

## **CSEM**

# EPIC Meeting on VCSEL Technology and Applications at Sony

#### Stefan Mohrdiek, 18. October 2019, Stuttgart

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CSEM - Swiss Center for Electronics and Microtechnology - Centre Suisse d'Electronique et de Microtechnique

#### Our mission

Development and transfer of microtechnologies to the industrial sector

- Close to industry, leveraging Swiss academic research
- **::** Cooperation agreements with established companies
- Encouraging the creation of start-ups

Non-profit RTO organization

**#** 470 people

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- \*\* 44 New ventures (last 20 years)
- **206** Industrial clients
- **::** 76 European projects



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# Technologies in focus at CSEM



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# Photonic Packaging & Assembly: Portfolio of Offerings



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#### MicroNano Optics & Photonics at CSEM

UV imprinted micro & nano optical components for VCSELs



# Applications and Packaging Infrastructure

- Photonics Packaging and Assembly Infrastructure
  - Cleanroom class 10'000: Humidity & Temperature controlled
  - Equipment for flip chip, eutectic & adhesive bonding, wire bonding, sub μm assembly

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- Beyond state-of-the-art  $\rightarrow$  CSEM approach for hermetic sealing  $\rightarrow$  next slide
- Applications cases ranging from Implants to space
  - 1. Application: Implantable VCSEL actuator for stimulation of hearing nerves
  - 2. Application: Optical transmitter with 1x4 VCSEL array for space
  - 3. Application: Miniature Atomic Clock

#### Highly localized laser based sealing

CSEM approach for hermetic sealing: Laser Assisted Diffusion Bonding

- High temperatures only locally at the joint (~100 mm wide)
- Very low stress, as parts inside the cavity will not heat up
- Very high shear strength > 100 MPa and temperature stability to 500°C



Laser soldering & welding station in cleanrom envrionment



Proprietary sealing technology

diverse ma

# EU project Astion Miniature, flexible electrode for optical stimulation in cochlea Application: Implantable VCSEL actuator for stimulation of hearing nerves

- Optically transparent, biocompatible, low permeability Sapphire package comprises
  - Long wavelength VCSEL laser array (1x19) at 1550 nm
  - Lens array for collimation
  - Pt/Pt-Ir leads with 400 µm pitch
- Successful stimulation of hearing nerves in-vivo in guinea pigs by opto-acoustic effect
- Hermetic sealing of package by laser assisted diffusion bonding







0.6 x 0.6 x 1 mm<sup>3</sup>

### **# CSem**

Laser-cut, multiple laser, platinum electrode encapsulated in silicone **Cesa** project: hermetical sealing of small size optoelectronics parts in glass Application: Optical transmitter with 1x4 VCSEL array for space

1x4 VCSEL array @ 850 nm & lens array

Optically transparent  $\rightarrow \geq 90$  % transmission

Hermetically sealed  $\rightarrow$  Including interconnects

Mechanically robust for space applications

- Operating conditions 0 to +85°C
- Storage conditions -40°C to + 125°C
- Shock resistance to 1000 g

Reliability Test name	Test standard reference	Test parameters
Vibration	MIL-STD-750 method 2056	20 Hz - 2g <sub>N</sub> 80/1000 / 2000 Hz - 20g <sub>N</sub> 4 minutes/axis/sweep dir.
Mechanical shock	MIL-STD-750 method 2016	100x 1000g, Tau< 1ms
Moisture resistance	MIL-STD-750 method 1021	10 cycles with 3h dwell time
Temperature cycling	MIL-STD-750 method 1051	Condition B (- 40°C+100°C), 1000 cycles
Resistance to glass cracking	MIL-STD-750 method 1057	10x dipping in boiling & cold (0°C) water
High temperature storage	JEDEC-JESD22- A103D	100°C for 1000 hours.

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4 different designs with rad hard materials Sapphire with and w/o lens Schott N-BAF4 & N-ZK7 type glasses



# Application: Miniature atomic clock for telco and space



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- 795 nm VCSEL @ 75°C, 0.1 1 mW
- Flat LTCC type housing
- Wafer level Rb cell to produce time reference
- Flat waveguide to couple through cell

- Similar applications in development for this type of VCSEL
  - Nuclear magnetic resonance gyro (NMRG)
     → for dynamic vehicle control
  - Optically pumped magnetometer (OPM)

     → for magneto-encephalography



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# :: CSeM

from research .... to your product

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