



Specialized Manufacturing and Quality Control

- Toptica's Dedicated Laser Offering -

EPIC Online Technology Meeting on Laser-based Semiconductor Processing 9th of June 2020

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Toptica serves the world with a broad laser technology portfolio provided as highly customized small series or in volume production

Overview Toptica Group



TOPTICA
Photonics AG
Germany

TOPTICA
Photonics Inc.
USA

TOPTICA
Photonics K.K.
Japan

TOPTICA
Photonics
China

Key Figures (02/2020)

Employees	320
Revenues	74 Mio € (82 Mio \$)
Founded	1998

Technology

Diode Laser Systems
190 – 4000 nm

Ultrafast ps/fs Fiber Lasers
390 – 15000 nm

Terahertz Generation
0.1 – 6 THz

High Power Laser Diodes
630 – 1120 nm
(Toptica eagleyard)

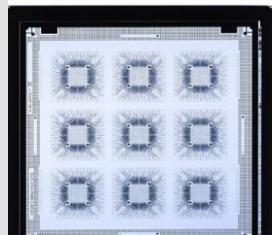
Toptica provides lasers for both, manufacturing and quality control

Overview of addressed applications in the semicon manufacturing process

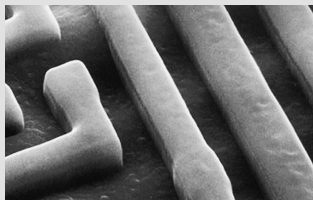
Manufacturing



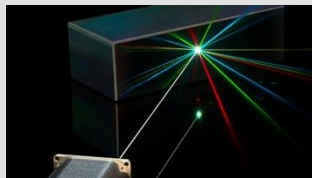
Micromachining



Mask writing

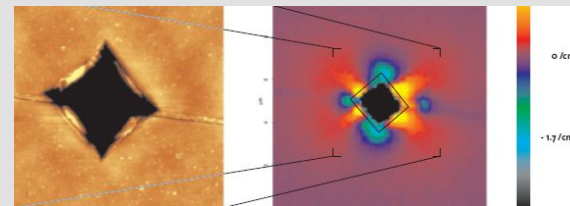


Microstructure creation



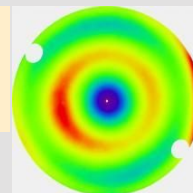
Writing holographic gratings for AR/VR

Quality Control

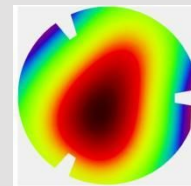


Raman spectrum of mechanical stress in silicon surface

Lens wave front



Wafer wave front



Interferometric Imaging of surfaces

Toptica provides Ultrafast Pulsed as well as Frequency Stabilized CW laser for Semicon Applications

Being close to the beginning of the value chain for multi-Watt applications, Toptica provides femtosecond and picosecond seed laser

Introduction to PicoFYb and FemoFYb



FemtoFYb and PicoFYb Seed Laser

- **Ideal seed source** for regenerative Amplifiers or amplifier chains (e.g. fiber amplifiers) in (sub) picosecond range - **Thousands in the field**
- Fiber-pigtailed output for easy integration
- Micro-mover feature for **highest life-time**
- All-in-one box design, **very low power consumption**
- Hard wire - control interface for safest operation conditions (e.g. preventing damages to amplifier chains if not seeded)
- Chirped output supports CPA setups and shortest pulses (bandwidth preservation)

Key Specifications

FemtoFYb 1030	- 400	- 600	-800
Wavelength	1030.5 ± 1.5 nm		... ± 0.5 nm
Pulse duration	< 400 fs	< 600 fs	< 800 fs
Average power	> 0.5 mW	> 3 mW	> 0.5 mW
Output	FC/APC fiber pigtail, > 40 cm long		
Repetition rate	30 MHz	20 MHz	20 MHz
Spectral width	typ. 4.5 nm	> 3 nm	< 3 nm
Polarisation	PER > 20 dB		

PicoFYb	1030	1064	1064 HP	1064-9000
Wavelength [nm]	1030.5±0.5	1064.3±0.5		
Pulse duration	< 10 ps	< 10 ps	typ. 6 ps	typ. 9 ps
Average power	> 10 mW	> 10 mW	> 50 mW	> 30 mW
Output	FC/APC fiber pigtail, > 40 cm long			
Repetition rate [MHz]	30	20, 30	20	30
Spectral width	< 0.5 nm			
Polarisation	PER > 20 dB			

For advanced micro machining in the microjoule regime or specialized seeding, Toptica presents a pulse laser with tunable repetition rate: the FemtoFiber vario

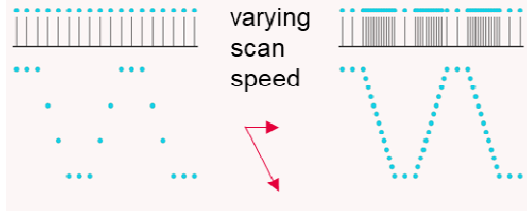
FemtoFiber vario - Summary

Overview and Applications

„real“ Pulse on Demand

- Variable pulse steps, quasi-continuously adjustable for advanced optical laser scanning, smallest increment 12.5 ns
- Integrated power control to ensure constant pulse energy

Typical:
without
advanced
pulse
control



FF vario:
with
advanced
pulse
control

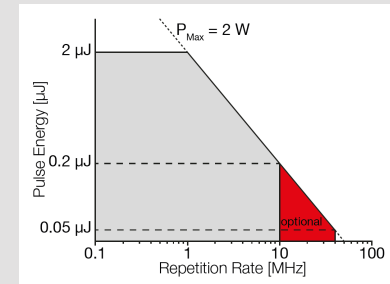
Target applications:

- Micro ablation, marking, structuring
- Microscopy, photo polymerization
- Volume modification of transparent materials
- Medical (surgery, etc.)

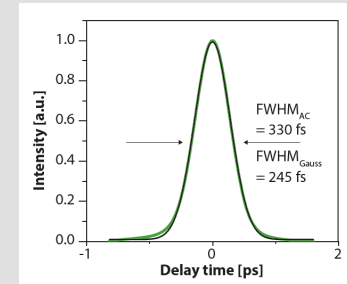
Key Specs of FemtoFiber vario 1030

Key Specifications:

- Air-cooled μJ -level fiber laser
- Industrial-grade system design
- Excellent beam properties
- Short warm-up times < 30 min cold start, < 1 min standby
- Up to 40/80 MHz repetition rate (full oscillator rep. rate)



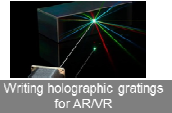
**Accessible pulse energy
as function of repetition rate**



**Autocorrelation at
2 μJ / 1 MHz**

An ideal replacement for Kr-ion lasers is Topptica's Holo-Litho - one example next to Semicon is writing holographic gratings for AR/VR

DLC Holo-Litho 405 - Summary



DLC Holo Litho 405

- < 0.08 kW and no water cooling
- Developed for low cost of ownership
- Fully-automated, push-button optimization of the opto-mechanics, as well as output power stabilization
- Easy, hands-off and remote operation



Key Specification	Value
Center Wavelength	405 nm
Power	1000 mW
Linewidth @ 5 us	< 1 MHz
Beam Diameter	1.3 +/- 0.3 mm
M ²	< 1.3 (1.15 typ.)
RIN	< 0.5% RMS
Lifetime (typ.)	> 5000 hrs

Additional Specification	Value
Water Cooling	Not required
Power Consumption	< 100 W
Warranty on Consumables	3000 hrs / 1 yr
Installation	Yes

As one example for quality control, interferometric applications need frequency stability while being cost-effective and of OEM quality

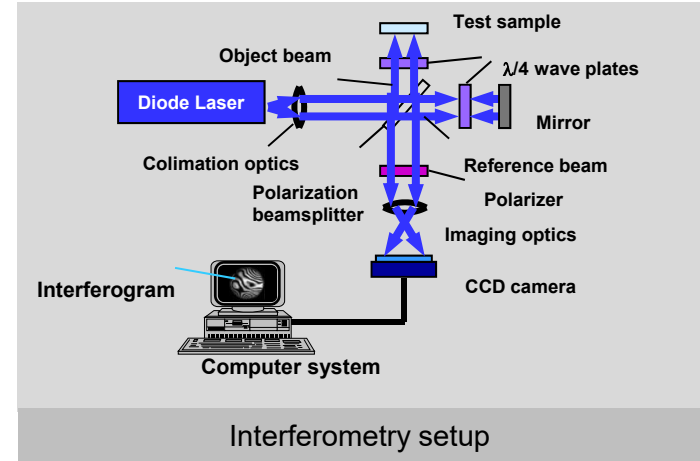
Example for quality control: Vibrometry / Interferometry and Positioning

General Application

- Analysis of surface topography with highest precision
- Stepper positioning for larger setups

Suitable lasers

- **iBeam smart WS** (e.g. 633 nm, HeNe replacement)
- **TopMode** for 405 nm
- **DFB pro** (e.g. 633 nm) for ultra high coherence (> 50 m)



TOPTICA solution



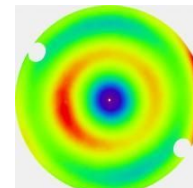
TopMode



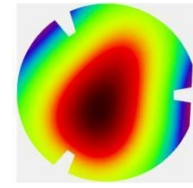
iBeam smart WS



DFB pro 633 nm



Lens wave front



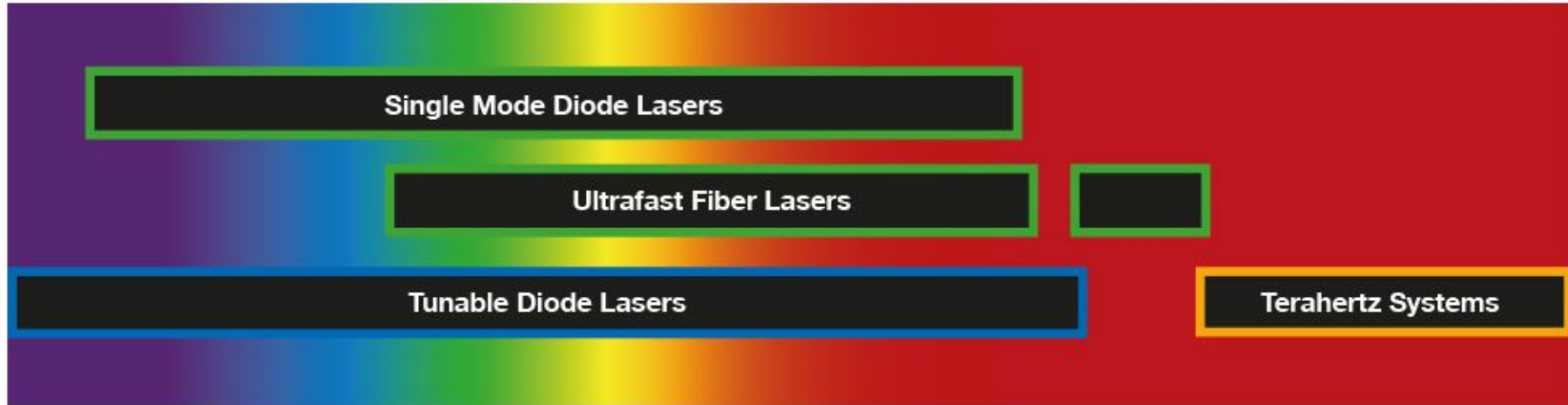
Wafer wave front

In summary, with serving „All Wavelengths“ and numerous power levels, TOPTICA is looking forward to discussing specific customer needs.



All Wavelengths.

190 nm - 0.1 THz



190 nm
1600 THz

0.1 THz
3 mm



Just Push the Button

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THANK YOU!