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Lasers in Microfabrication – Green Production Saves Cost and Energy

Dr. Lutz Aschke, LIMO Lissotschenko Mikrooptik GmbH, 19.4.2010

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Green Production – Green What?

It's all about efficiency:

> Save energy

> Save resources

> Avoid toxic materials

> Avoid waste

⇒ **Save money!**

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Ways to Green Production

> Use of efficient tools → save energy

> Short product life cycles → avoid tooling costs

> Mass production → high throughput, simultaneous processing

> Use of new processes to replace chemical processes → avoid toxic materials

> Precise materials processing → avoid waste, increase yield

⇒ **Save money!**

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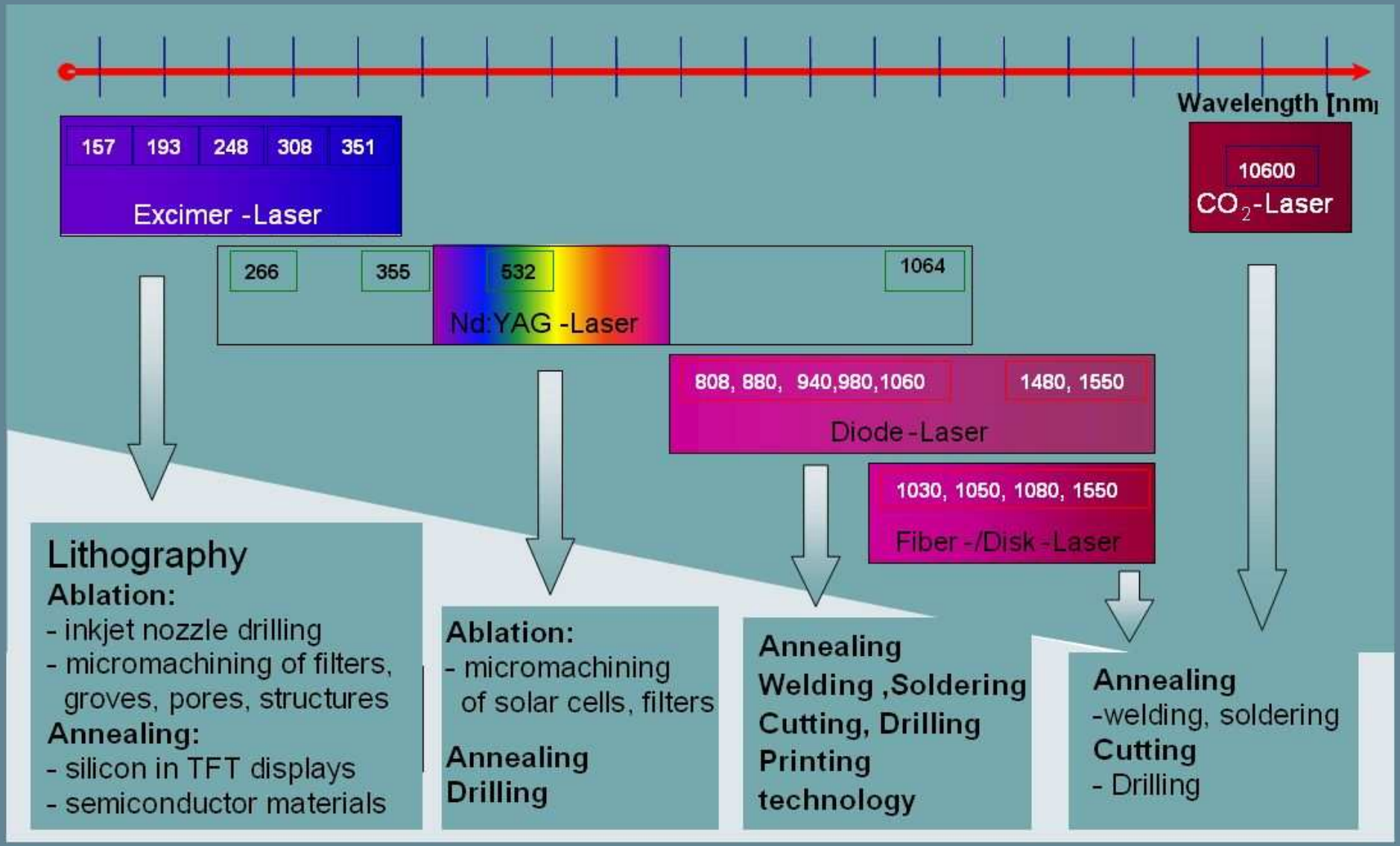
Wide Range of Laser Sources & Applications



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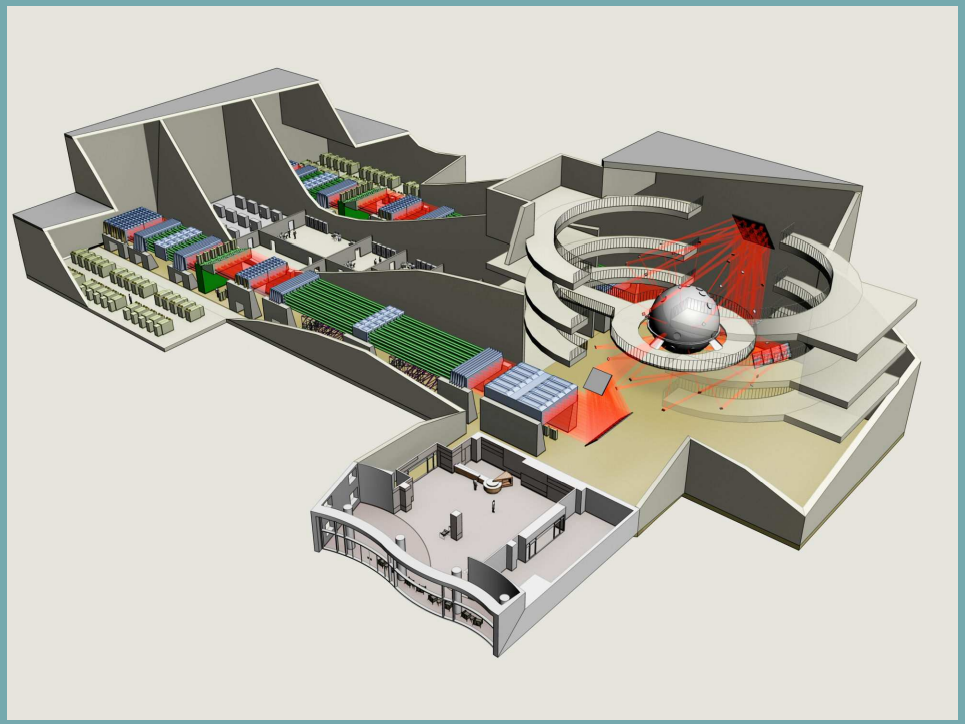
Wide Spectrum of Mass Consumption of Laser Power

Nuclear fusion



Hair removal

Source: Hiper, FH Münster

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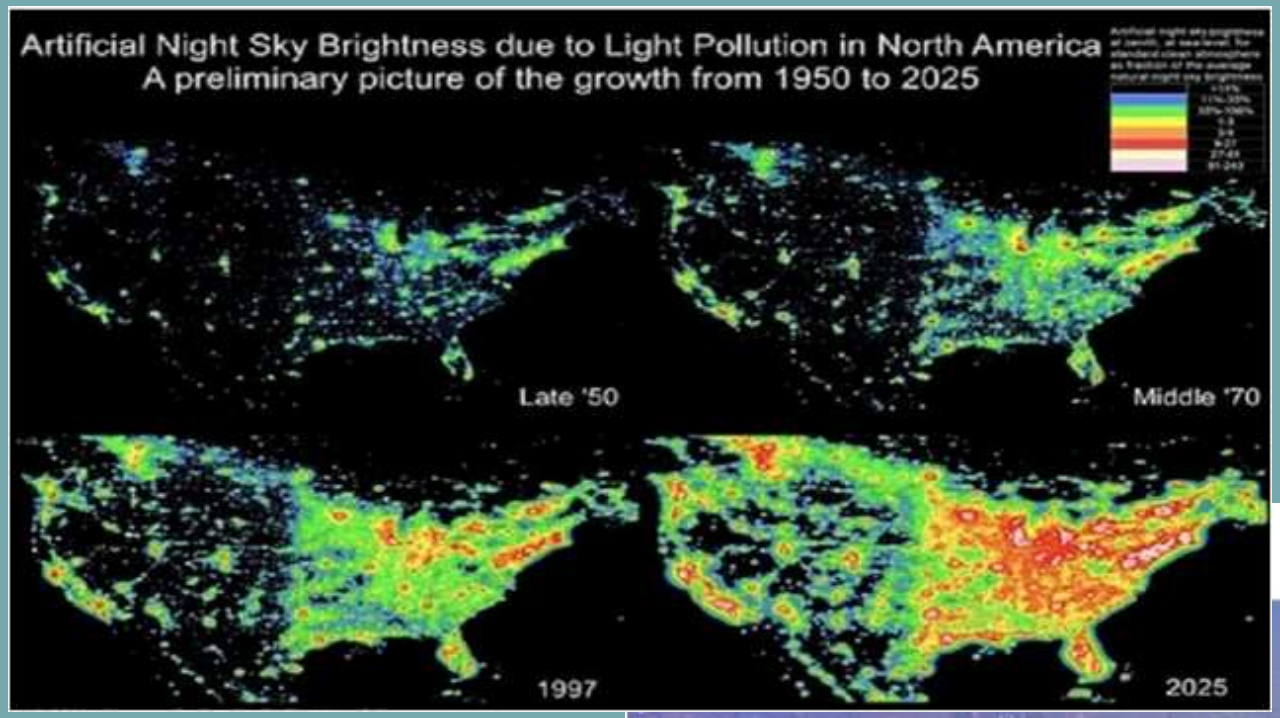
One Source of Learning for Cost Reduction



Source: Jenoptik

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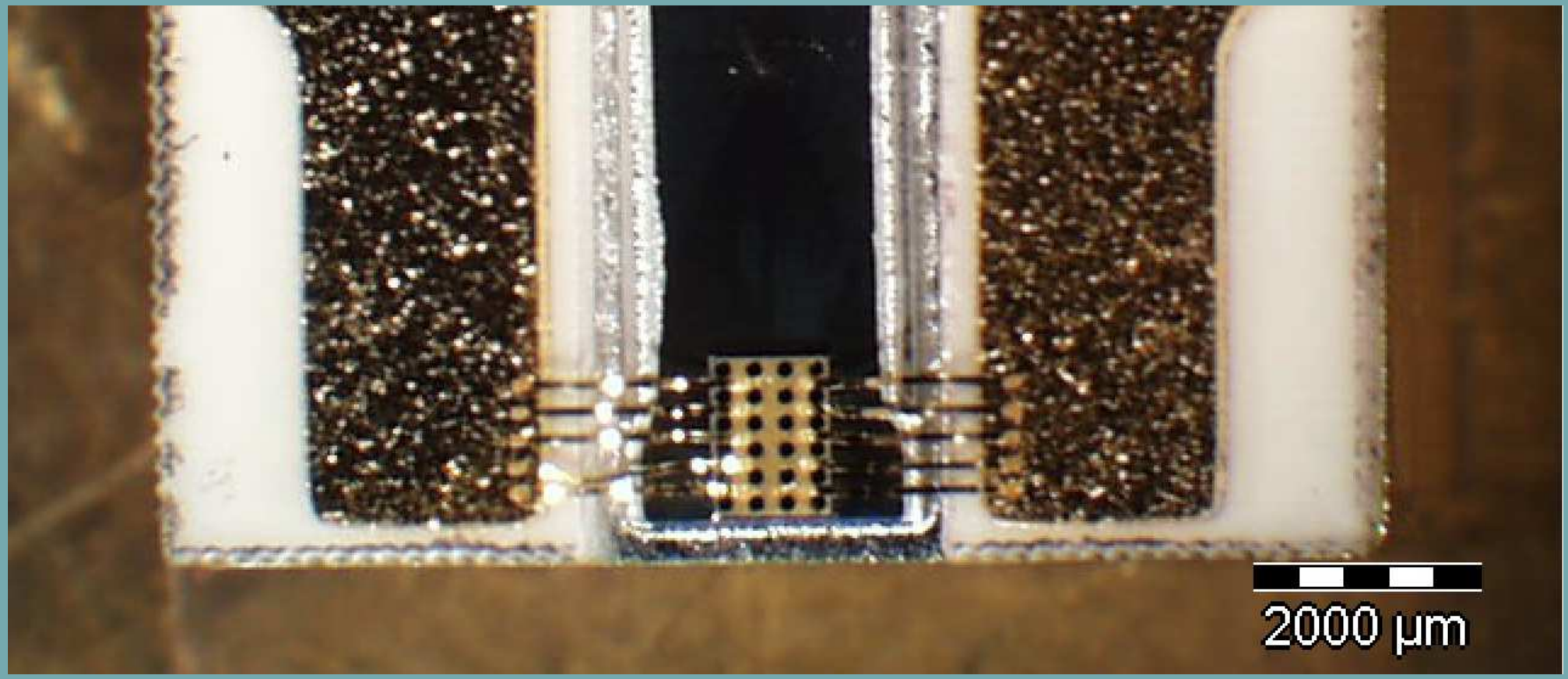
VCSEL – Good Example for Synergies Between SSL & Laser Technology



Source: Jenoptik

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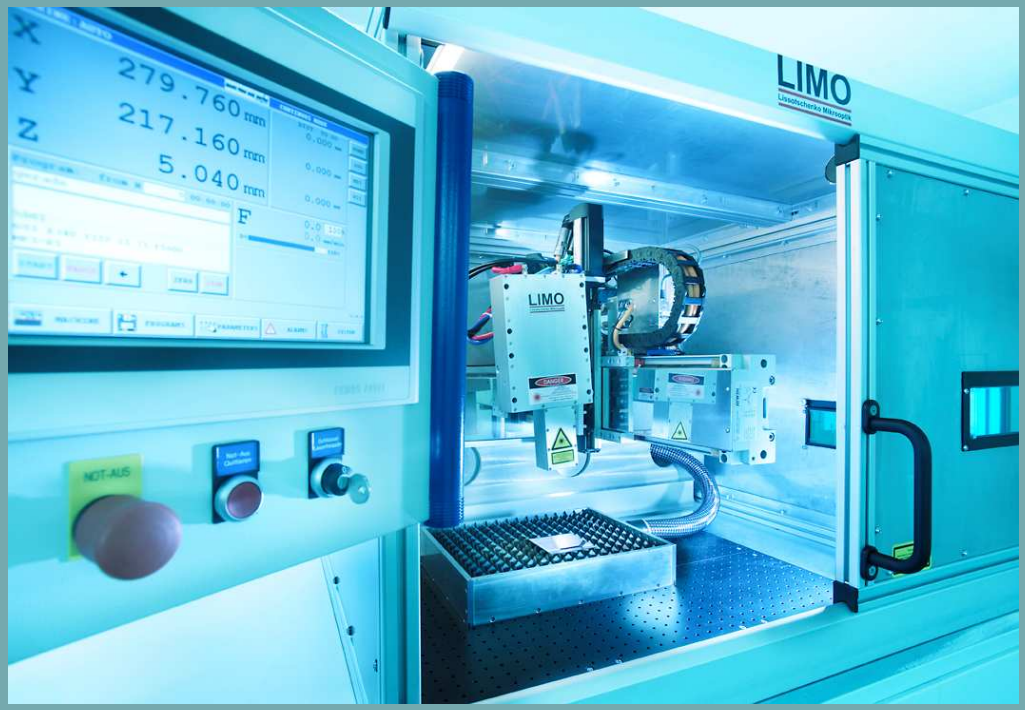
Laser Enables Production without a Need of Expensive Tooling

- Easy change of processing parameters
- No change of tools necessary
- No new systems necessary

→ Save materials and tooling costs



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Higher Throughput with Simultaneous Processing

Example of simultaneous plastics welding with a ring laser
at minimum processing time (speed < 2 s cycle time)

→ Save time and tooling costs

→ Reduced footprint


Courtesy of Siemens VDO

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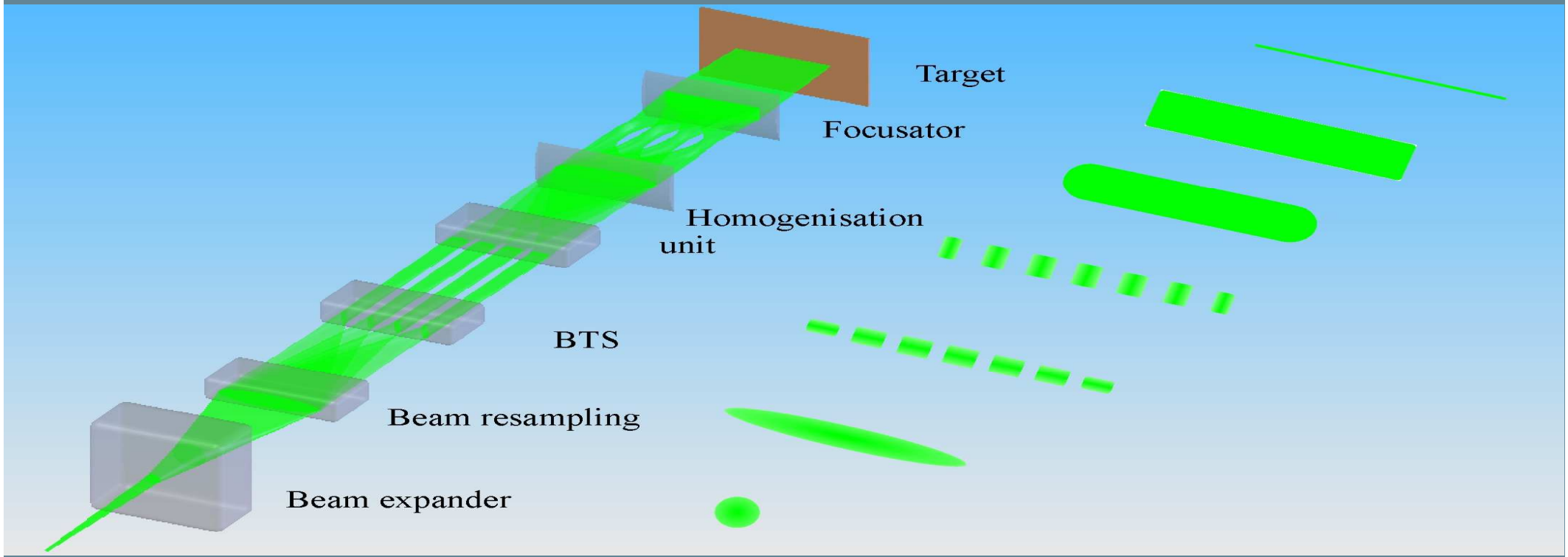
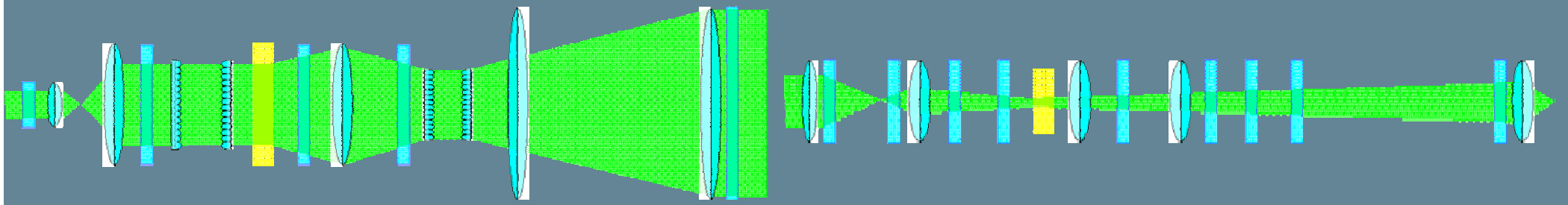
Large-area Processing





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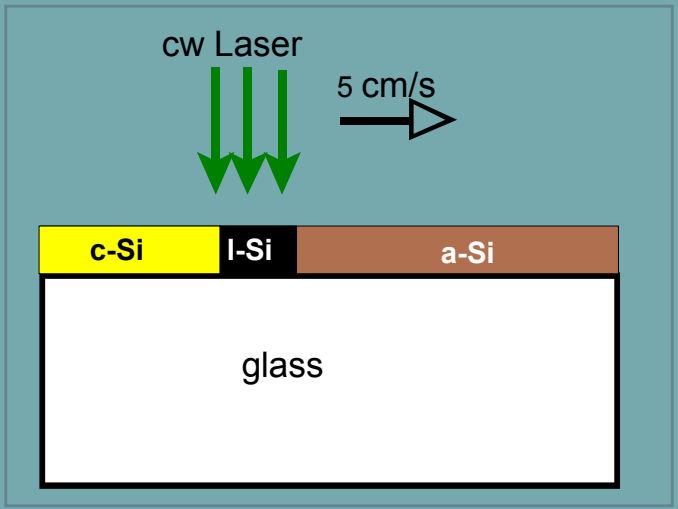
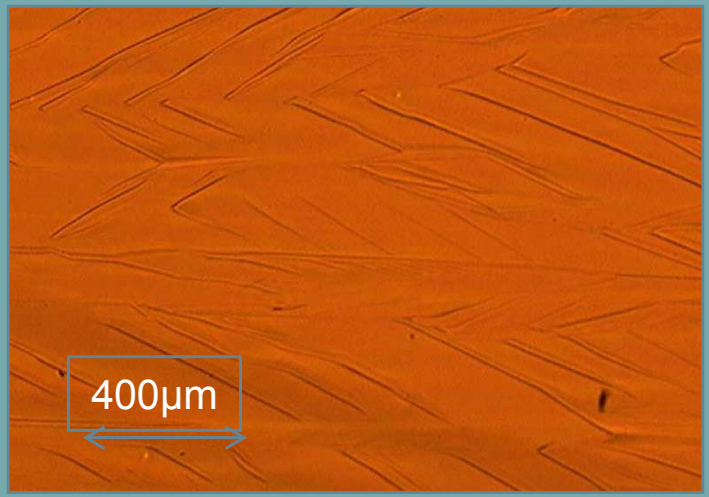
Large-area processing

Example recristallization of amorphous silicon (a-Si) diode lasers

→ Laser processing enables more efficient solar cells





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Laser photons as economic alternatives to other energy sources (e.g. ovens and radiators from IR to UV)

Source: Chicago Flame, Härterei Thoelen

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Reduction of Process Steps Due to Direct Processing

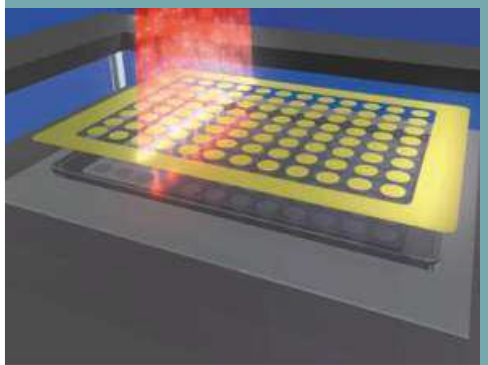
Example of patterning and lithography

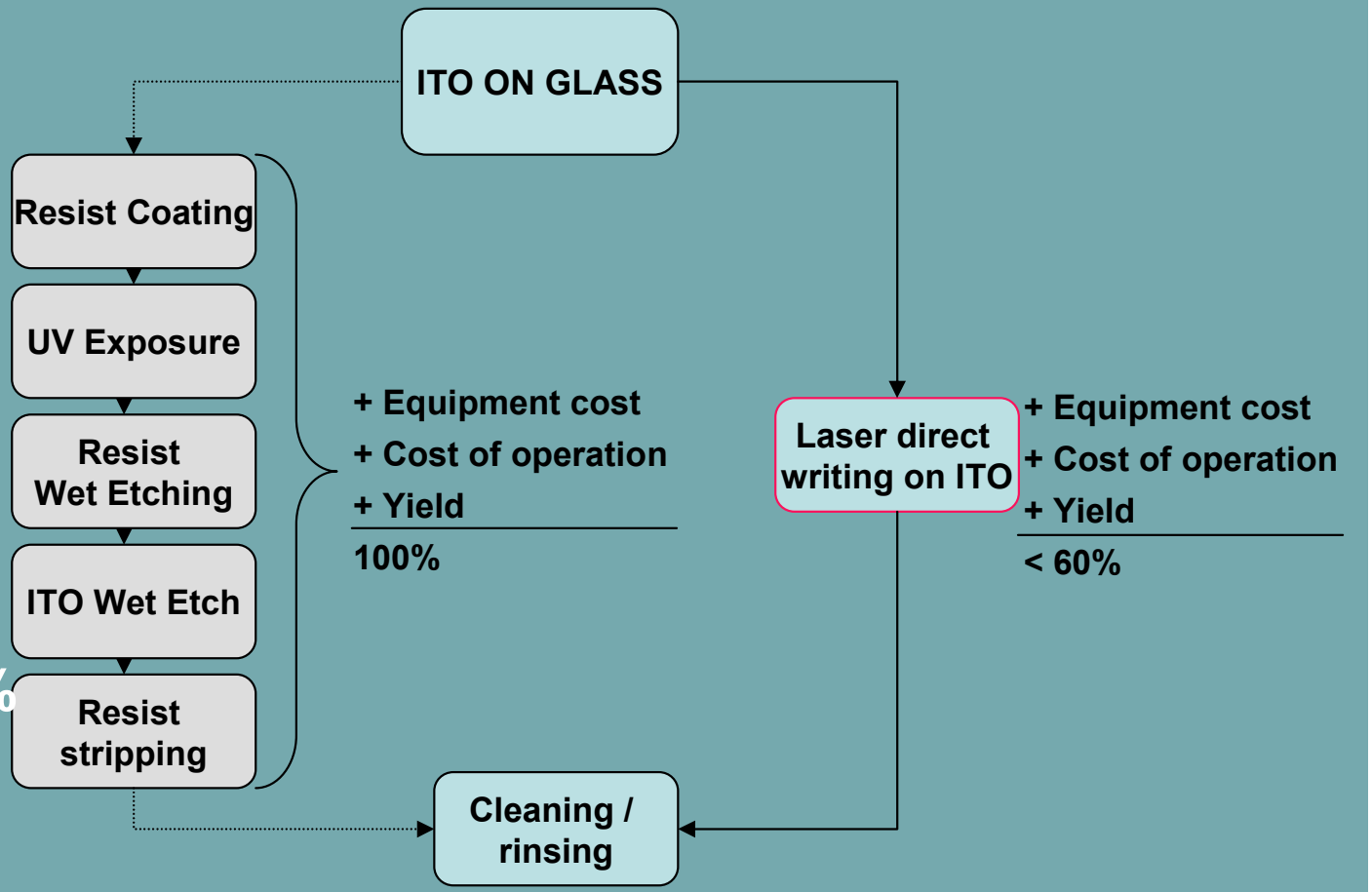
→Reducing of chemical processes

→Reduced costs for equipment

→Reduced costs of operation yield

→→ **cost reduction 40%**





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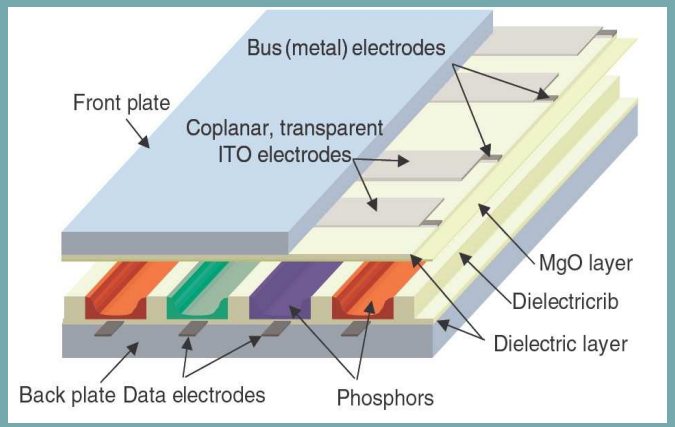
Reduction of Process Steps Due to Direct Processing

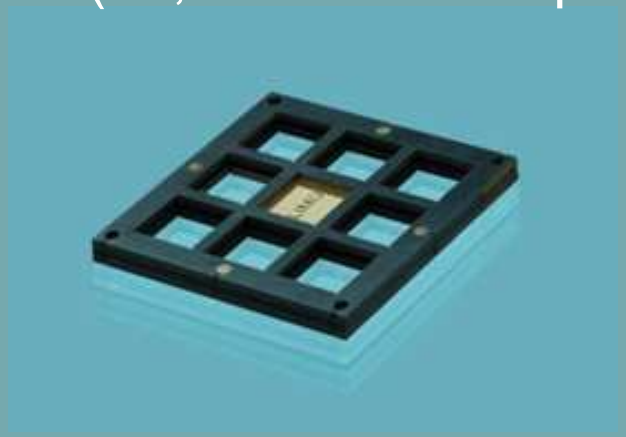
Example of patterning and lithography

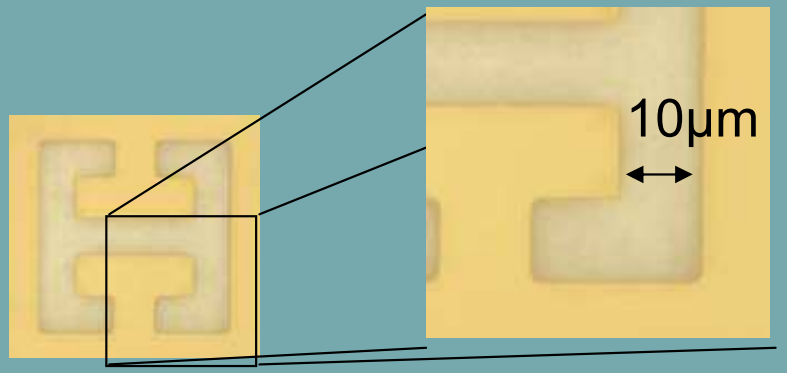
Mask illumination for “single pulse” ablation of thin films with Nd:YAG lasers

→High yield (larger process window)
by homogeneous illumination

→Better performance
(10,000 ablations per second & laser)







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High Miniaturization Potential due to Precise Laser Tools

- Smaller laser tools
  - → Reduced materials costs
  - → More efficiency in compact size
  - → Reduced footprint

- Micro processing (e.g. micro lithography: computer chips; production of mobile phones)
  - → Reduced materials costs
  - → Higher throughput

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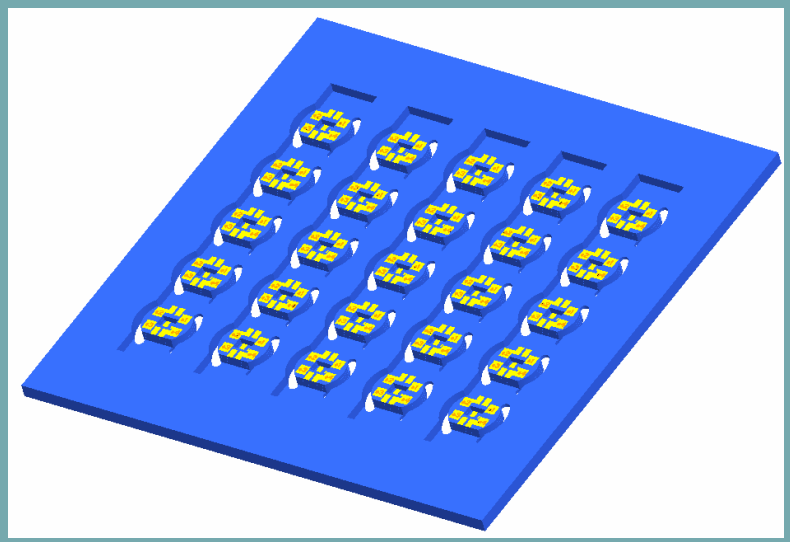
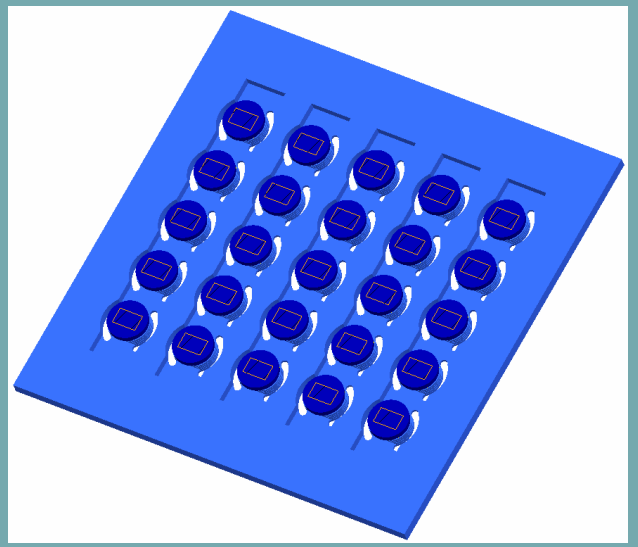
Wafer-Level Assembly

- Massive parallel processing
- Better automation potentiale

→Reduced costs for products with
micro technology (incl. laser products!)



Wafer-level production



Wafer-level assembly

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History

1998
market leadership: refractive micro optics

1999
new product line:
diode laser
systems

2004
- extension of laser and optics product lines: beam shaping systems, turn-key diode laser systems
- Applications Center

2008
German Innovation Award 2007 for LIMO's laser beam shaping systems with free-form micro lenses

Innovationspreis ®
der deutschen Wirtschaft
The World's First Innovation Award

1995
production launch at "Technologiezentrum Dortmund"

2007
first laser process development system

1992
founded near Paderborn

2001
facility expansion
at Dortmund Wickede

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Resources

200 employees - more than 300 patents - R&D rate 15 %

strong vertical integration

60 scientists & development engineers

approx. 2000 m² clean rooms

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self-developed, partly automated quality control

800 m² in-house metal machine shops

in-house development & production

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Thank you for your attention!

Our Mission

“We make business partners in laser materials processing,
in medical technologies and in photonics more successful using cutting edge technology.”

MAKELIGHT**WORK**