

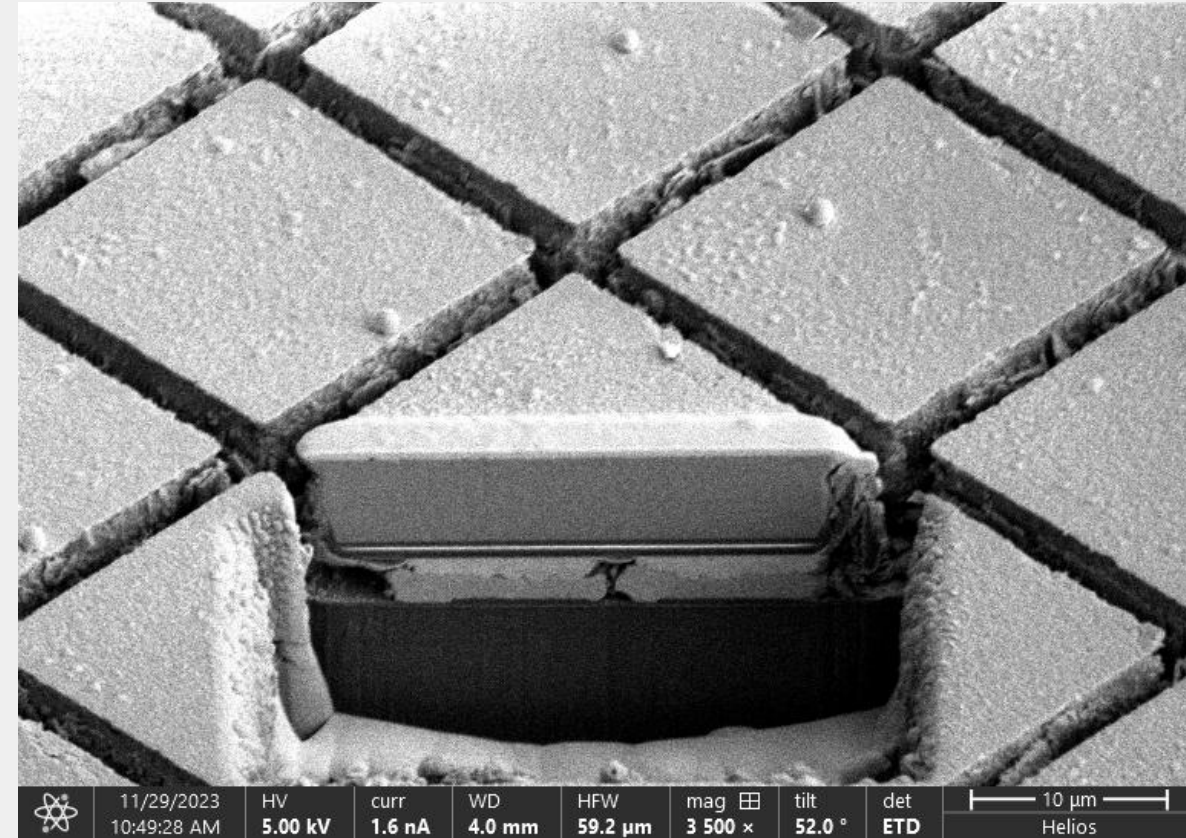


# QubeDot



## MicroLED technologies for quantum systems

Jan Gülink  
QubeDot GmbH  
(co-founder & CTO)



# ■ QubeDot

## We:

- **Founded 2019**
- **45+ person years of development**
- **Unique technology to process GaN material system**
- **Passionate TEAM of ~15 employees**

## The difference:

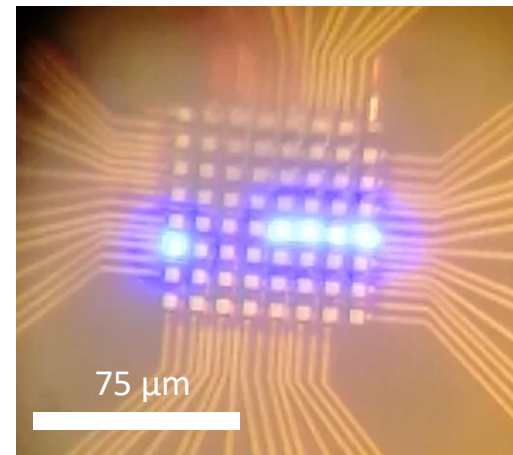
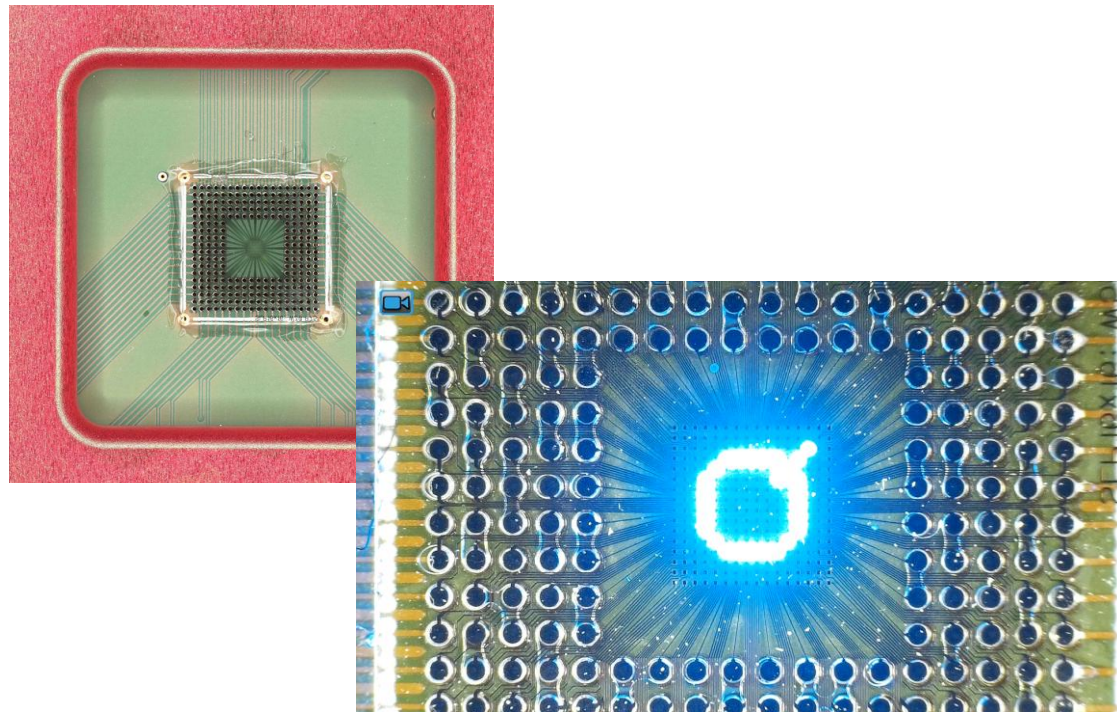
- **Big Players do not touch their standard processes and often do not think outside their box**
- **We understand the InGaN material system**
- **We are safe to provide any design from 1 ... 1000  $\mu\text{m}$ !**
- **Customers receive their customized microLED solution even in small quantities within short lead times**



# ■ Monolithic approach: SMILE Platforms

- System with 16 x 16 pixels
- Standardized contact ring for different pixel sizes & pitches & wavelengths.
- 170 kHz frame rate

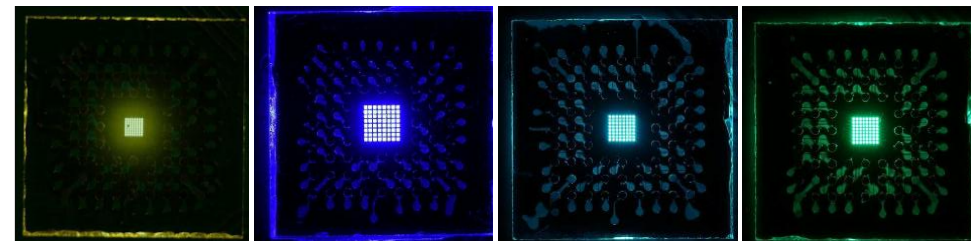
- System with 8 x 8 pixels
- Standardized contact ring for different pixel sizes & pitches & wavelengths.



5 μm pixel size  
5 μm distance.

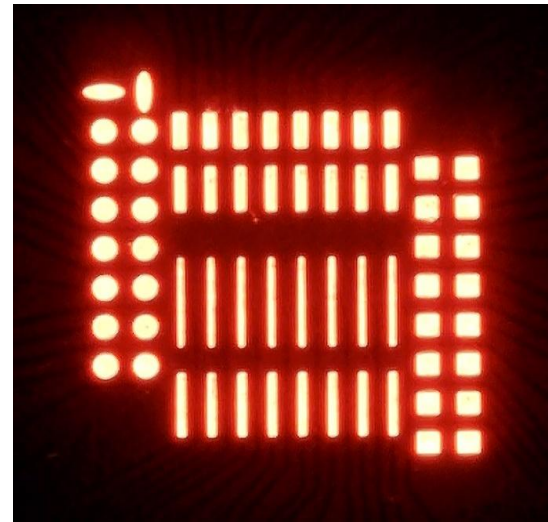
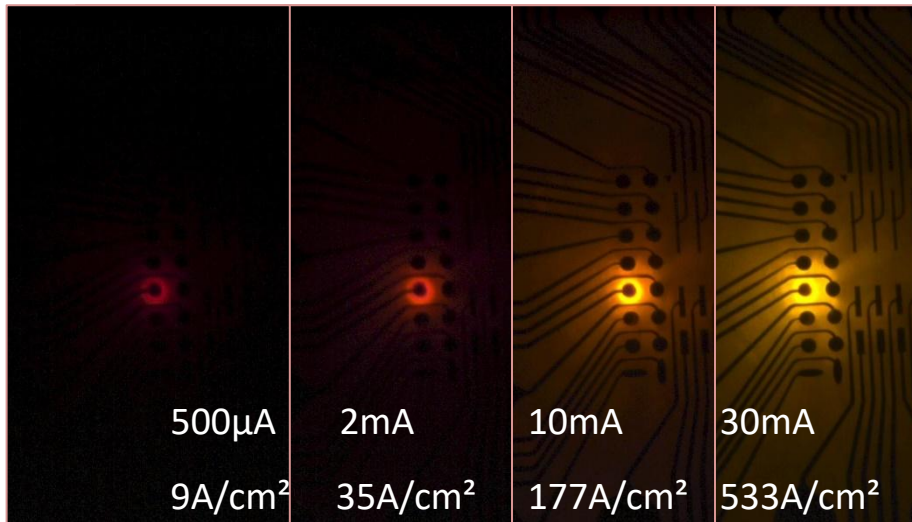
Single pixel  
modulated with  
1kHz in this video.

Too fast for camera.

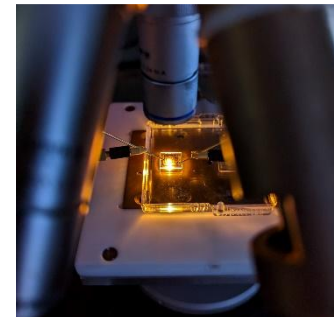
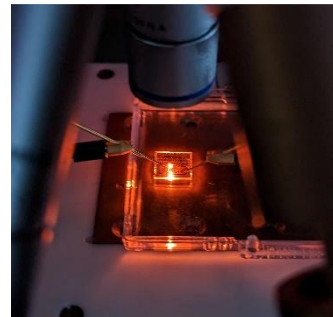
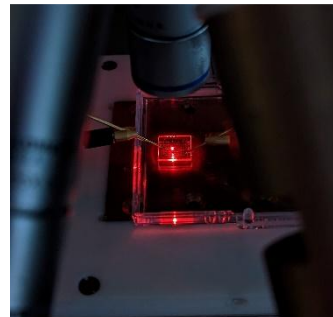
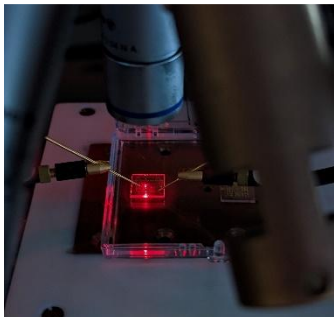


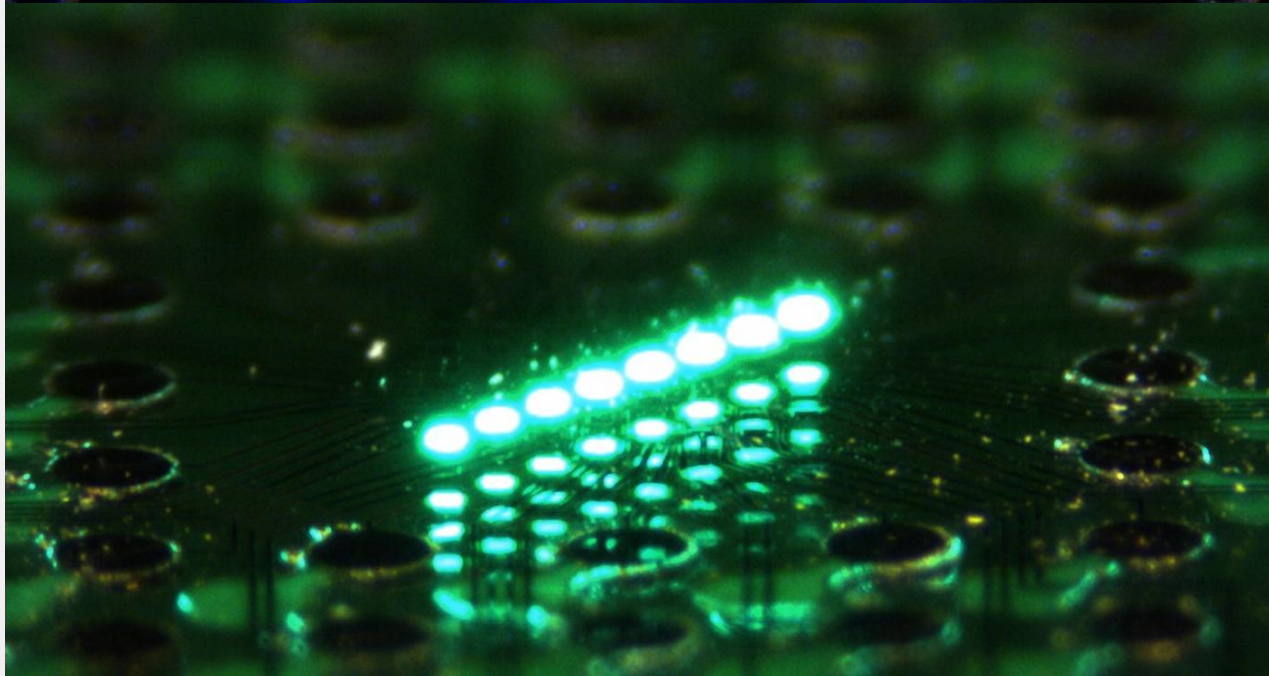
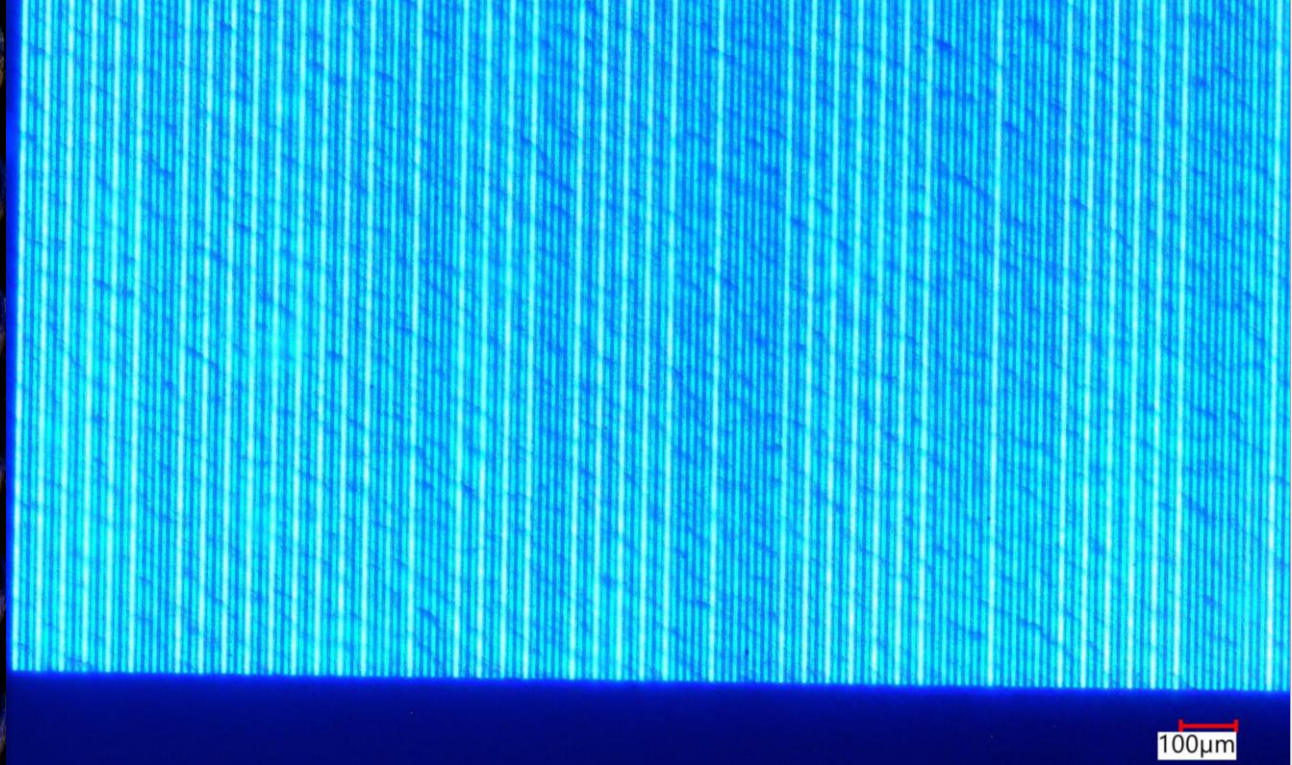
From UV to green of course...

# ■ SMILE Platforms – Tuneable native red InGaN



- Red microLEDs with feature sizes down to 3 µm.
  - Tuneable
  - Can be adapted to customer designs with several emitters on a chip or distinct microLEDs on wafer
- Pixel form is size-independent

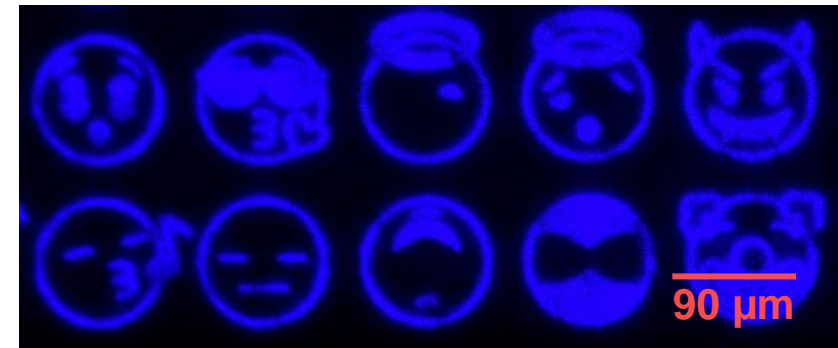
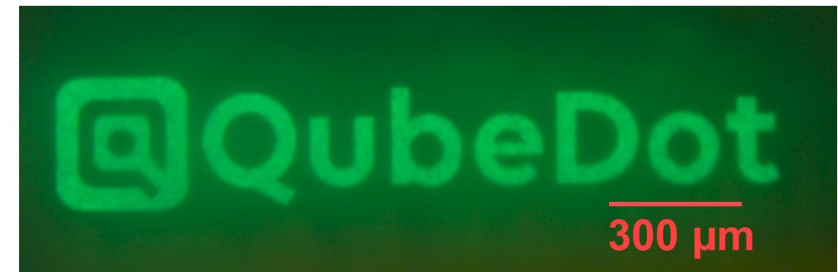




# ■ Example: Information displays



Place additional information **off-axis** by projection here on monolithic  $\mu$ LED die with form-independent pixels



# ■ Assembly of microLED displays



Copyright: Yole presentation @ Techblick 2021

Die size

**What about the efficiency in the low single-digit micron regime?**

Transfer

**Which transfer mechanism is fast and reaches >> 99,9999% placement yield?**

**Example 4K Display:** 3840 x 2160 (pixels) x 3 (RGB) = 24.88 million microLEDs.  
 If 99,99% successful transfers.  
 → Still 2489 dead pixels...

## ■ Assembly of quantum computers

Ion-trap based quantum computers need to integrate & combine for example

- Different photonic elements (VCSEL / DFB laser, waveguides,...)
- Electronics (microwave circuits,...)
- Fiber coupling interfaces

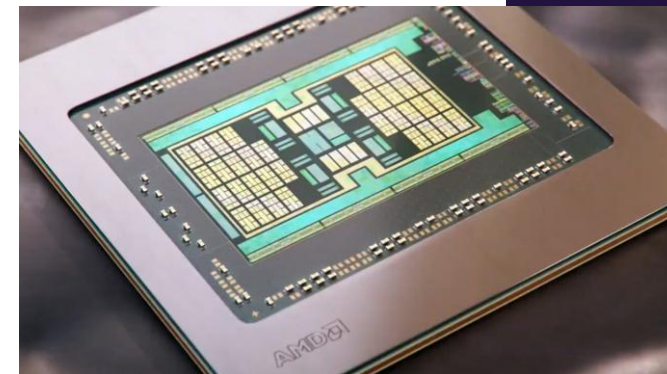
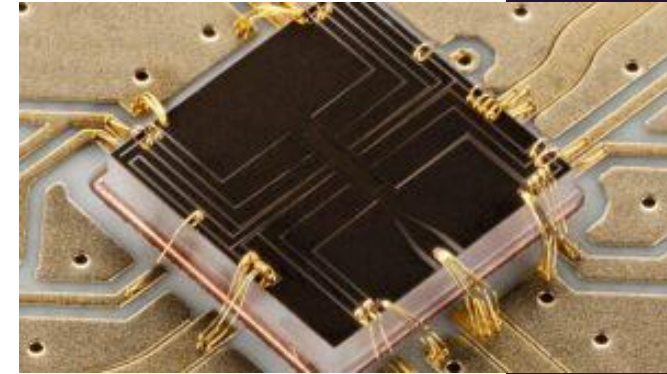
On an interposer e.g. with TGVs and high thermal conductivity,...

No single material system can fulfill all requirements.

For scalability & system size reduction:

- Hybrid on-chip integration // Chiplet Design
- Fast & parallel element transfer & connection

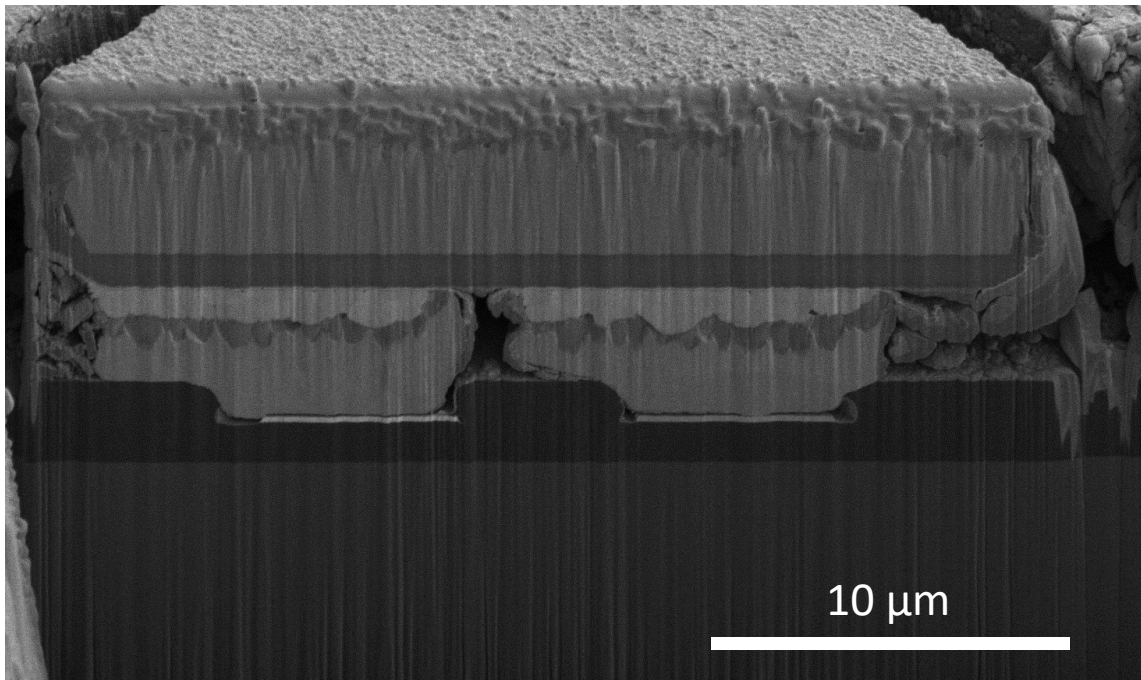
Similar to microLED displays or chiplet design in modern CPUs...





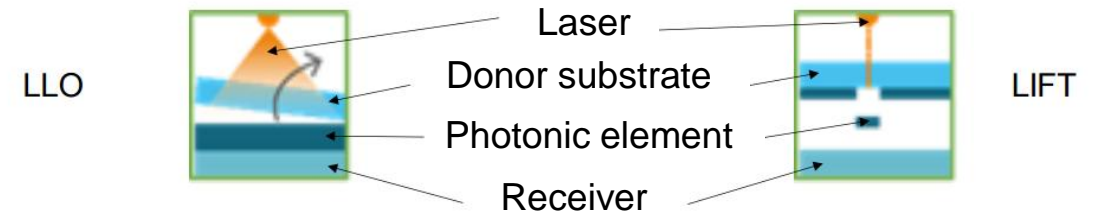
# ■ Transfer of photonic elements

Best semiconductor process is nothing without proper transfer tools and reliable interconnection technology.



We perform and offer

- LLO after bonding or
- LIFT for direct  $\mu$ LED transfer+bond

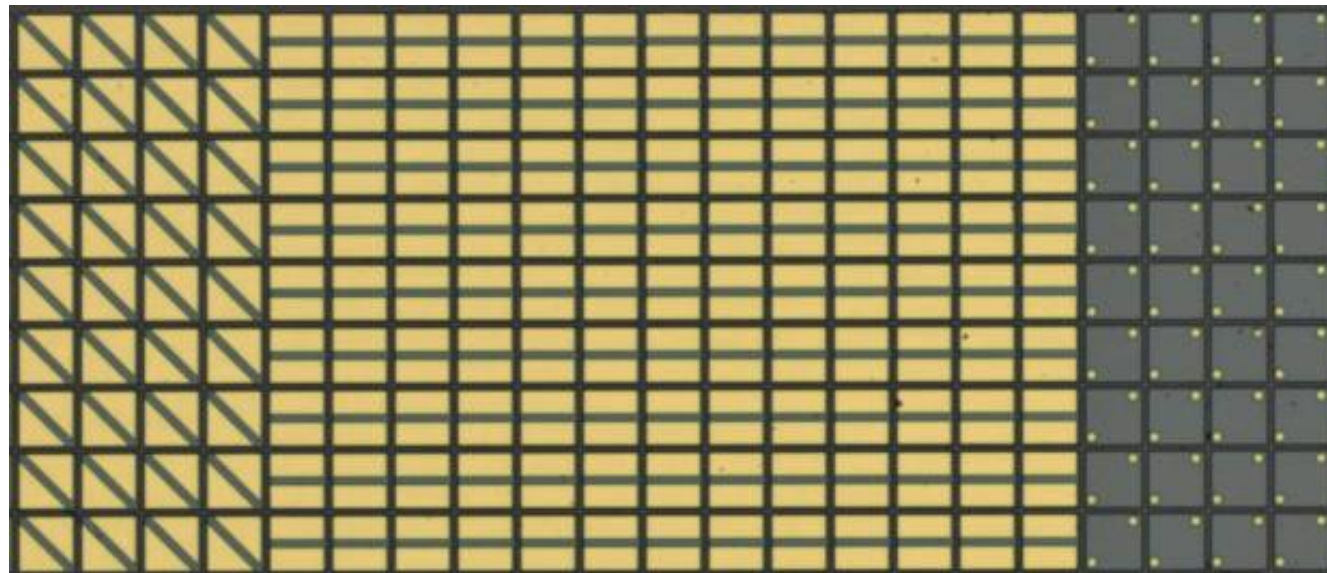


**Laser Induced Forward Transfer (LIFT)** is highly parallel and can transfer millions of units per hour.

## ■ Towards standardization of photonic dies

### Potential size of

- Die 14 // 20 // 40 // 80 // +  $\mu\text{m}$
- Contact pad 5 ... 40  $\mu\text{m}$  – any shape
- Emitter 2 ... 75+  $\mu\text{m}$

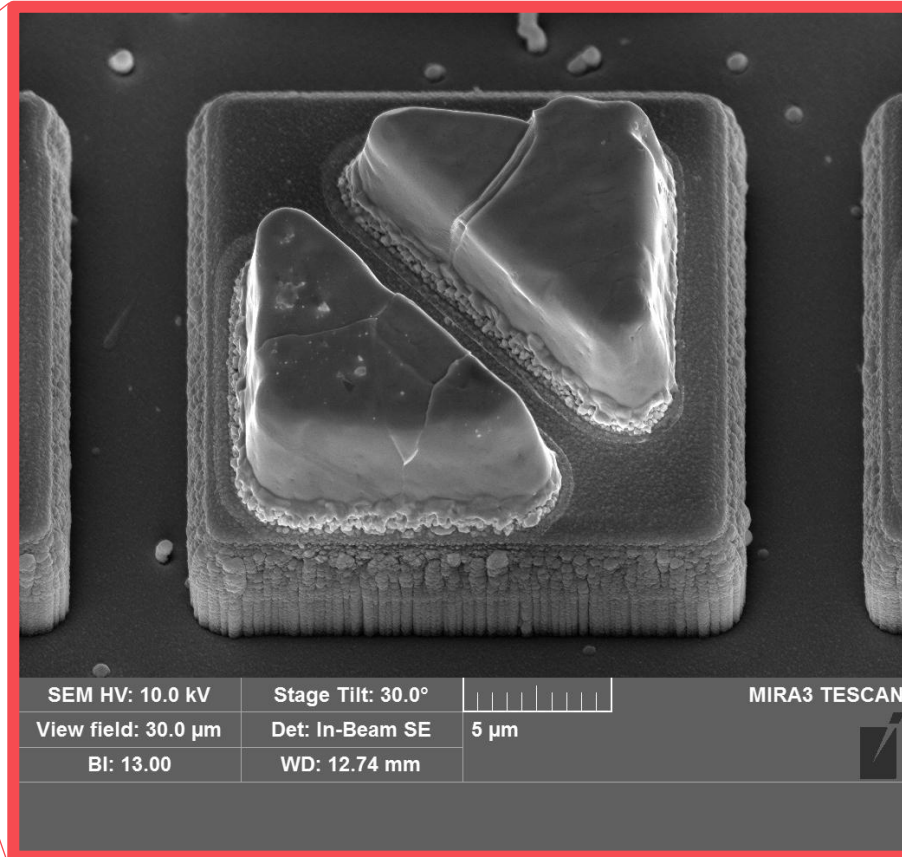
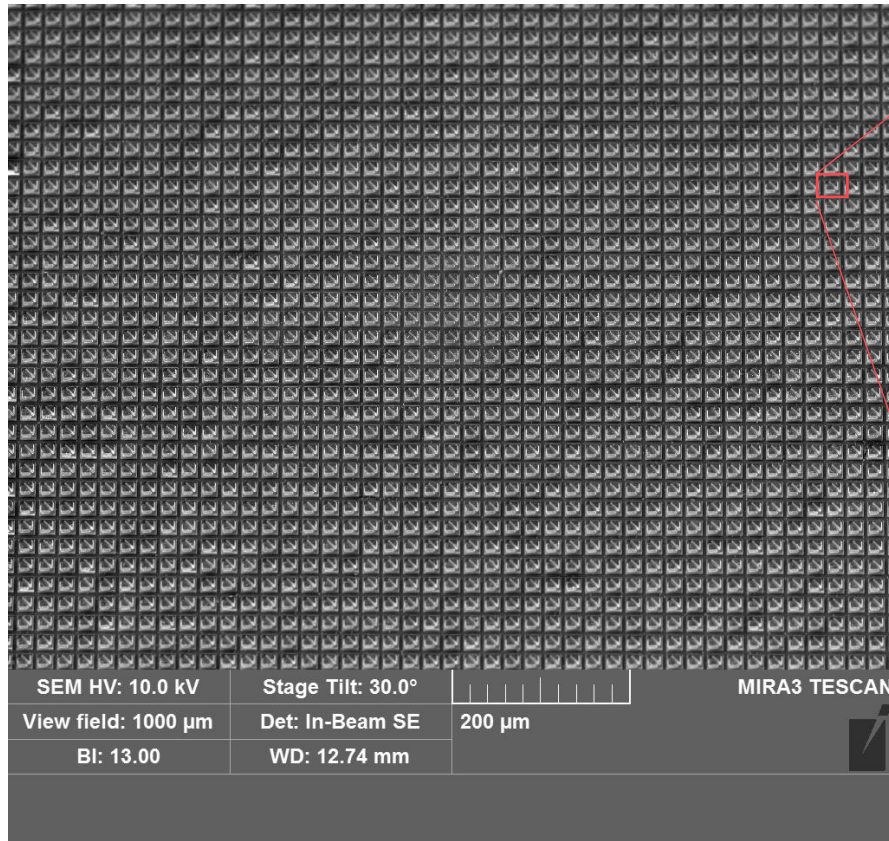


Dies with size 80 x 80  $\mu\text{m}^2$  with different contact pads. Ready for transfer.

No “golden way” yet in the industry.

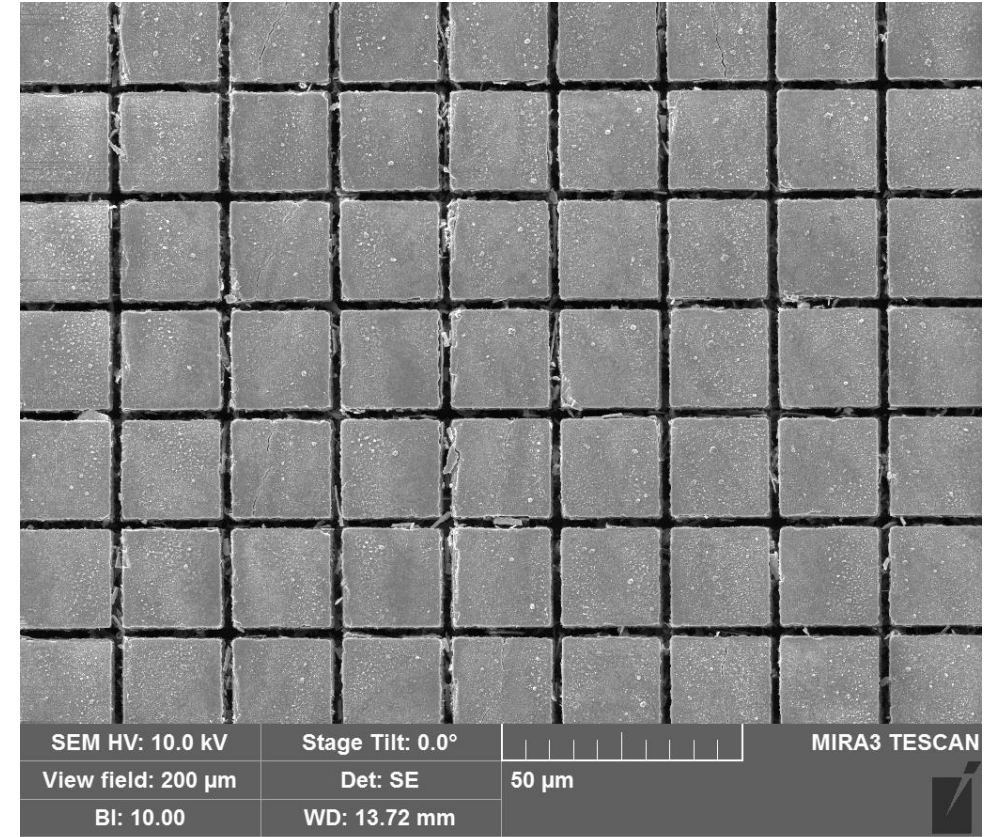
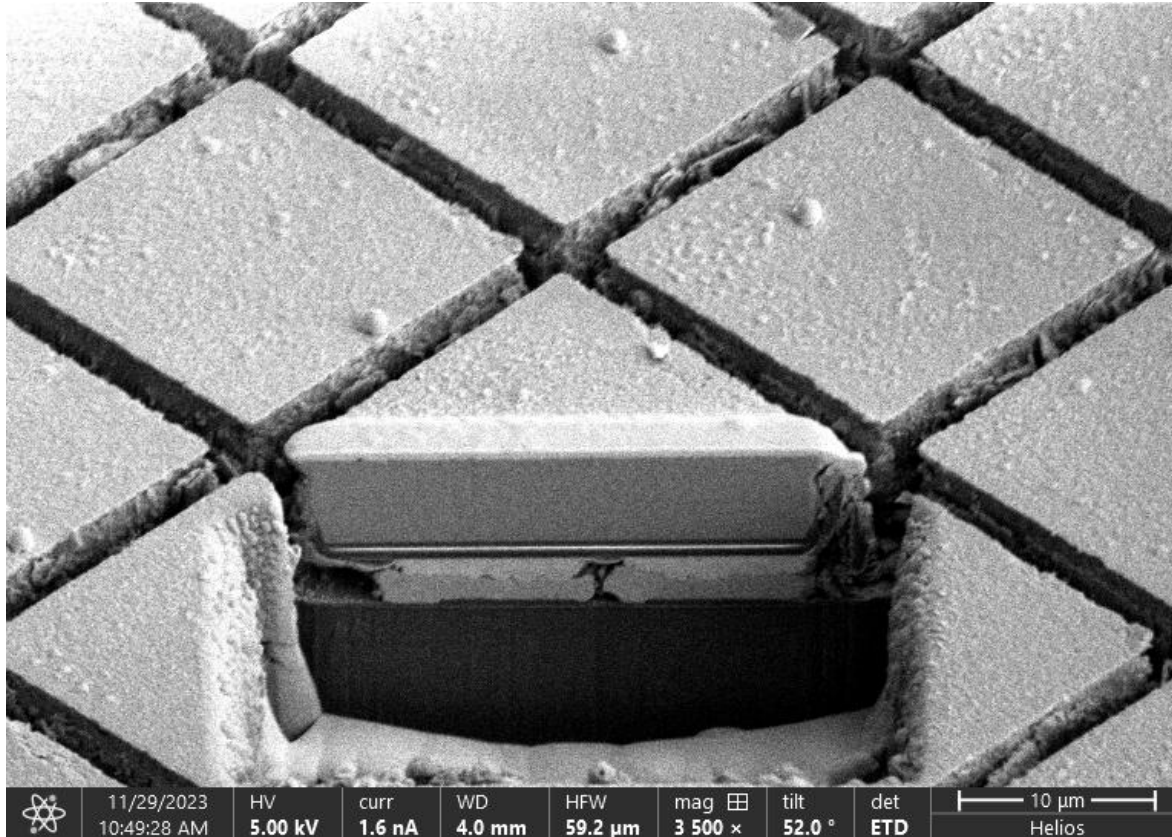
Standards regarding die sizes, contacts, and emitters have huge benefits at the interfaces of all industry players.

# Towards standardization of photonic dies II



Die size 14 x 14 µm<sup>2</sup>.

# Towards standardization of photonic dies III



Die size 14 x 14 µm<sup>2</sup>.

## ■ EPIC questions

*What can you do for them?*

- Design and processing of LEDs, Lasers, and waveguides
- Application-specific interposer and receivers
- Transfer
- Assembly and Interconnects

*What can they do for you?*

- Learn about the versatile possibilities of QubeDot and the GaN material system
- Talk to us about needs and potential capability matches 😊

## ■ Your personal contact

**Jan Gülink, M.Sc.**  
QubeDot GmbH  
Wilhelmsgarten 3  
38100 Braunschweig

P +49 531 801 636 10  
M [j.guelink@qubedot.com](mailto:j.guelink@qubedot.com)



Stay **connected**

