



Advanced VCSEL manufacturing platforms

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Product Line Director

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DIODE LASERS FOR
CONSUMER ELECTRONICS

1 BILLION

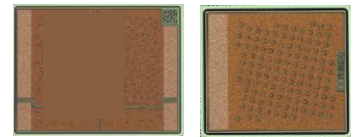
ZERO

TOTAL
VOLUME

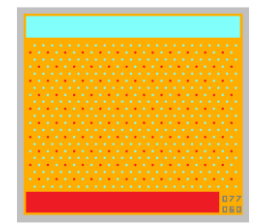
FIELD
FAILURES

Lumentum 3DS Product & Technology Evolution

6-inch VCSEL
10um aperture
min. 30um pitch



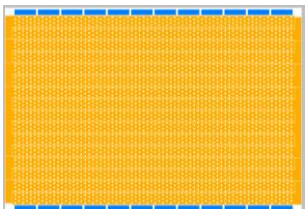
Multi-layer metal



Multi-junction VCSEL

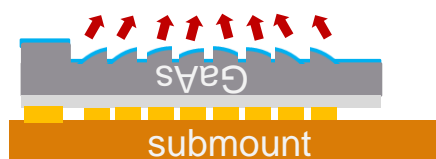
Improved PCE

42% 44% 48%

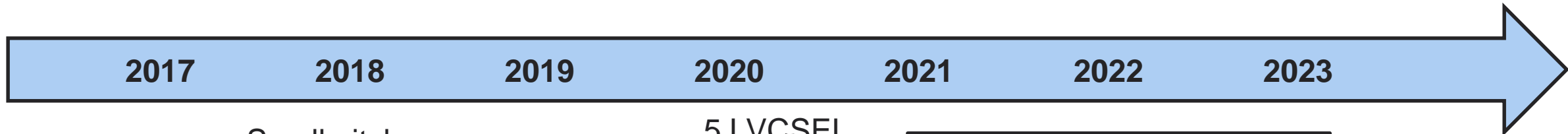
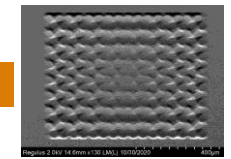


Matrix addressable

All-in-one VCSEL



Back emitting
Integrated lens
Addressable



2017

2018

2019

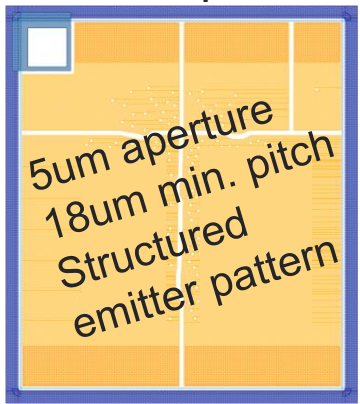
2020

2021

2022

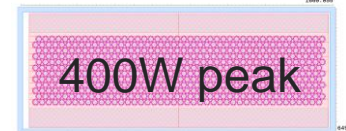
2023

Small pitch



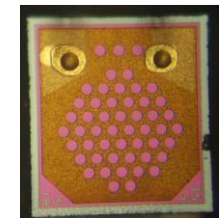
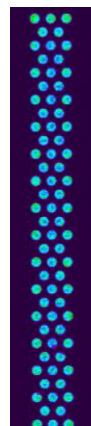
5um aperture
18um min. pitch
Structured
emitter pattern

5J VCSEL



400W peak

Automotive



Long-wavelength DFB

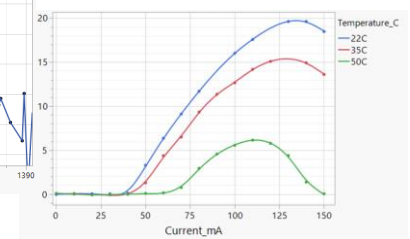
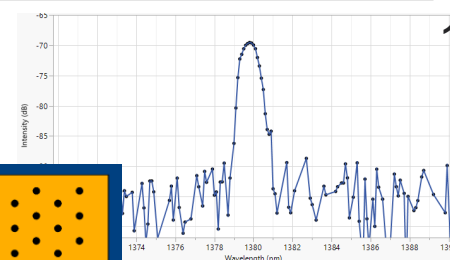
13xx nm

Long-wavelength VCSEL

13xx nm

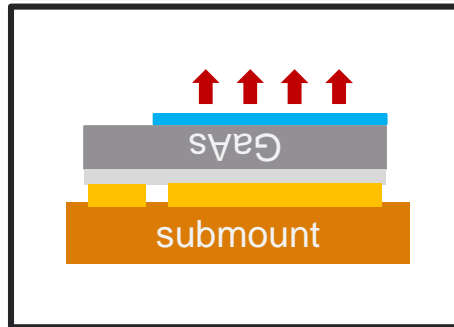
Polarized
VCSEL

14xx nm



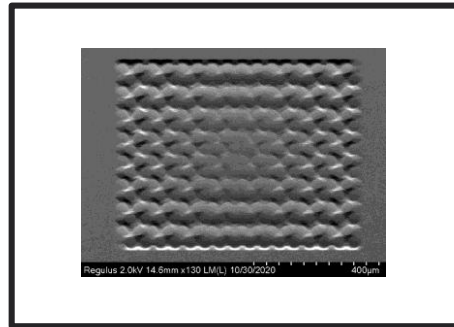
Gen 2: Advancing the VCSEL Technology Platform

Backside emitting



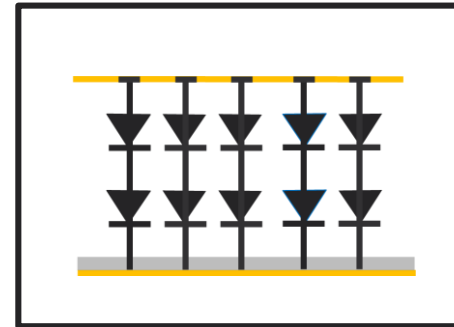
Improves & simplifies packaging

Integrated microlens



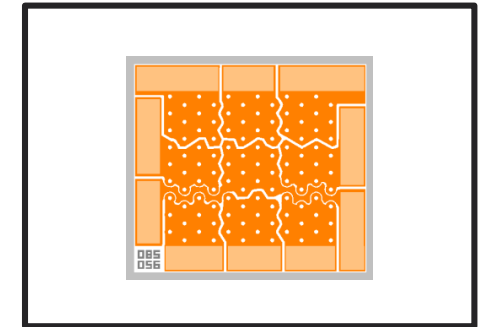
Enables custom optical profiles to eliminate additional optical elements

Multi-junction



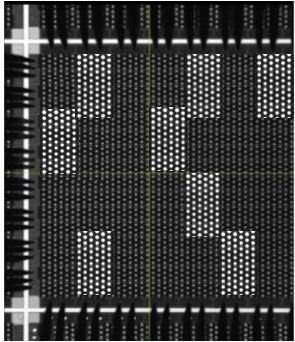
Provides highest output power and efficiency

Addressable emitters

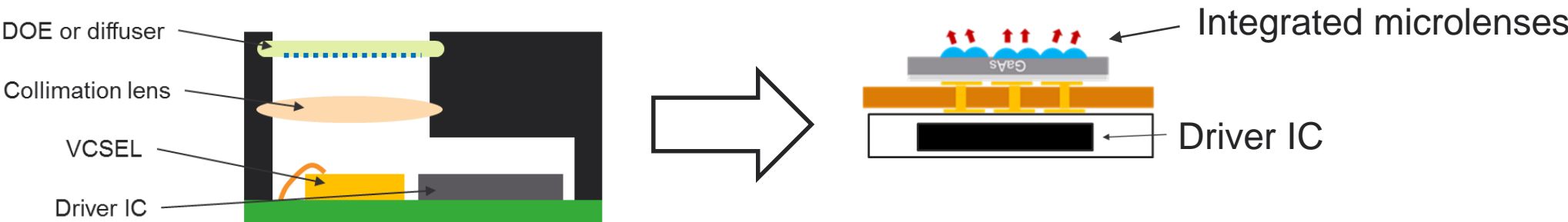


Utilizes advanced multi-layer metallization to provide design flexibility

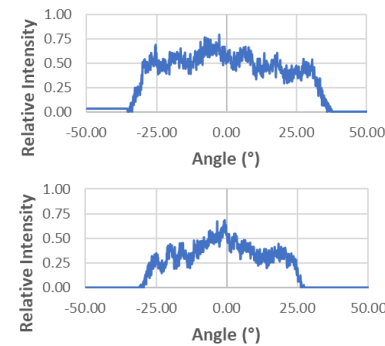
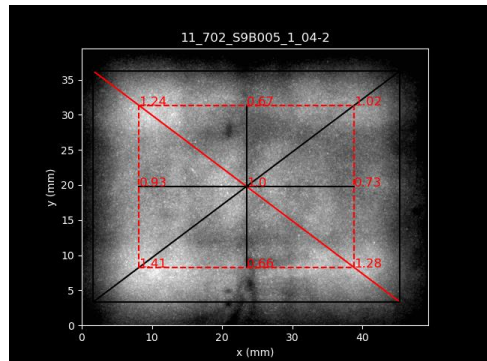
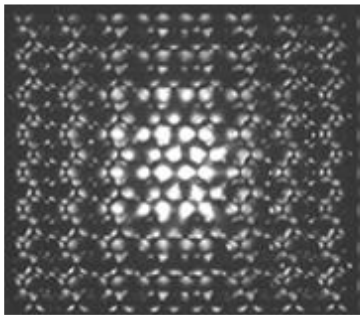
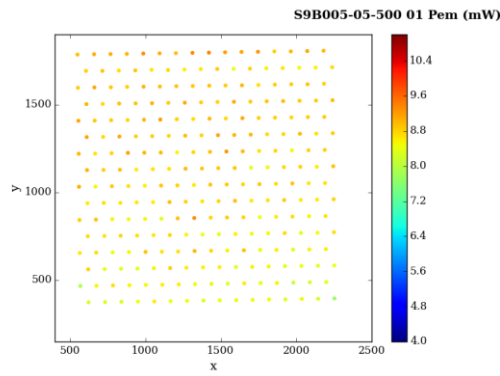
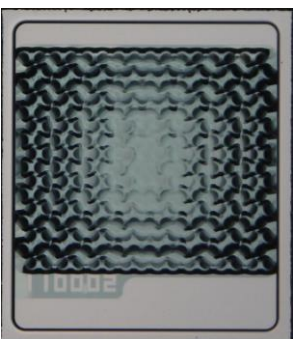
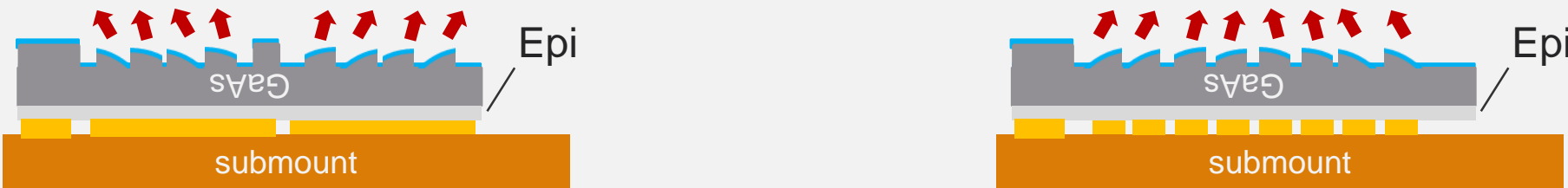
Addressable VCSEL Array Configurations



Gen 2: Integrated Optics with Advanced Technology



VCSEL design flexibility provides complete illumination solutions



Lumentum 3D Sensing Applications

Smartphones



Automotive



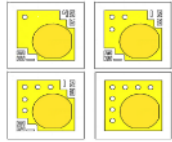
IoT Markets



Lumentum 3D Sensing VCSEL Product Summary

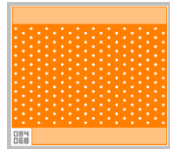
Gen 1 VCSEL products

For eye tracking



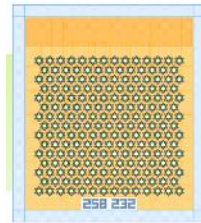
10s mW

For GR sensors

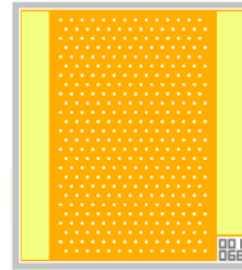


<1W

World facing ToF + SL illuminators



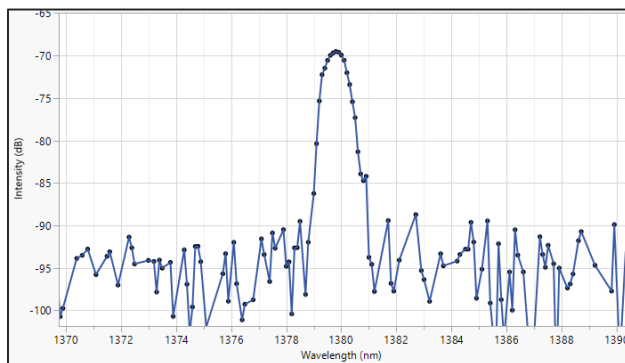
2W



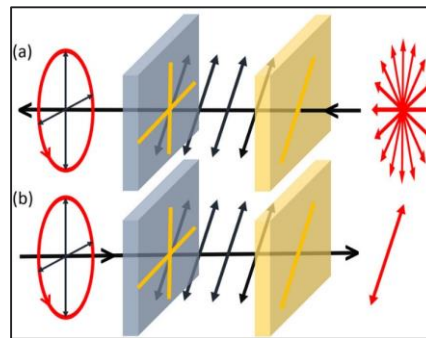
4W

Advanced 3DS VCSEL technology

Long-wavelength VCSEL

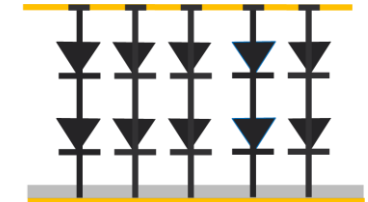
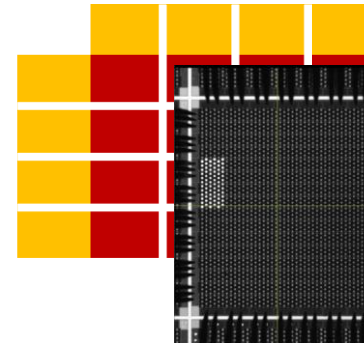
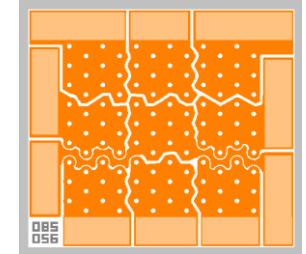


Polarized VCSEL

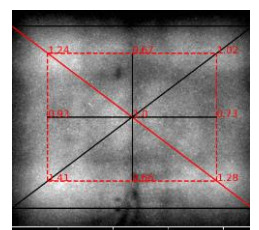
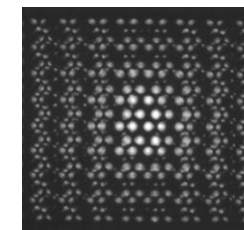
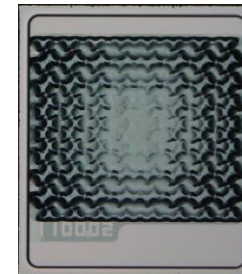
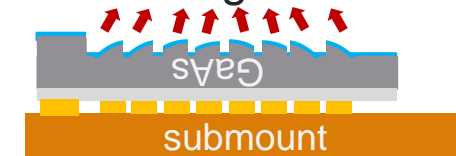


Gen 2 VCSEL solutions

- Multi-layer metal
- Addressable array
- Multi-junction VCSEL



BSE with integrated microlens



Summary

- The latest generation of VCSEL chips are the light sources of choice for advanced sensing solutions
- VCSEL development has advanced rapidly as high-volume applications drive innovation and infrastructure
- Lumentum is focused on advancing VCSEL technology, the manufacturing platform, products, and integration
- Ecosystem partners are established for module integrators, detector solutions, and electronic integration



Thank you!

