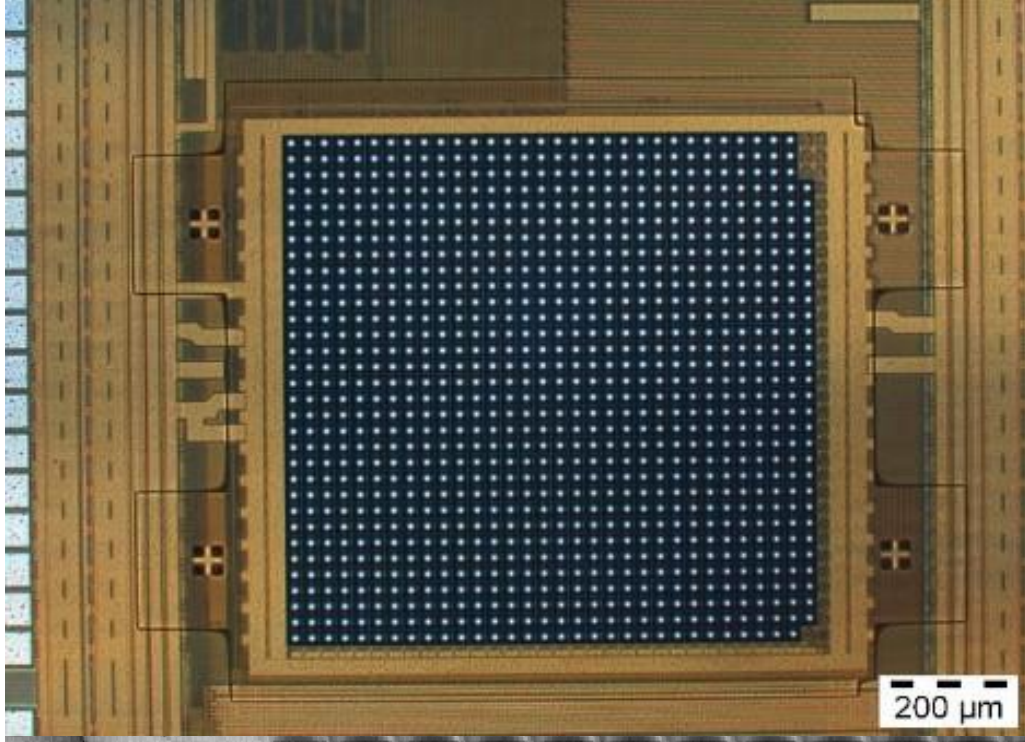
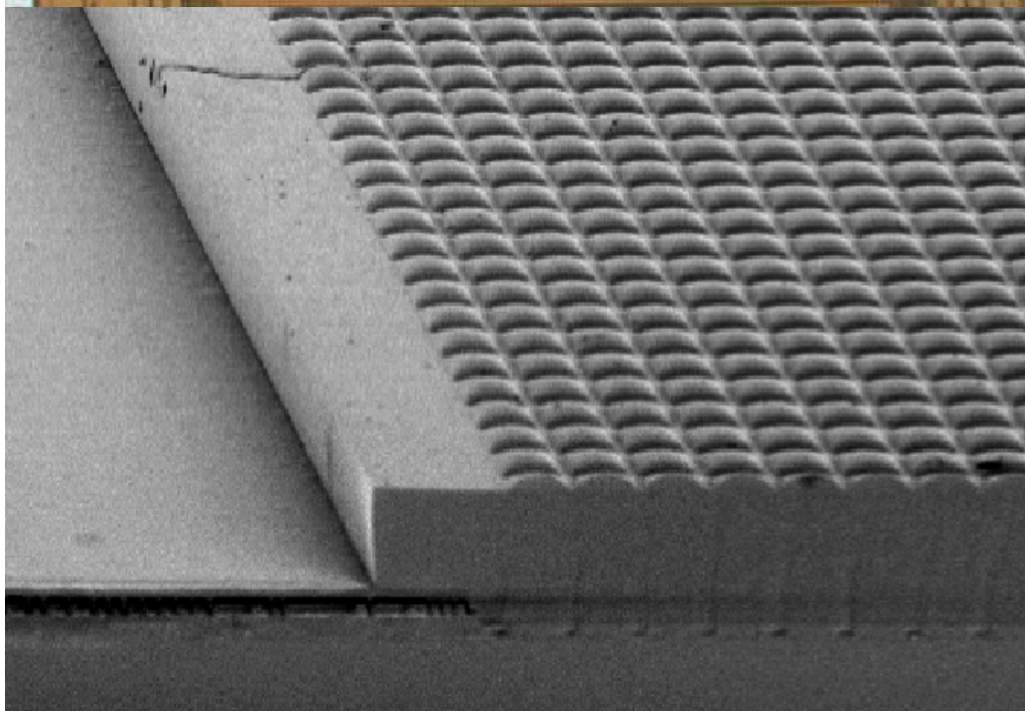
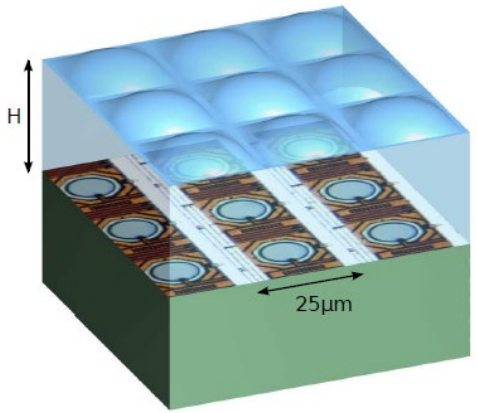
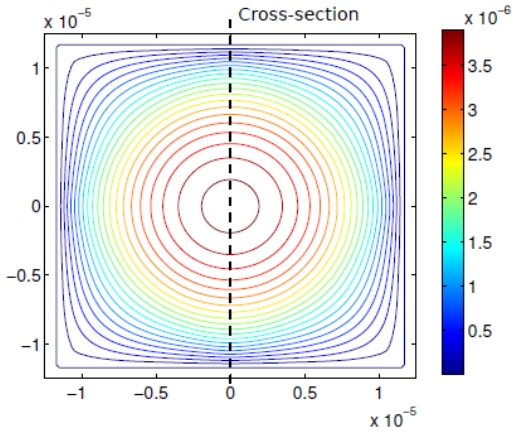
INTEGRATED MICRO LENS ARRAY ON SPAD SENSOR IMAGER

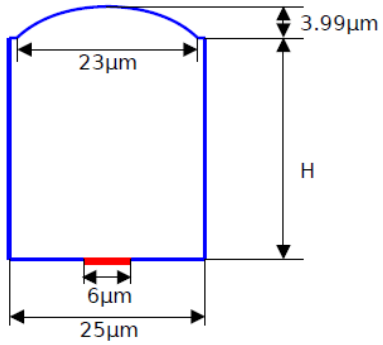
- Direct creation of micro-lenses on a SPAD
- Increase of detector efficiency
- From design to fabrication





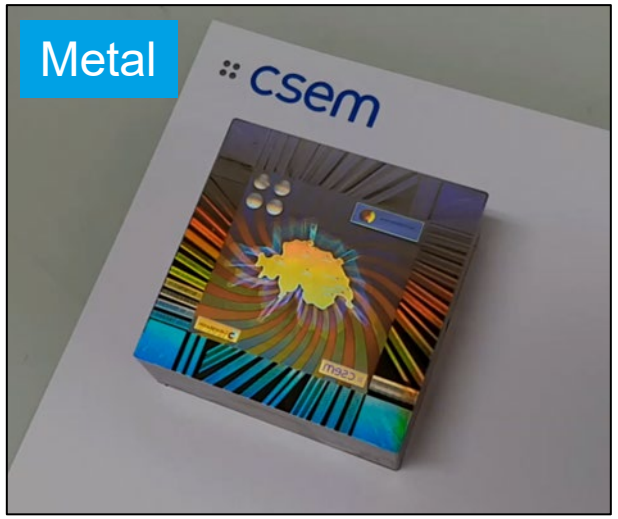






SURFACE NANO-STRUCTURING FOR OPTICAL PURPOSES

- Surface nano-structuring is a cost-effective technology to transfer optical patterns on almost any material
- Materials:
  - Metals
  - Glasses
  - Thin foils
  - Silicon
  - Ceramics
  - Polymers



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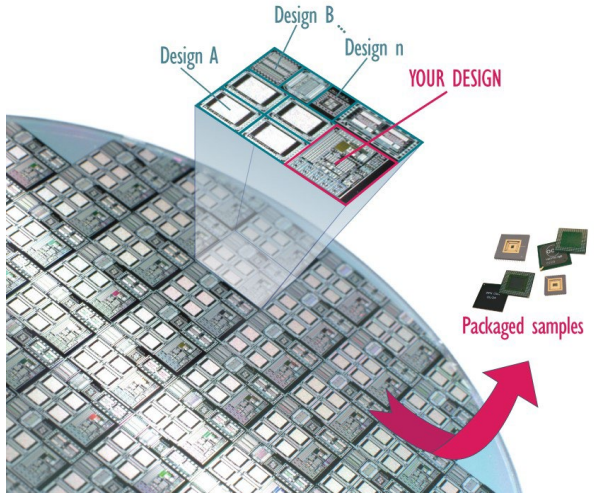
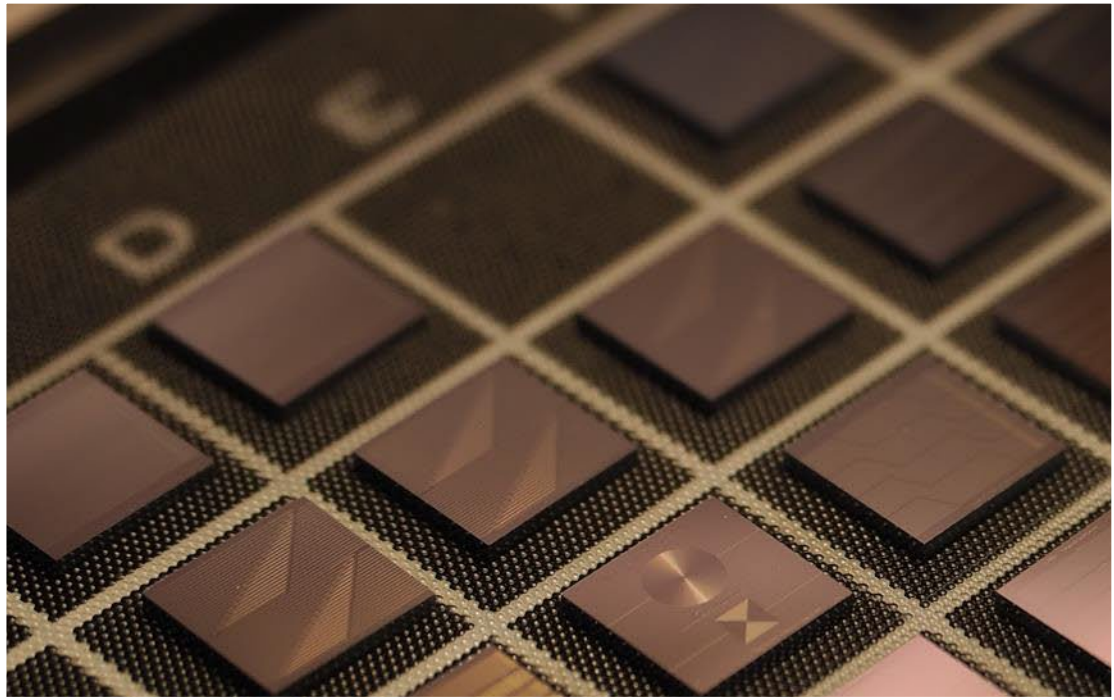
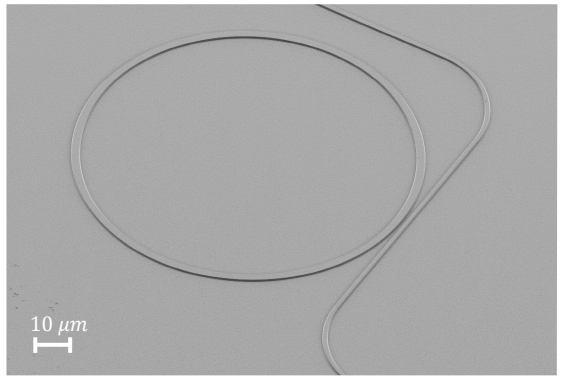
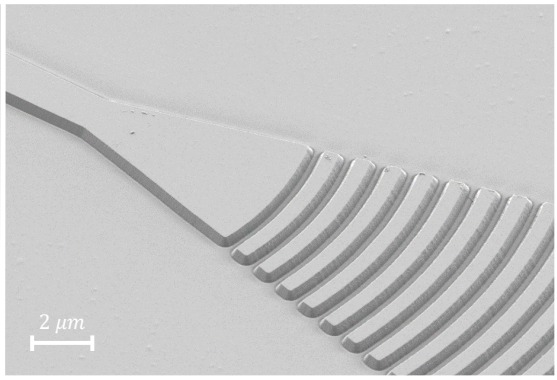
LITHIUM NIOBATE PHOTONIC INTEGRATED CIRCUITS

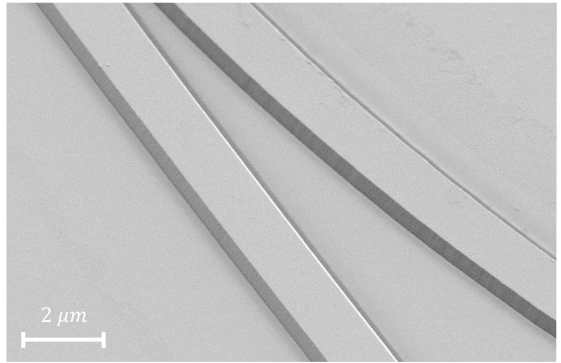
- PIC design and testing
- Foundry
- Unique TFLN MPW platform in Europe

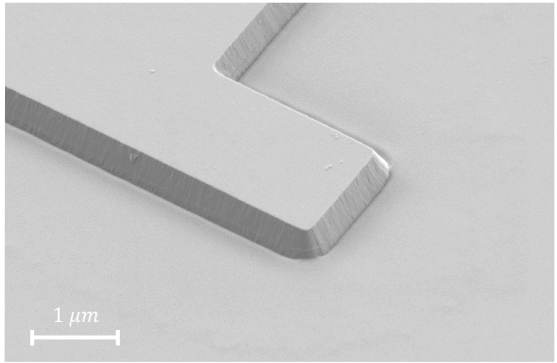










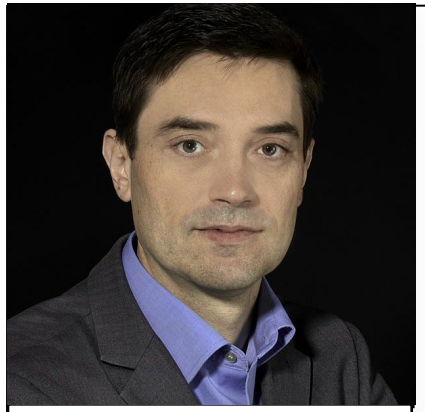


COMING NEXT...

MORE EXCITING TALKS FROM CSEM!

- *Expanded beam connector for datacom*
  Guillaume Basset, PhD
  Tuesday 14:10 @expo stage

- *New capabilities for the cost-effective fabrication of fiber-to-PIC interconnects*
  Egvenii Glushkov, PhD
  Tuesday 12:10 @expo stage



Guillaume Basset

All Sessions by Guillaume Basset

3 December 2024
Enabling fast and reliable optical communication

14:10
-
14:25

Expo stage
Expanded beam connector for datacom

Bruno Sfez, Founder of Sfez Technologies and Guillaume Basset, Micro-Nano-Optics Group Leader at CSEM

Evgenii Glushkov

Evgenii Glushkov works as an R&D Engineer at the Swiss technology innovation center (CSEM), specializing in Micro- and Nano-Optics, and has >10 years of experience in microfabrication. Evgenii obtained his PhD in Microengineering from the École Polytechnique Fédérale de Lausanne (EPFL) in 2021, where he was working on optically-active defects in solid-state systems for sensing, super-resolution microscopy and integrated photonics.

All Sessions by Evgenii Glushkov

3 December 2024
Micro-optics in integrated photonics

12:10
-

Expo Stage
New capabilities for the cost-effective fabrication of fiber-to-PIC interconnects

csem
40 YEARS OF INNOVATION

csem

TAKE ON CHALLENGES WITH THE RIGHT TEAM