

# **ENABLING INDUSTRIAL MICROLED DISPLAY MANUFACTURING BY DUV LASER SOLUTIONS, A FUTURE PROOF APPROACH**

**EPIC Online Technology Meeting on Photonics for  
New Display Technologies**

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Coherent



- Displays - A well known market for Coherent laser equipment
- Industrial mass production - 24/7 solutions all over Asia

MicroLED display manufacturing – A task for Lasers

# microLED DISPLAYS

For very large TVs and  
tiny wearable displays

microLED display



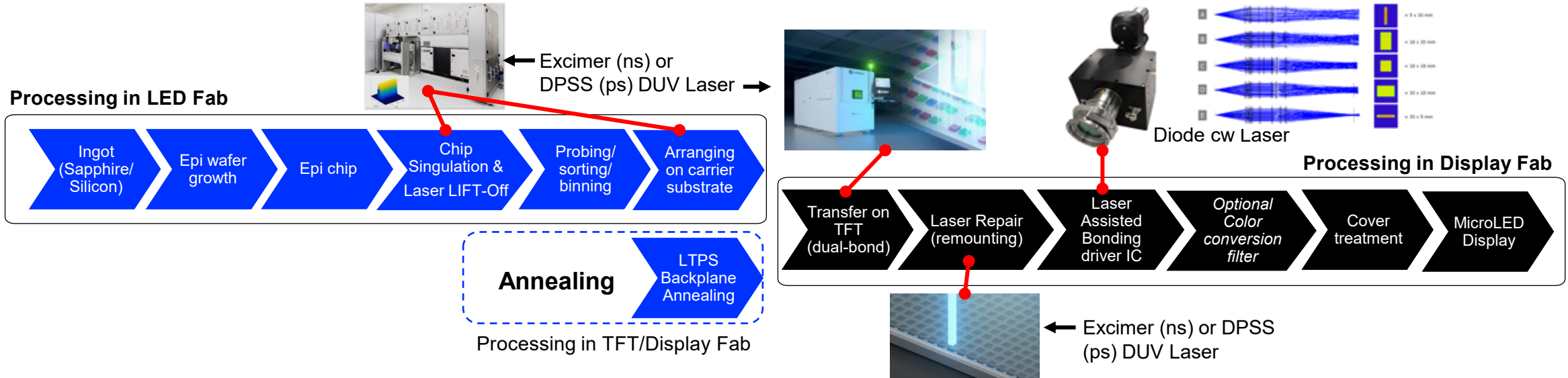
Compound Semi

+

Display Equipment

# MICROLED DISPLAY MANUFACTURING PROCESS CHAIN – A LASER VIEW

Beyond - microLED



**Laser LIFT-OFF (LLO)**

Release from EPI Wafer

**Mass Transfer (LIFT)**

Pitch Conversion

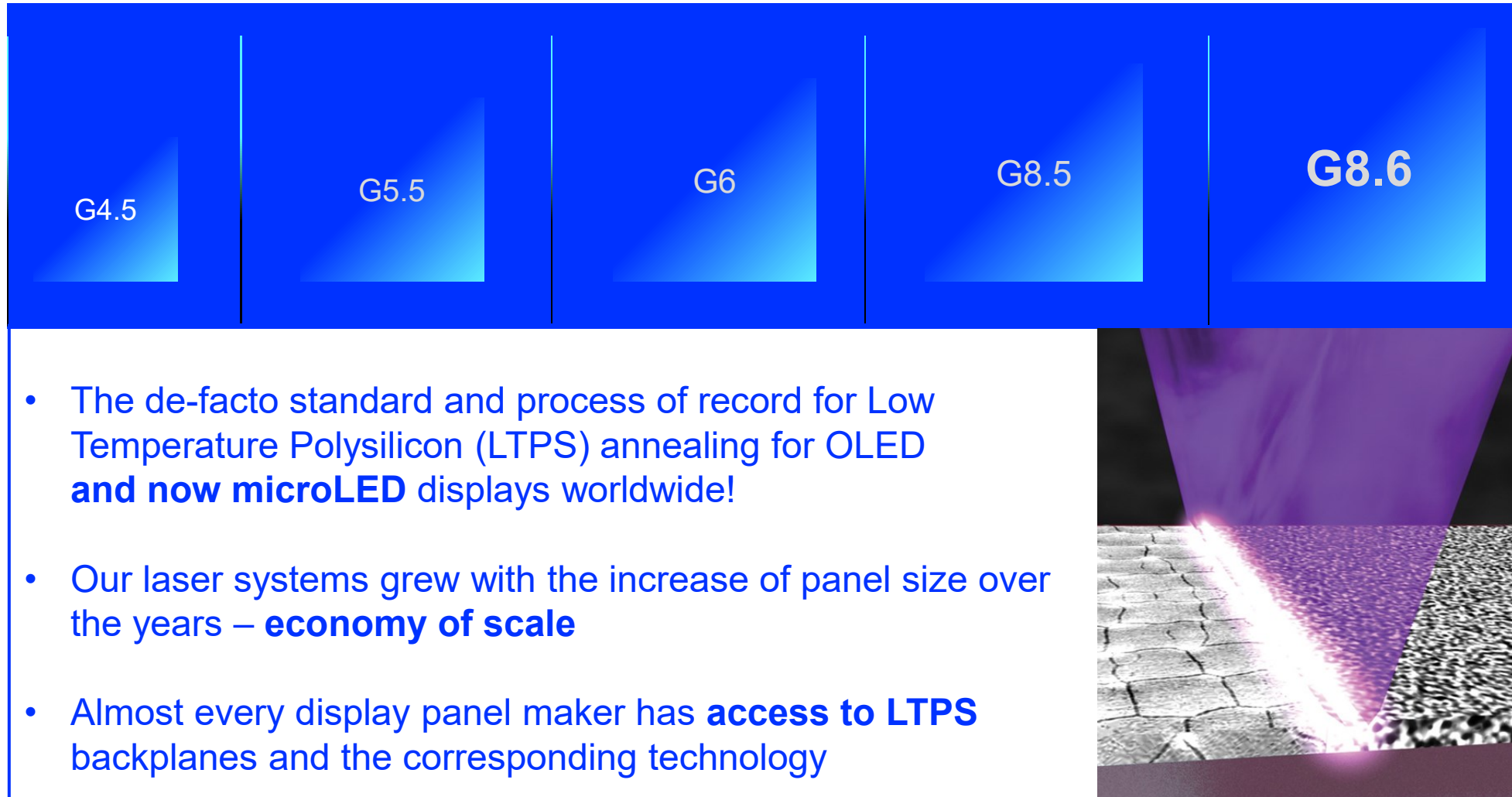
**Laser Repair**

Individual Remove / Refill

**Laser Assisted Bonding (LAB)**

Selective Bonding

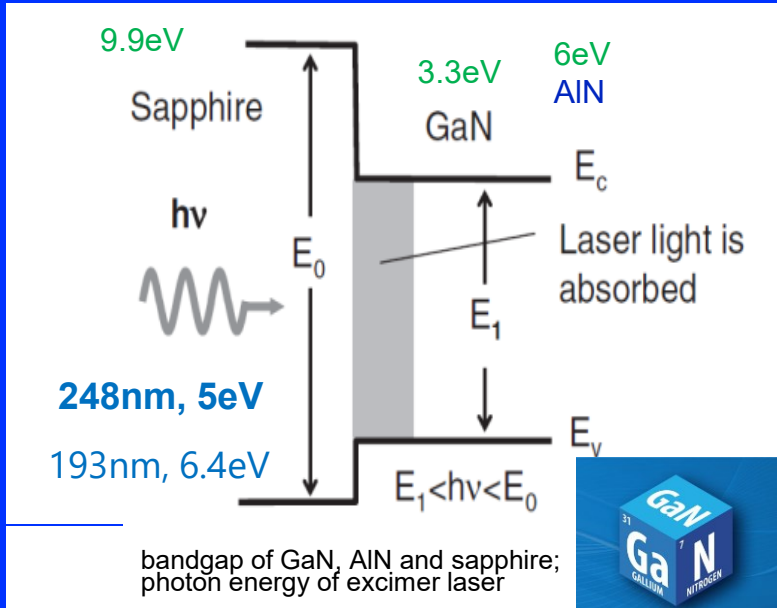
# LTPS BACKPLANE ANNEALING: OVER A DECADE OF SUCCESSFUL MASS PRODUCTION



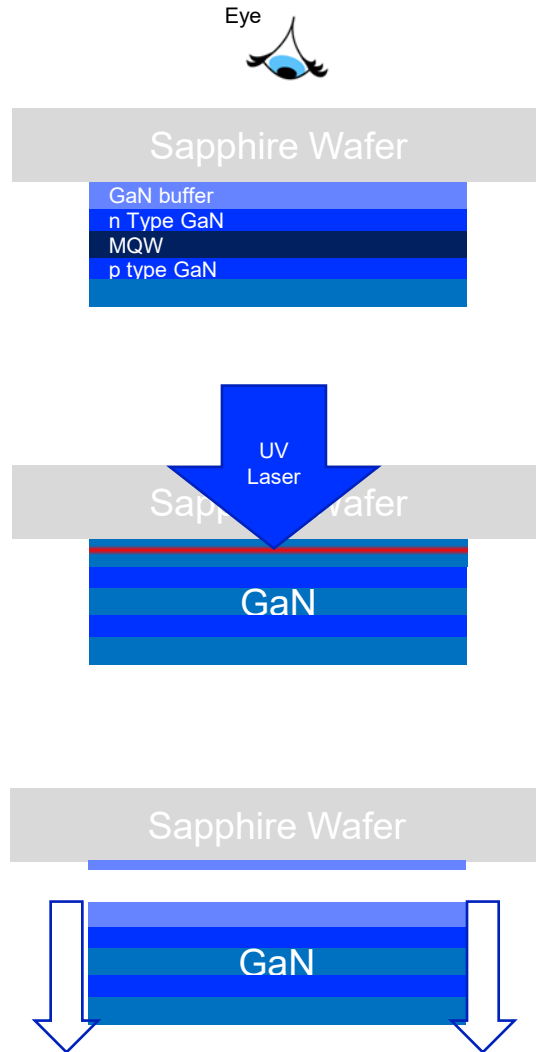
- The de-facto standard and process of record for Low Temperature Polysilicon (LTPS) annealing for OLED **and now microLED** displays worldwide!
- Our laser systems grew with the increase of panel size over the years – **economy of scale**
- Almost every display panel maker has **access to LTPS** backplanes and the corresponding technology



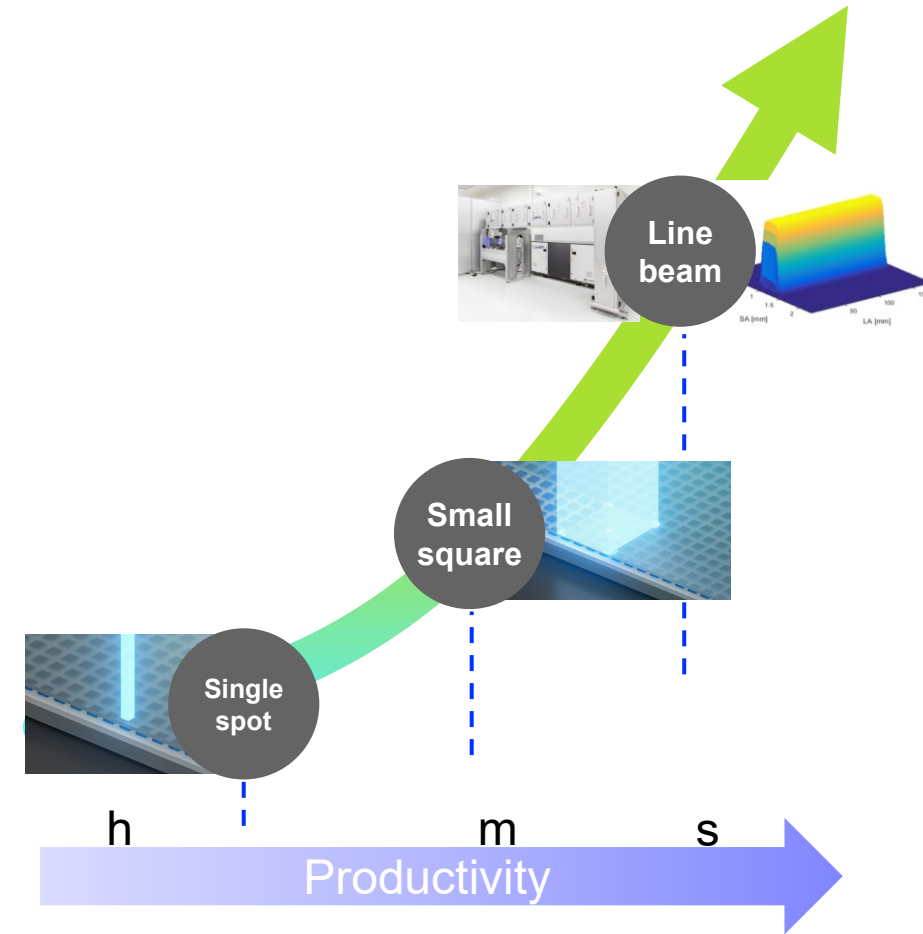
# III-V SEMICONDUCTOR GaN ON SAPPHIRE



- UV Excimer laser give the wavelength (photon energy) to directly find linear absorption for the GaN, AlN material system



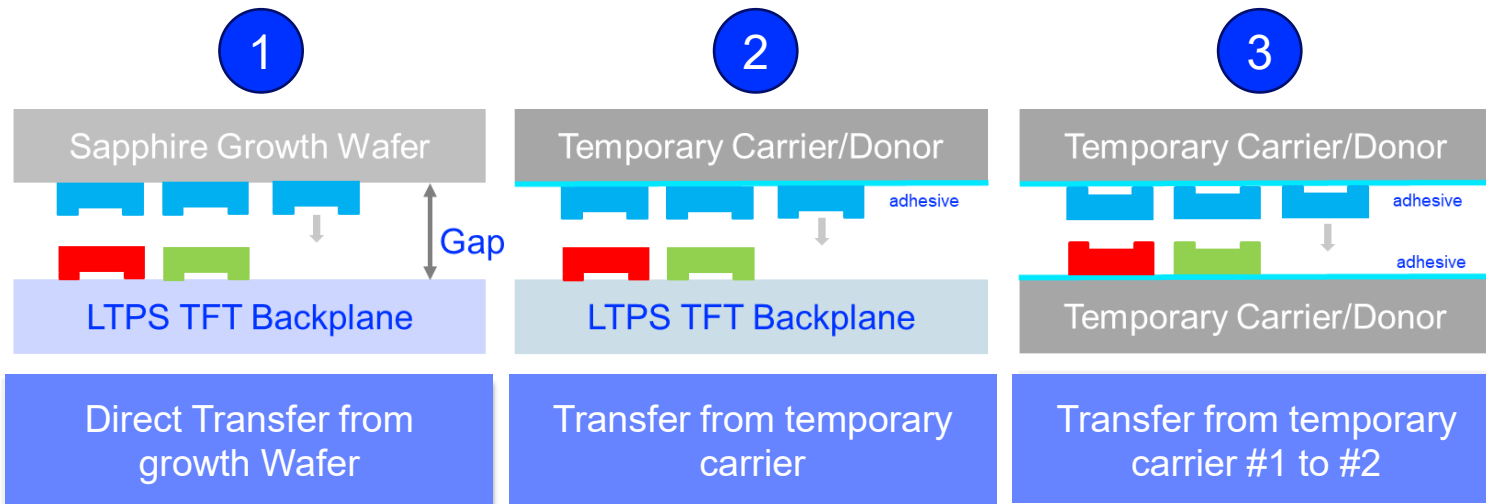
## Laser LIFT-OFF



UV Wavelength mandatory for damage free ablation

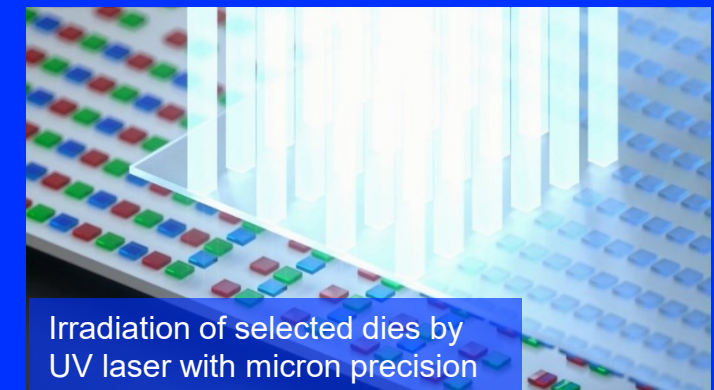
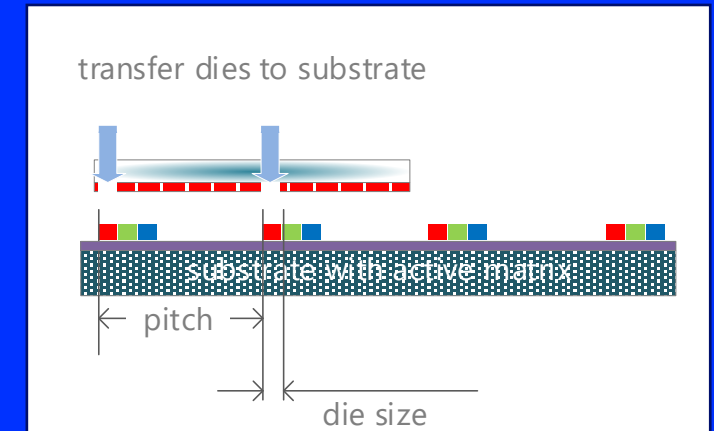
# MASS TRANSFER BY LASER

Three Different Scenarios  
Laser Induced Forward Transfer (LIFT)



Coherent's Laser approach can offer all kind of transfer  
– direct from EPI wafer or from carrier!

## Laser Induced Forward Mass Transfer

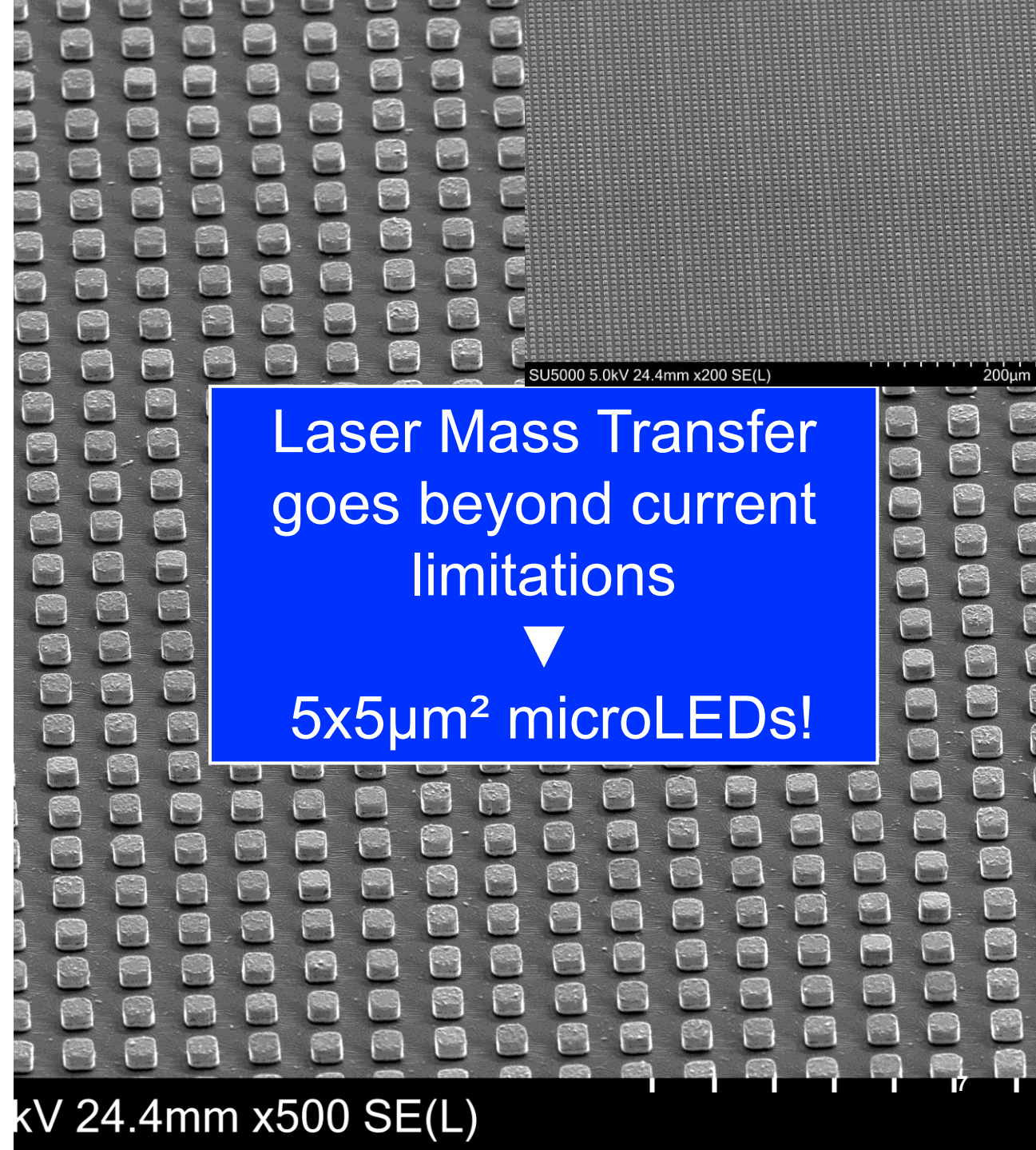


# MicroLED MASS TRANSFER IS ONE OF THE MOST CRITICAL PROCESSES

MicroLEDs must further shrink to become cost competitive, yes!

But will this ever happen?

Laser Mass Transfer is the most promising technology!



Laser Mass Transfer  
goes beyond current  
limitations

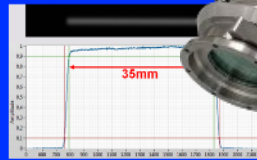
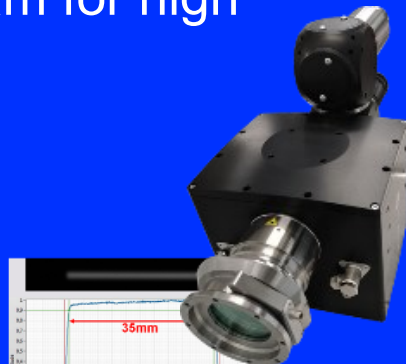
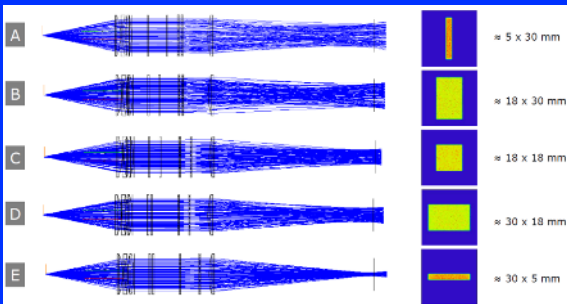
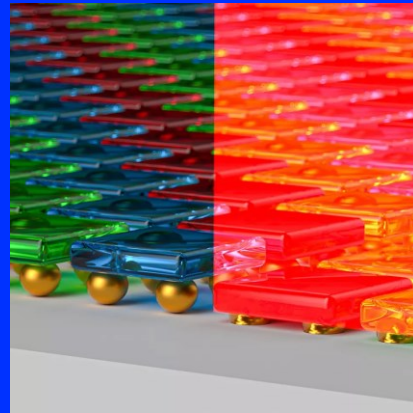


5x5µm<sup>2</sup> microLEDs!

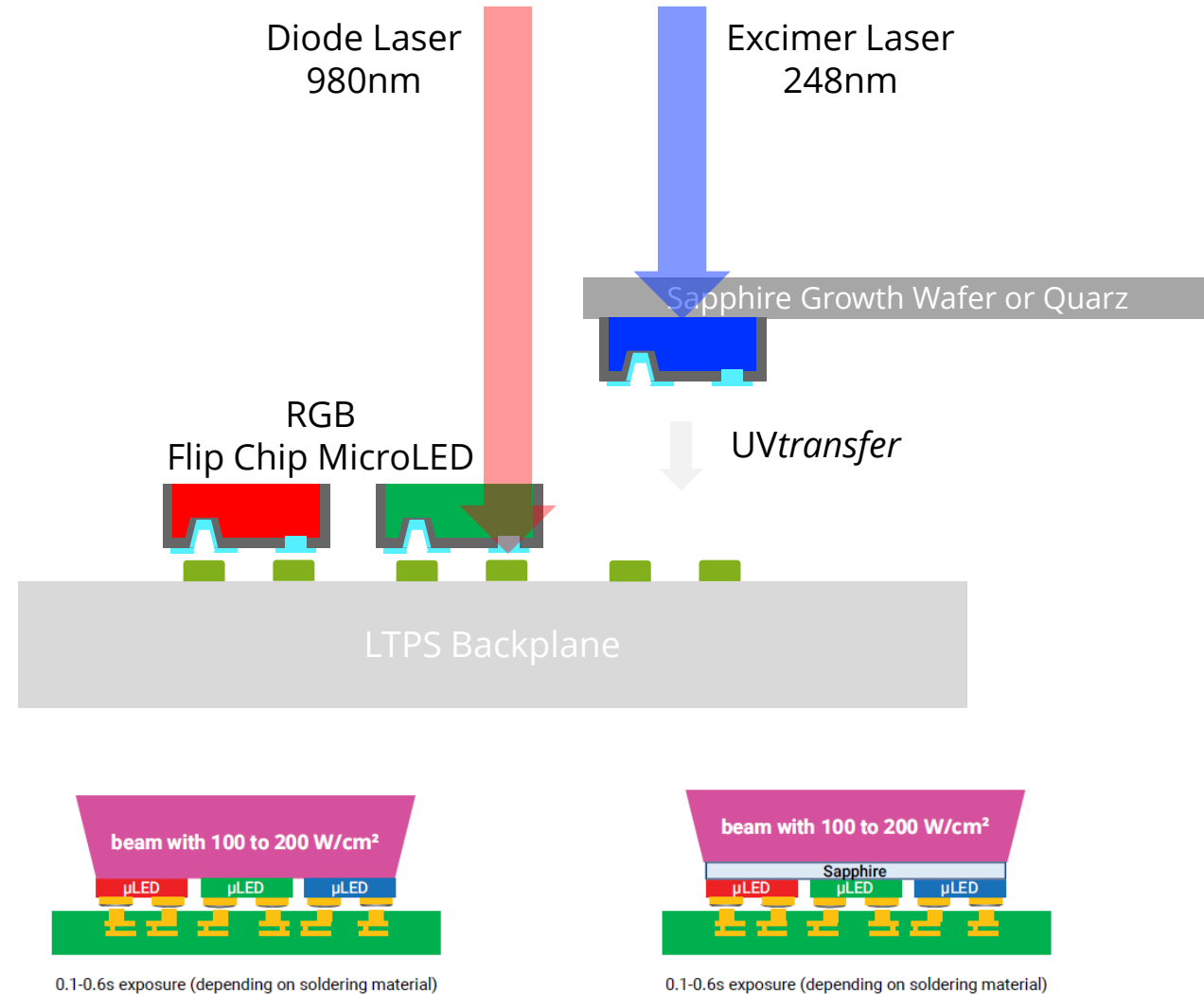
# MICROLED – LASER ASSISTED BONDING (LAB)

## Laser Assisted Bonding

- less thermal budget
- + selectivity
- + less warpage
- + 980 nm diode laser wavelength transparent for GaN MicroLED's
- + homogenized large area beam for high throughput

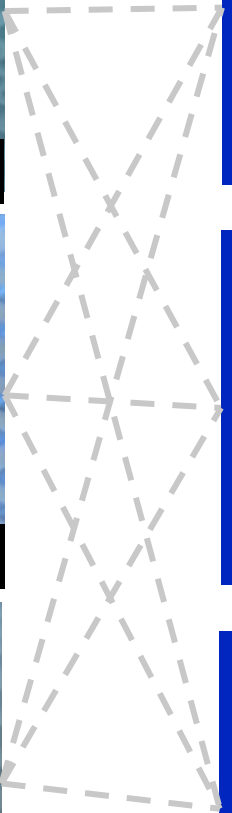
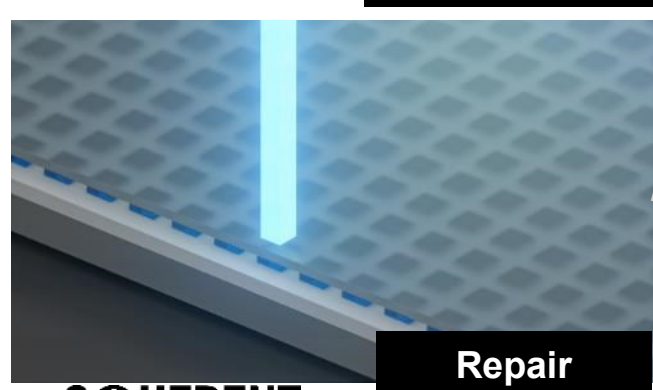
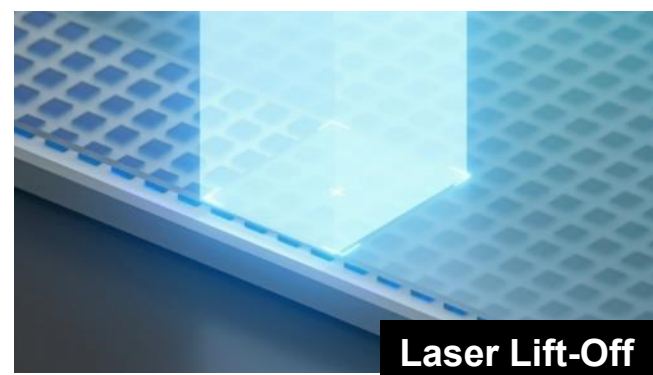


Example: 35 x 4mm<sup>2</sup>  
Edge steepness: ~1.2 mm (10-90% intensity)





# OUR CUSTOMERS HAVE THE CHOICE – LASER, OPTICS, TURN-KEY SYSTEM



**Turn-Key Solution**

- *UVtransfer* Turn-Key 248 nm System
- Laser, Optics, Stages, Imaging, Software
- Designed for industrial customers



**OEM System**

- Laser + Optics designed on customer requirements
- Standard configurations available
- Mask Imaging and Line Beam systems



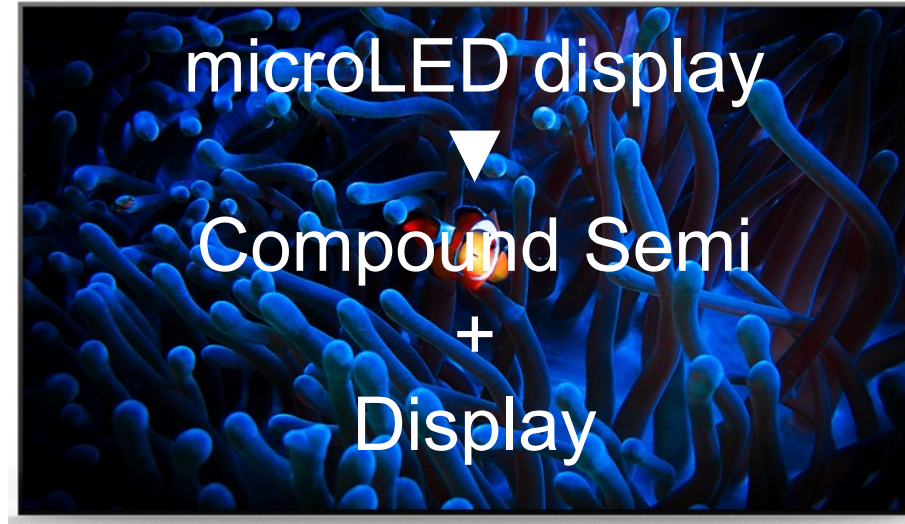
**Laser**

- DUV Lasers established for MicroLED processing
- Reliable industrial laser sources at different energy levels
- Scalable power



COHERENTS VERTICAL INTEGRATION

# SUMMARY



- One key to success of next generation microLED displays: the microLEDs must get small!
- Lasers are essential for microLED display manufacturing and offering future-proof solutions!
- We have demonstrated laser equipment scalability and laser mass production in OLED display industry!

Will it get real?  
...at least we are on a pretty good path to it!  
Stay tuned!

**COHERENT**