FLEXIBLE SMARTPHONE – LASER CHALLENGE

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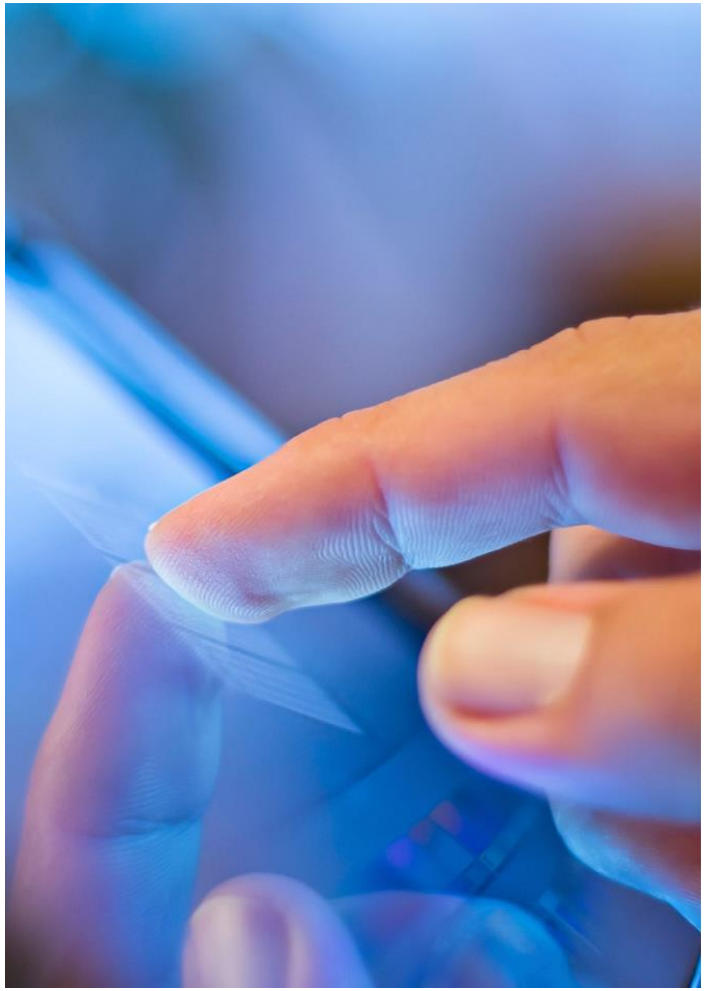
Overview

- Coherent at a Glance
- Laser Trends in Smartphone Mfg
  - Short Pulses / Short Wavelengths
- Enabling Flexible OLED Displays
  - Line Beam Systems for LTPS & Laser Lift Off



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Leading and Innovating Together

HQ in Santa Clara, CA, USA (est. 1966)

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COHERENT | DILAS

COHERENT | NUFERN

Sales M$ 1,000 **Orders M$ 1,700** **Employees 5,000**

COMPONENTS

Lasers

TOOLS

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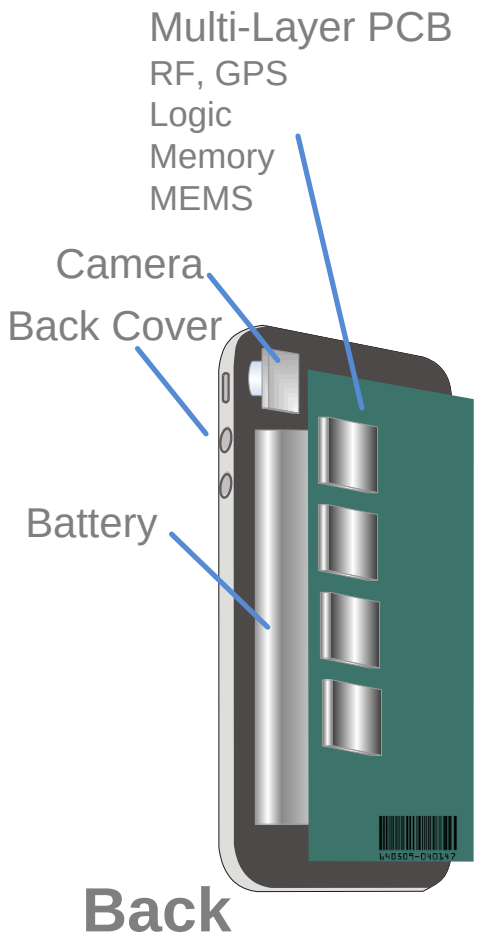
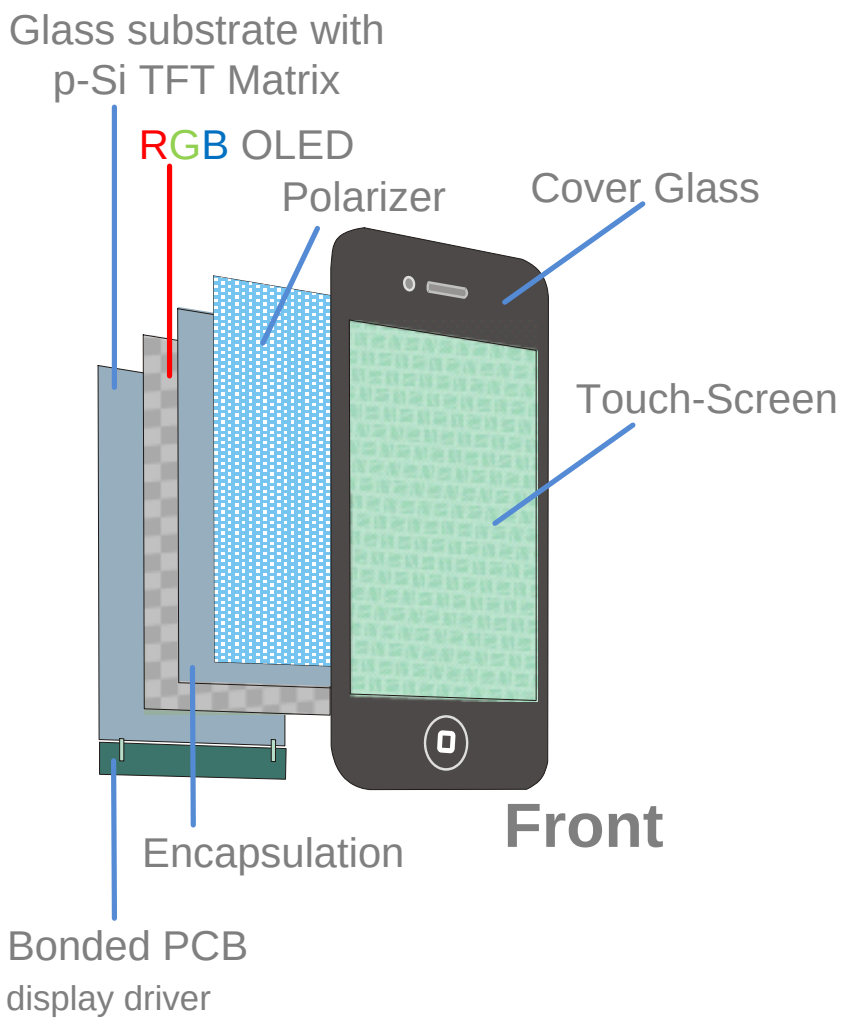
Smartphone – An Amazing Number of Laser Processes

- **Laser Crystallization**
  - **Poly-Silicon backplane, LTPS**
- Glass (FRIT) Welding
- Thin Film Cutting / Structuring
- **Glass Cutting**
  - Thin, curved
  - Strengthened glass
- **Laser-Lift-Off**
- Laser Induced Thermal Imaging
- **µ-Via Drilling**
- Battery welding
- **Marking**
  - Serialization
  - Design, Decoration
- Display Repair
  - Backplane, Array, Cell, CF, OLED





Similar Structure Inside a Smartwatch - Just even Smaller!

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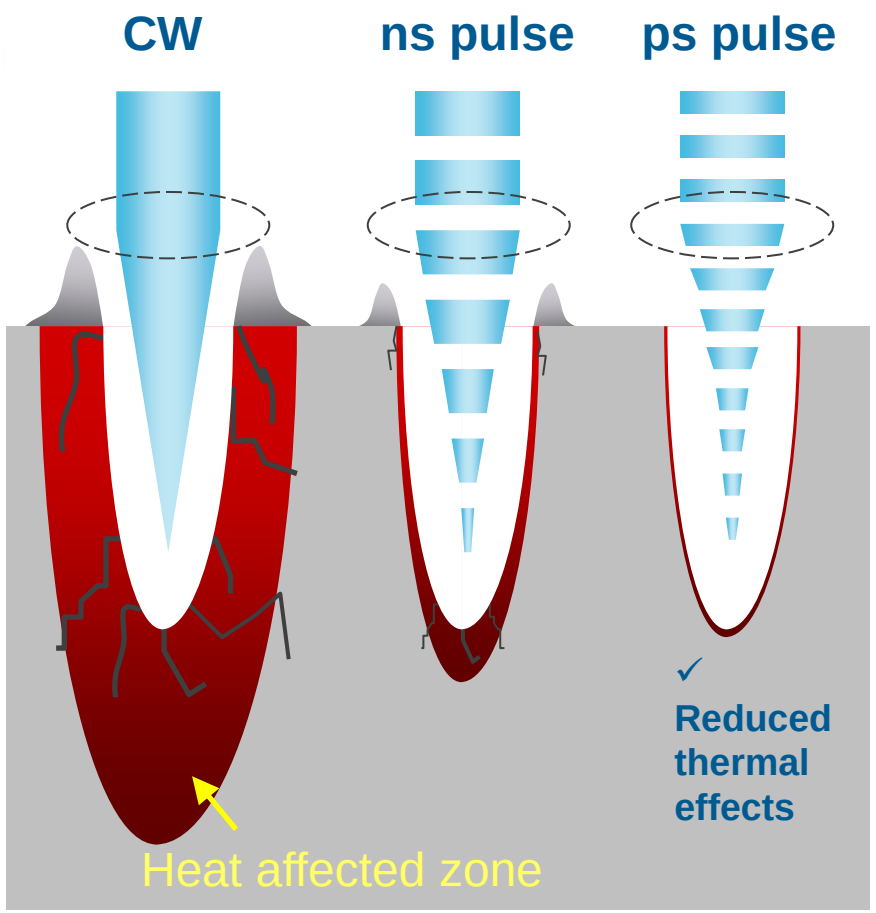
Display Glass Trends – Shorter Pulses, Novel Cutting Schemes

- Thinner Glass
  - Image quality
  - Lightweight
- Stronger- Durable
  - Strengthened glass – GORILLA, DRAGONTAIL .
    - Cover Glass
    - One-Glass Solution Touchsensor
    - Bezel free
- Stylish Design
  - Rounded corner
  - Notches, holes
  - Curved glass



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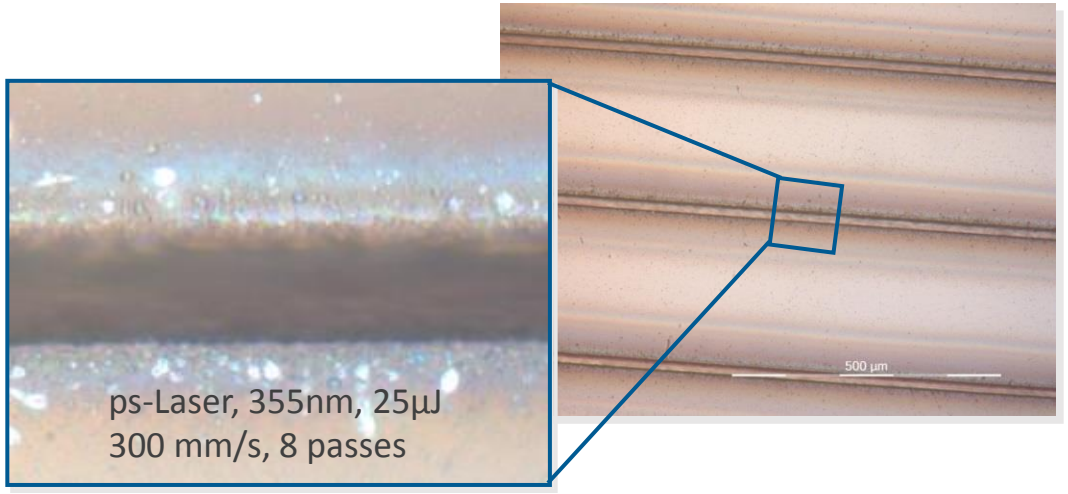
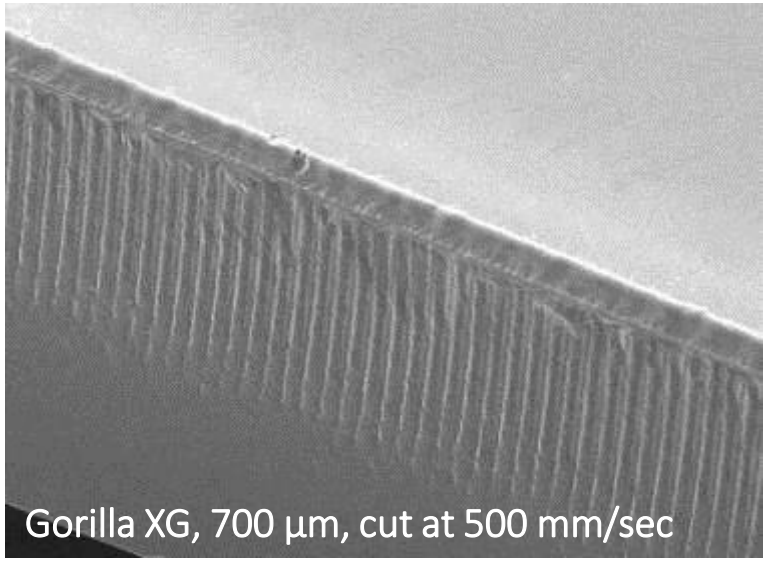
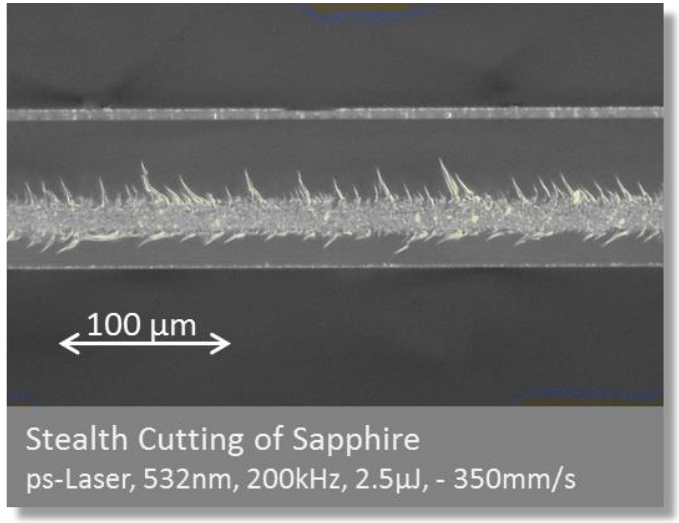
Laser Cutting of Thin Display Glass

- **Scribe and Break**
  - 355nm, ns-, ps-Lasers
- **Stealth Cutting**
  - 532 nm, ps-Lasers
- **Filament Cutting**
  - 532 nm, ps-Lasers







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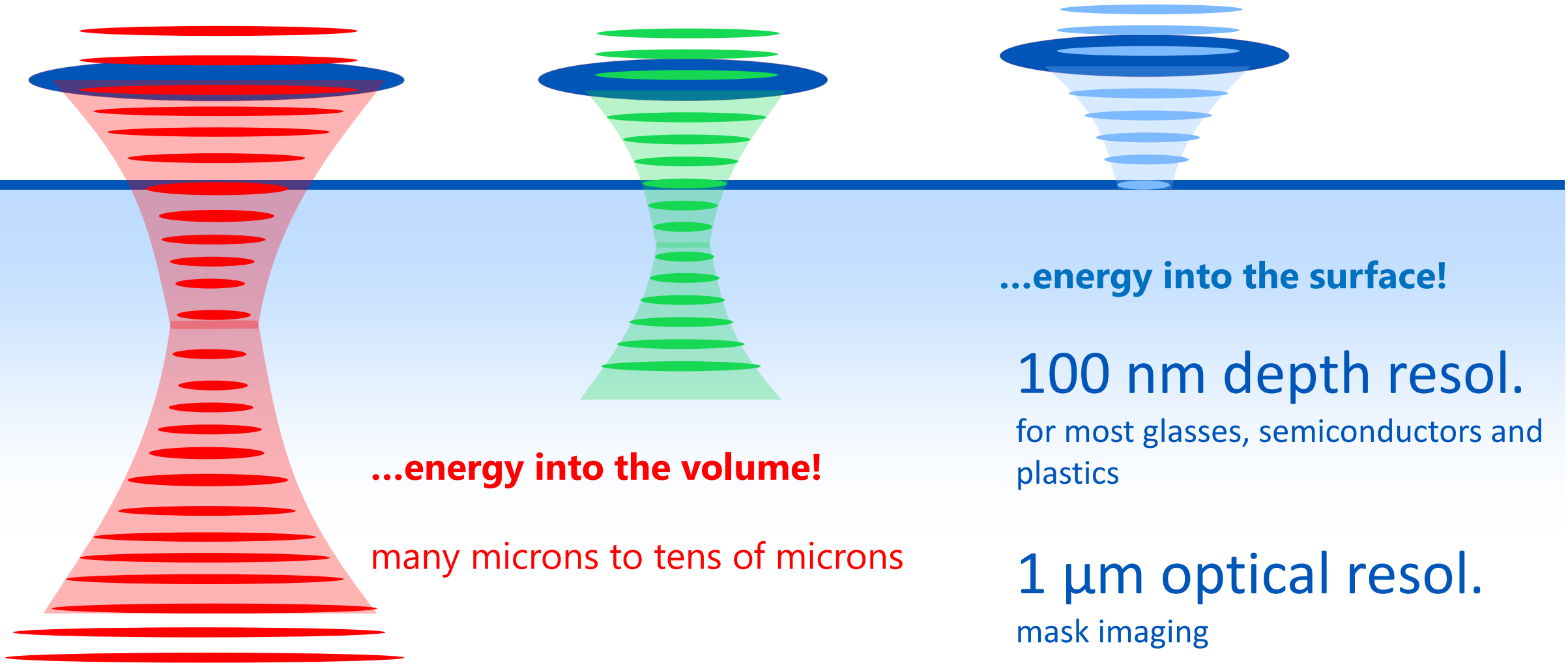
Short Wavelengths for Surface Selective Processing

Infrared >1,000nm

Green (532nm)

UV (193, 248, 308, 355nm)



...energy into the volume!

many microns to tens of microns

...energy into the surface!

100 nm depth resol.

for most glasses, semiconductors and plastics

1 µm optical resol.

mask imaging

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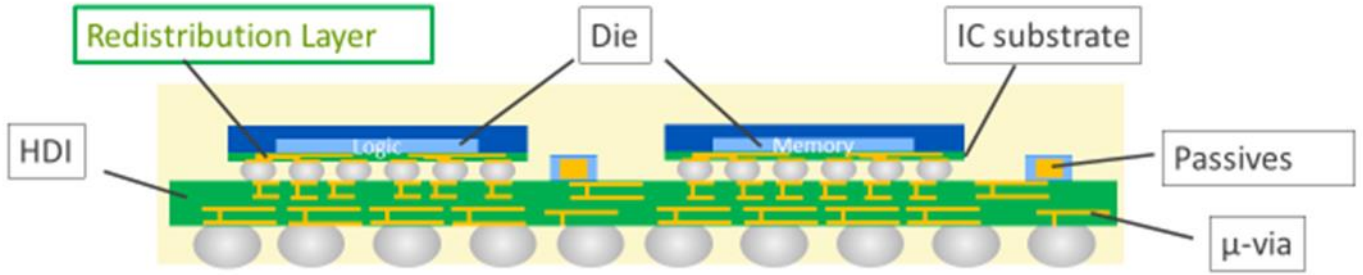
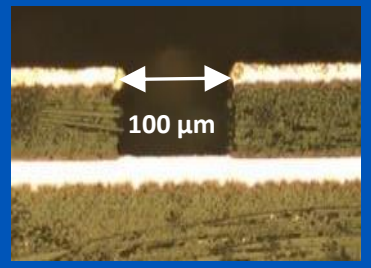
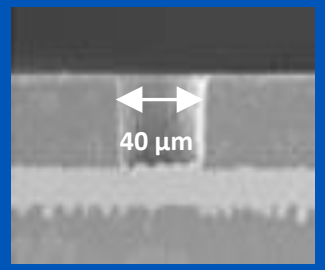
µ-via Drilling with CO_2, ns-DPSS and Excimer Lasers





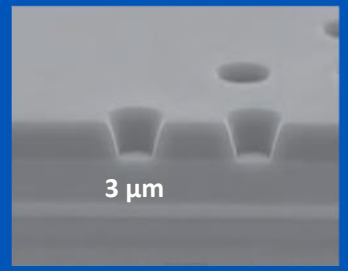
CO_2

Galvo scanner



ns-UV

Galvo Scanner



Excimer

Mask imaging

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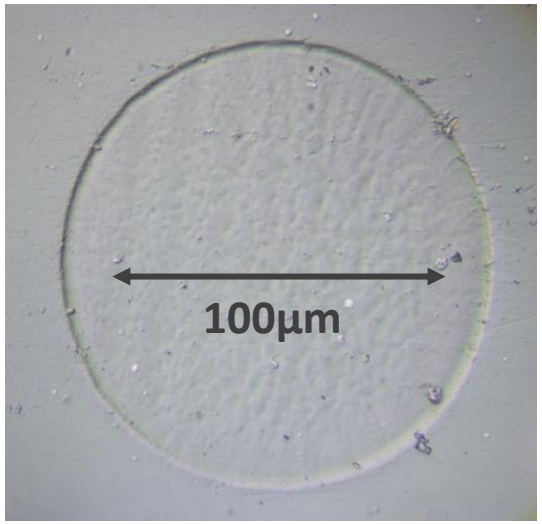
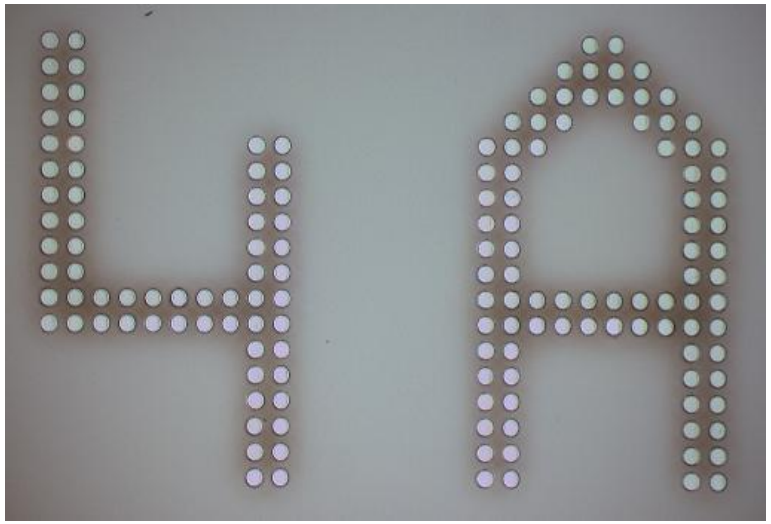
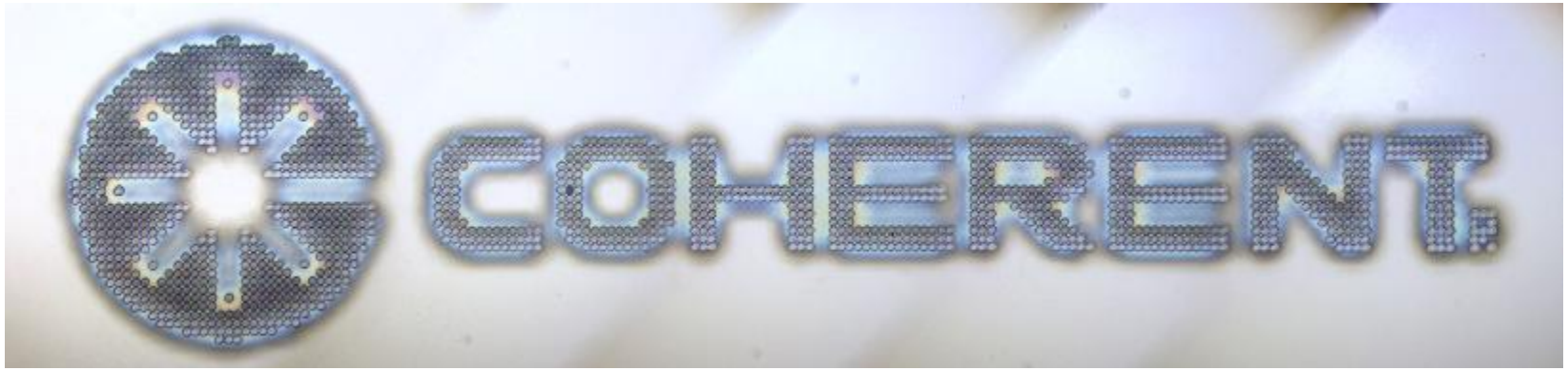
Marking/Engraving Hard and Transparent Materials @ 193nm





- Sapphire
- Quartz Glass
- Diamond



Excimer Lasers: Scalable UV-Power for Mobile Displays

> 1 kW – Stabilized Output Power

> 1 Joule – Pulse Energy

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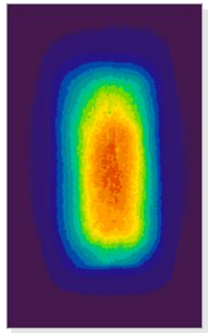
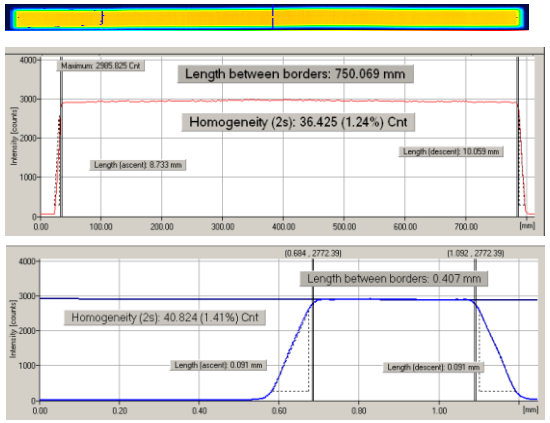
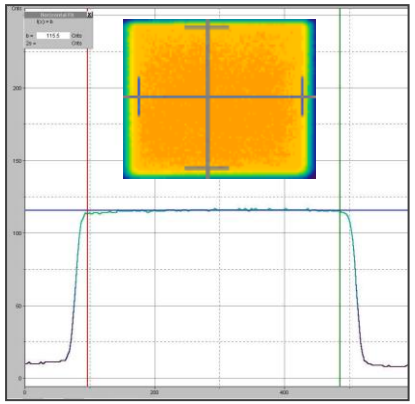
Large Footprint Processing (FLUENCE STABILITY <1%, RMS)

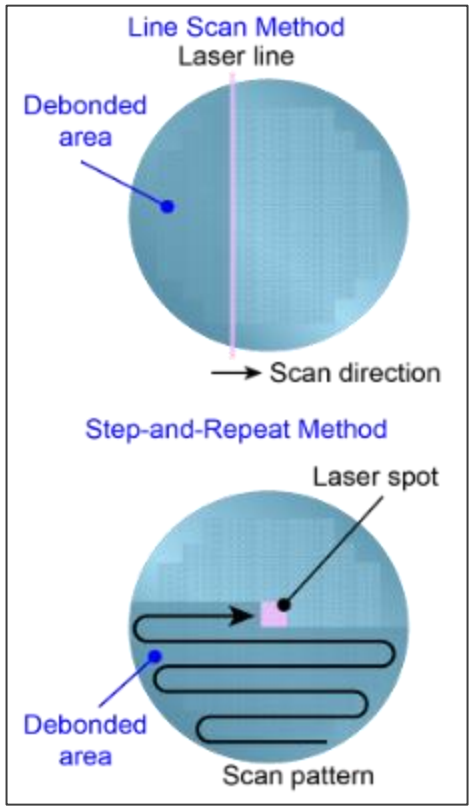


Line

Square







Raw Beam → Conversion to → Line or Square → Efficient processing of your samples

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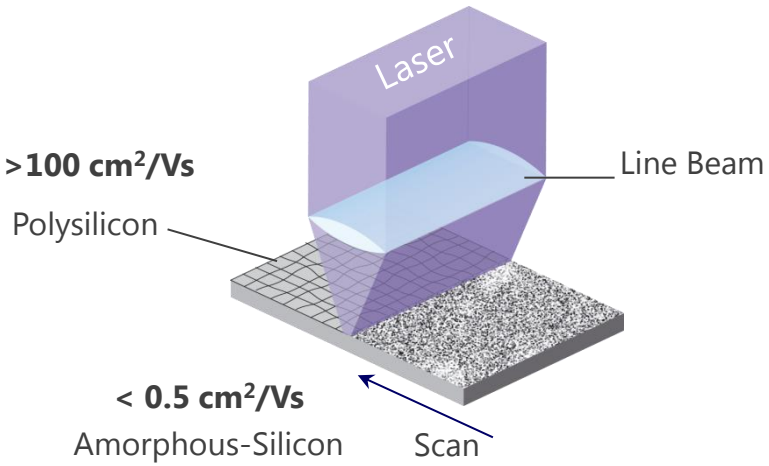
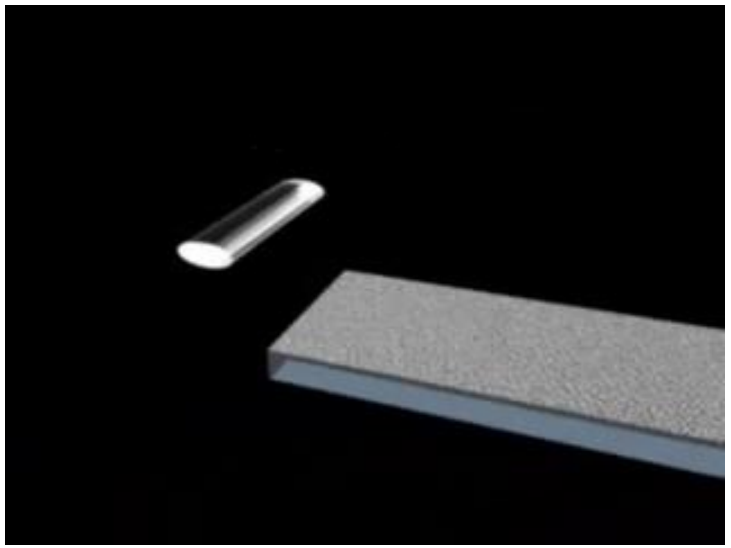
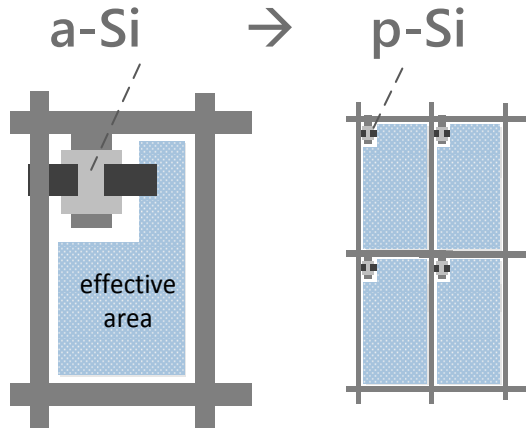
High Mobility Polysilicon Backplanes (LTPS) for 300+ ppi



Excimer Laser Annealing at 308 nm





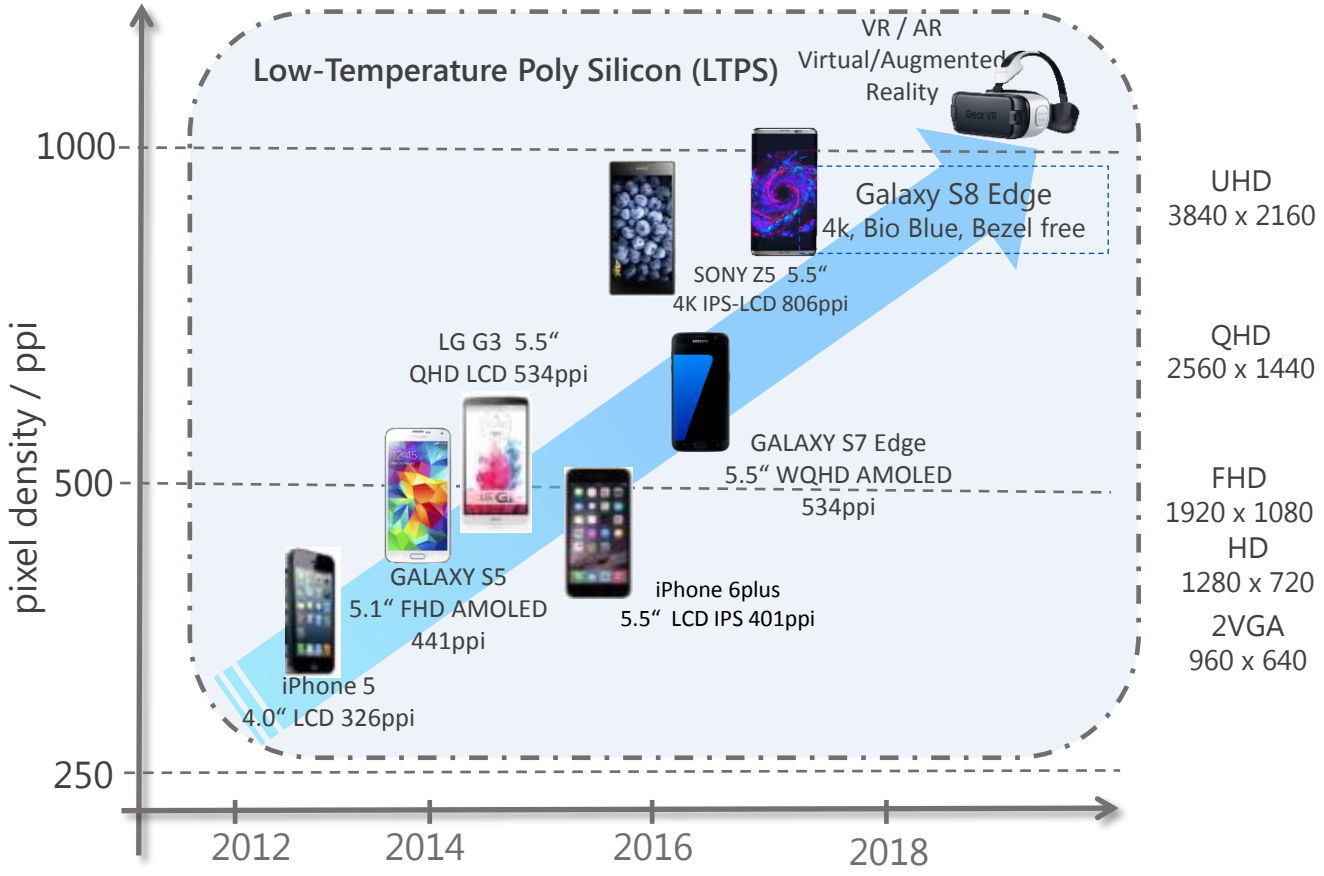
TFT Backplane Feature

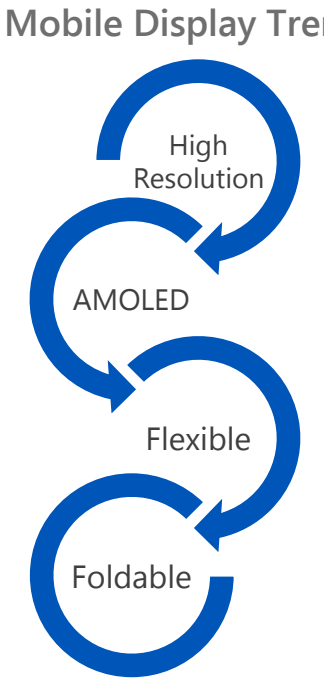
- High Electron Mobility → Small TFT
- High current stability (V_T Stability)
- CMOS - Integration of Driver-Electronic

Mobile Display Benefit

- Highest Resolution
- Less Power Consumption
- TFT Stability for AMOLED/Flexible
- Bezel-Free Design

MOBILE DISPLAY TRENDS – LARGER SIZE / HIGHER PPI / FLEXIBLE





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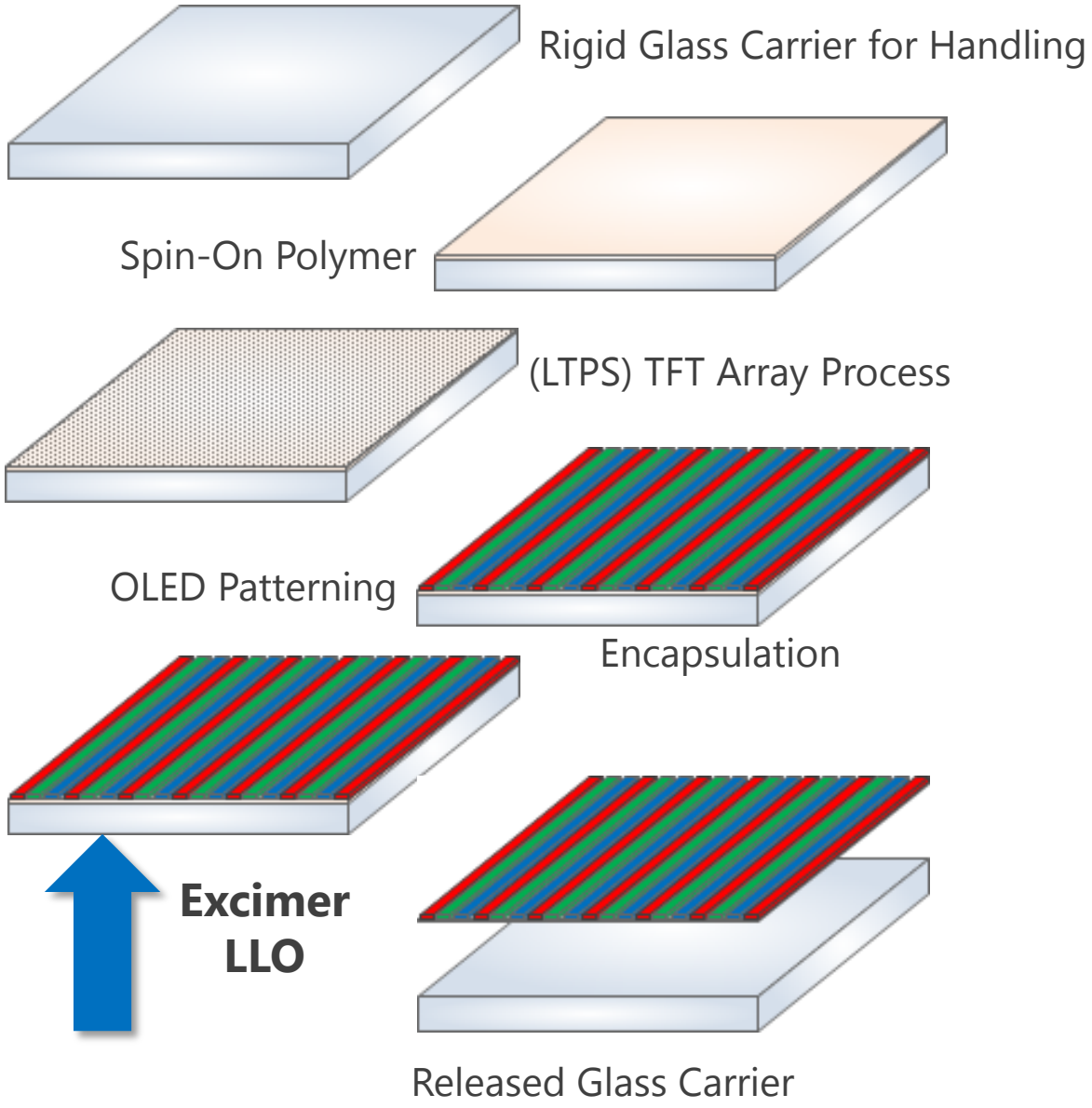
Flexible OLED Displays via Excimer Laser Lift-Off



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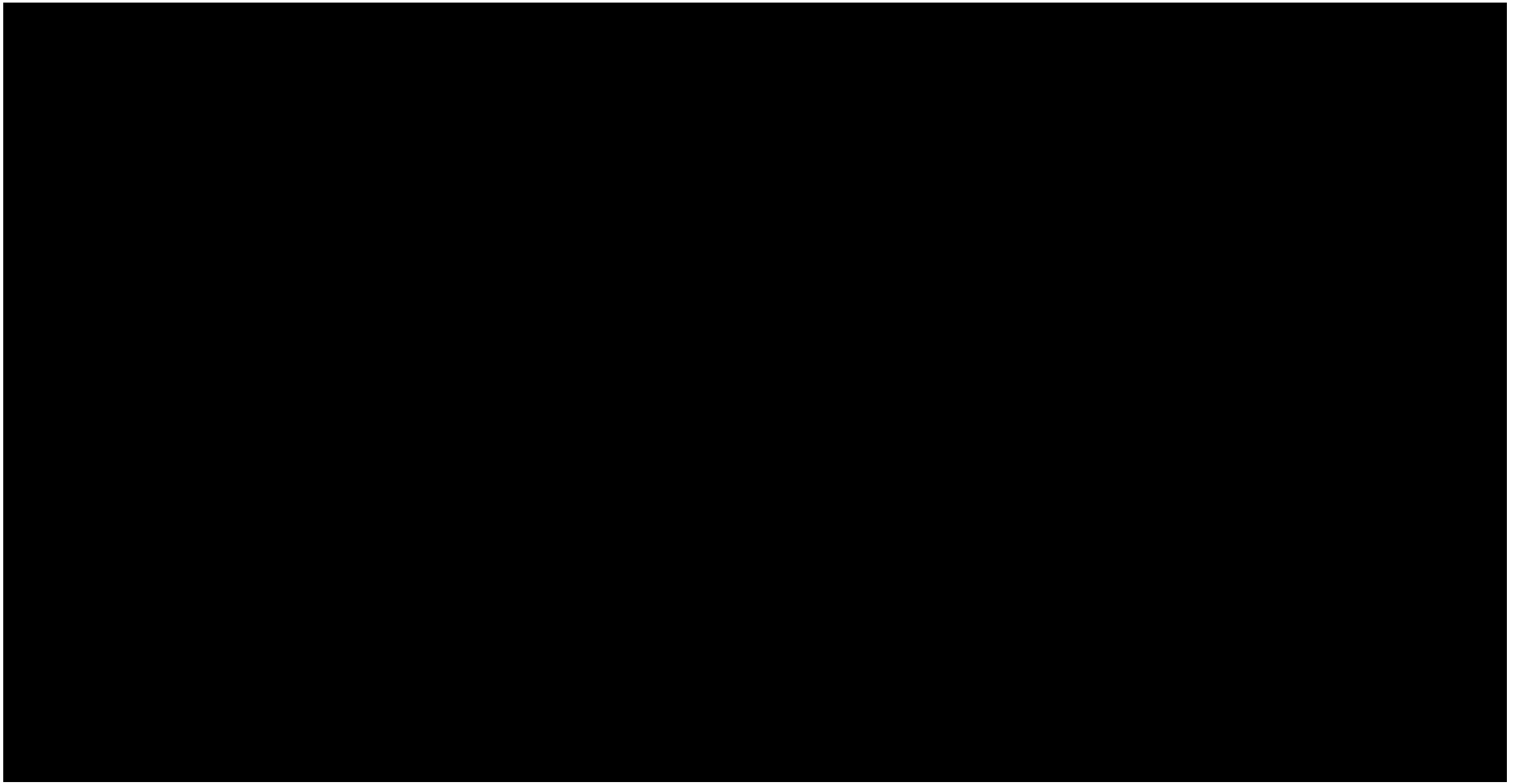
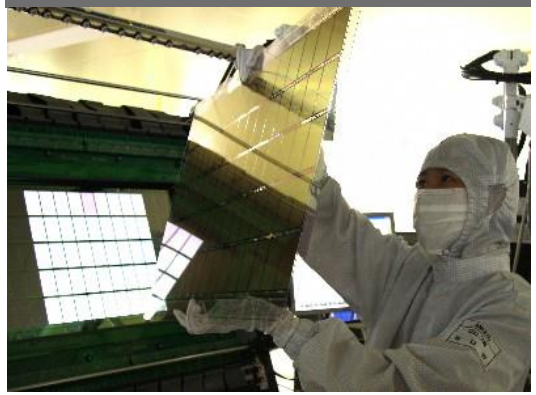


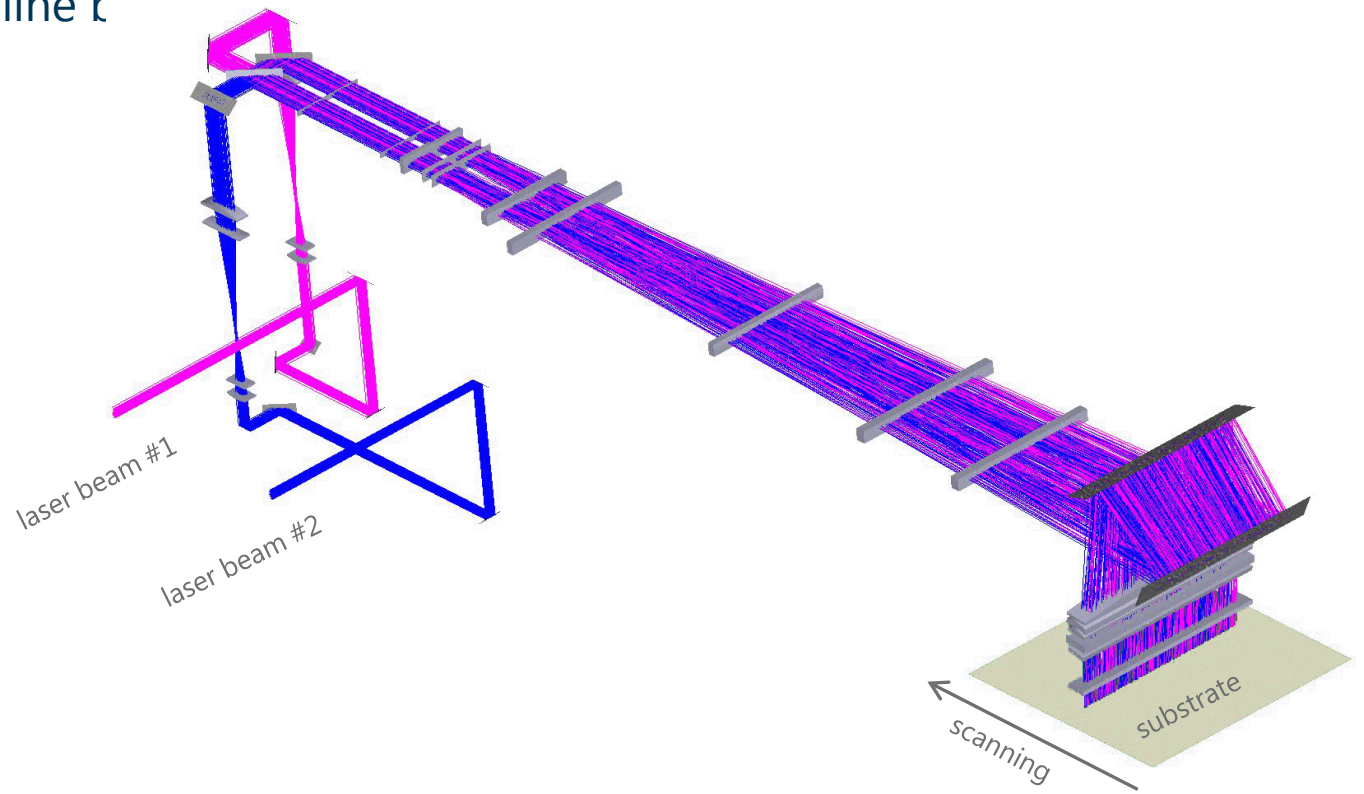
Polysilicon for mobile displays (Many million panels each year)

Gen 4 Glass~0,35 m²



LONG LINES FROM COMBINED BEAMS (LineBeam750)

- Dual oscillator laser with time-synchronized beams
- Integrating and mixing of multiple laser beams
- Homogenizing and shaping into uniform line b



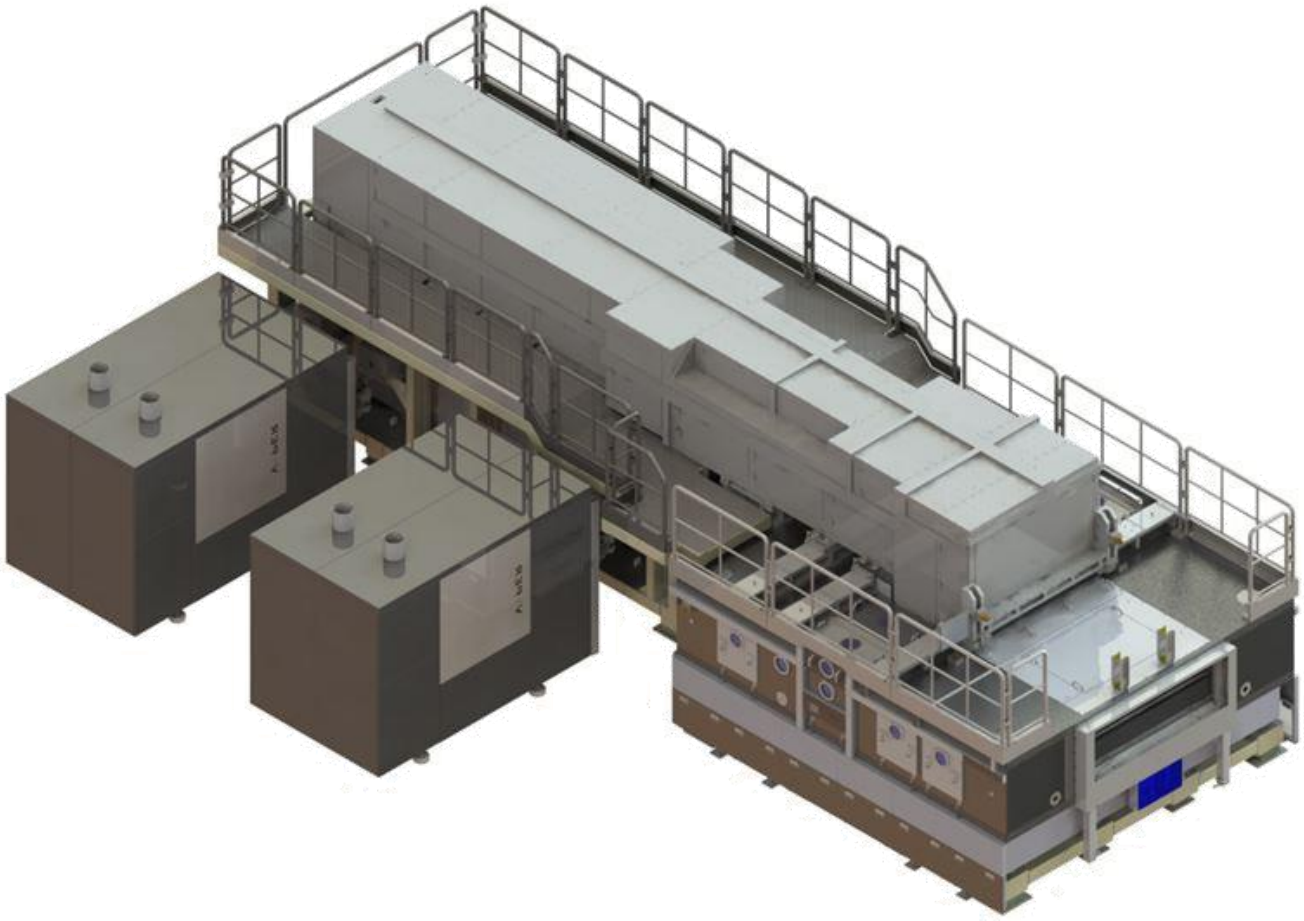
2 x 1,000 mJ/pulse
2 x 600 W

→

750mm x 0,4 mm line
400 mJ/cm²

LB1300 - 4 Beams with 1,300 mm Line Beam Length

15,000 m^2 polysilicon area per month
1,000,000 mobile displays per month



4 x 1 Joule (2,4 kW)

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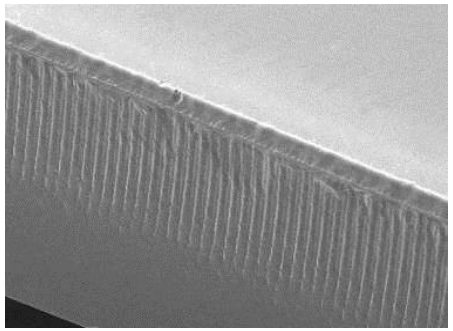
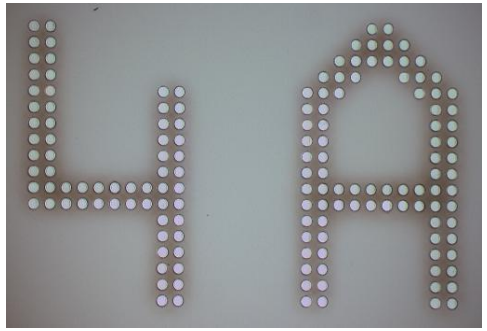
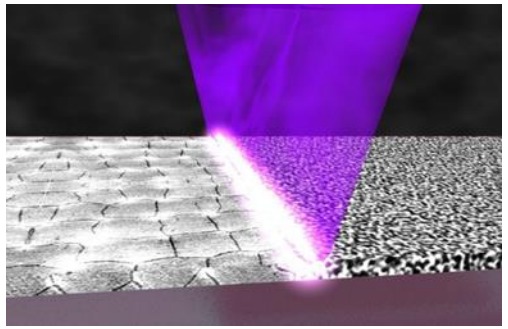
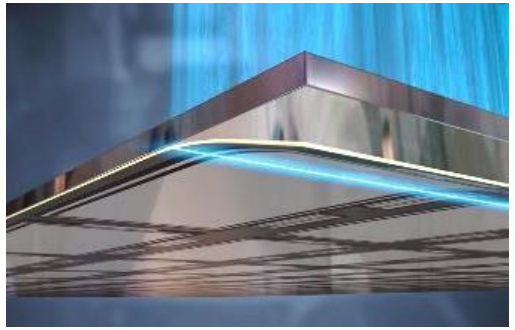
Excimer-Optical System LB1500 (6 x 1 Joule; 3,6 kW)

Summary

The “Mobile Computing Revolution” is being enabled by a multitude of high volume 24/7 laser processes

Continued progress in laser technologies and processing experience will extend the range of applications and create exciting future products.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