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VII. ITG-Workshop Photonische Aufbau- und Verbindungstechnik

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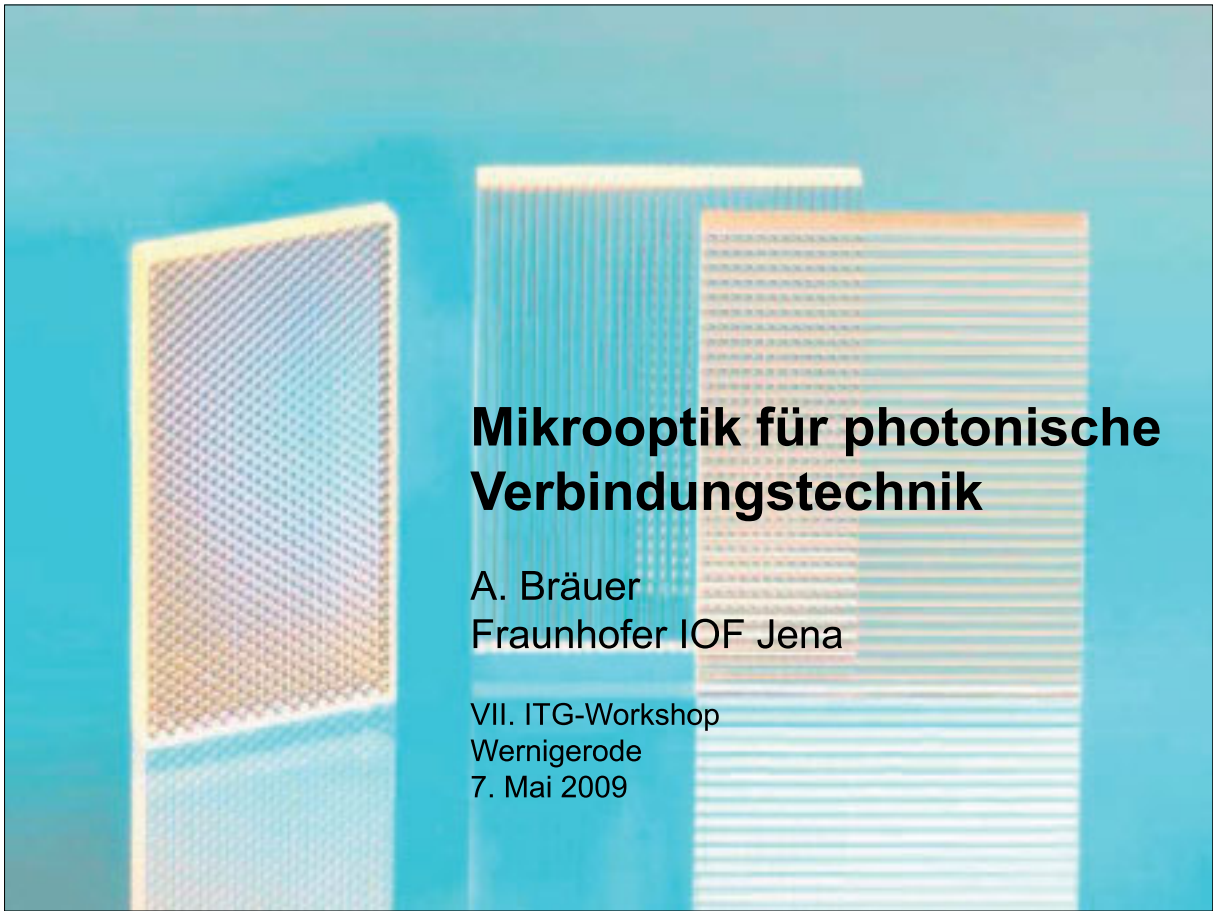


Mikrooptik für photonische Verbindungstechnik

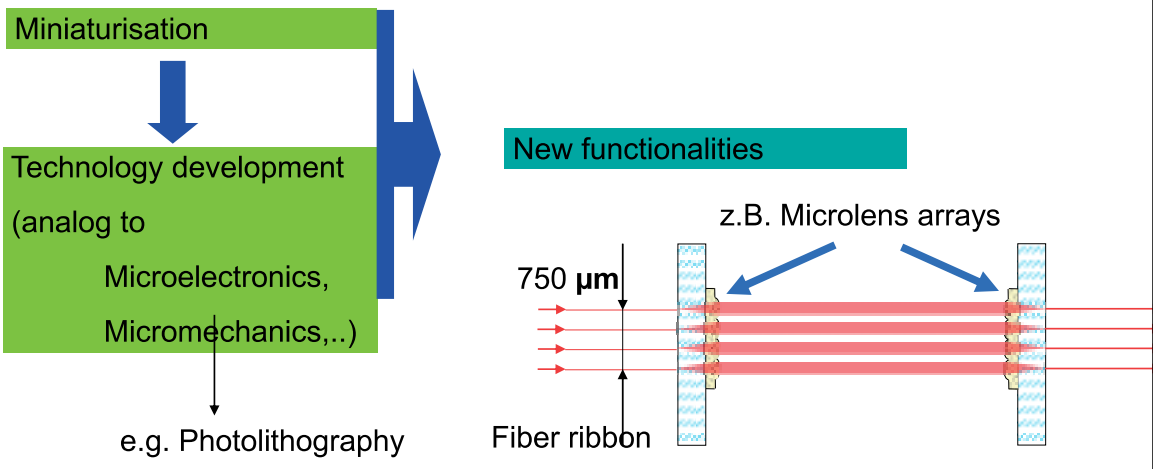
A. Bräuer
Fraunhofer IOF Jena

VII. ITG-Workshop
Wernigerode
7. Mai 2009

Tailored Light - Licht nach Maß

Definition of Microoptics ?

- „...efficient exploitation of light opening up new applications for optics ...“ (Fa. Heptagon)
- „enabling technology using microelectronical equipment“
- NOT ONLY ‚miniaturised, low-cost optics‘, BUT:



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Tailored Light - Licht nach Maß

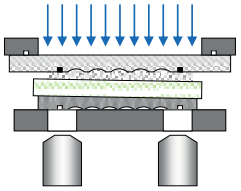
“Mikrooptik für photonische Verbindungstechnik”

Wesentliche Rahmenbedingungen sind (Zitat Klaus Schulz):

- Kosten
- Baugröße
- Energie
- Packungsdichte
- Funktionsdichte

Wie können mikrooptische Bauelemente dem am besten Rechnung tragen ?

- Wafer-level Optik-Technologie



- UV-Replikationstechnologie zur Herstellung
- Gleichzeitige Herstellung von Mikrooptik und Koppelstelle

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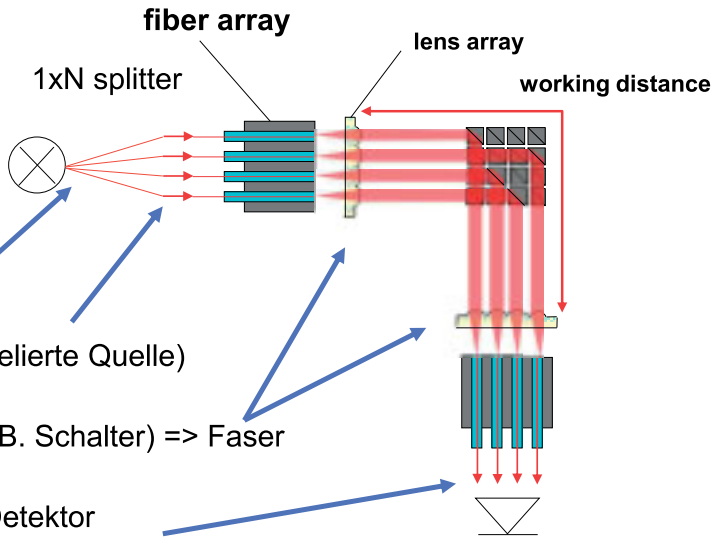
Tailored Light - Licht nach Maß

Mikrooptik für photonische Verbindungstechnik

Wesentliche Koppelstellen



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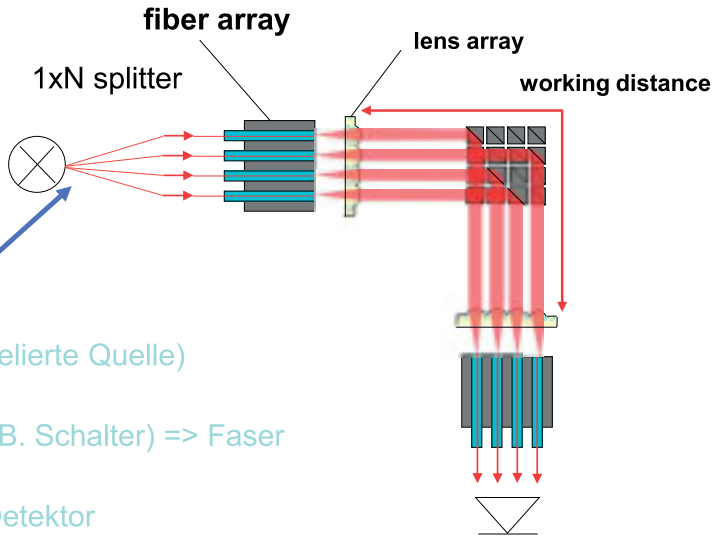
Mikrooptik für photonische Verbindungstechnik

Wesentliche Koppelstellen



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Tailored Light - Licht nach Maß

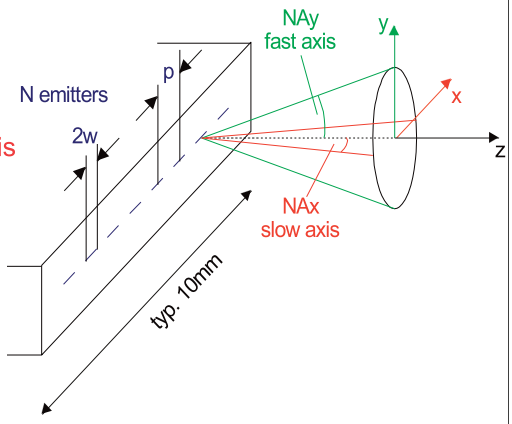
Etch-emitting Laser => Fiber coupling

Requirements for Laserdiode to-fiber-coupling:

Beam parameter product $w_0 \cdot NA = M^2 \lambda/\pi$

Single emitter (typ.): $M_y^2 < 1.5$ fast axis
$M_x^2 \approx 15...50$ slow axis

Fiber 100/200µm 0.22NA $M_x^2 \approx 43 / 86$



Efficient coupling for $M_{laser} < M_{fiber}$

>> Main problem: Slow axis beam quality
>> Solution: Optical rearrangement of emitters – several principles

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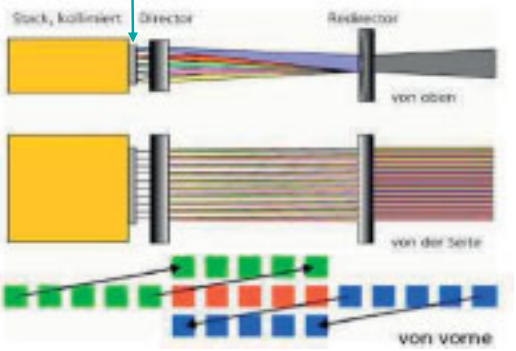
Tailored Light - Licht nach Maß

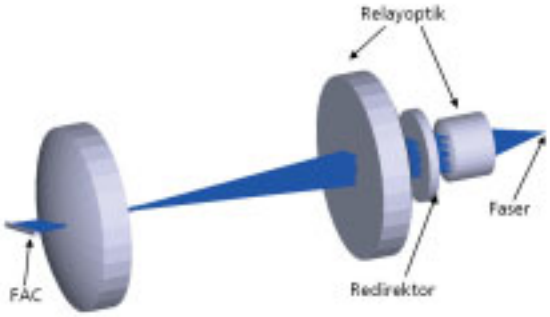
Laser => Fiber coupling: Skew ray imaging coupler

Principle

FAC ‚inclined' (‚fast axis collimation')



Design



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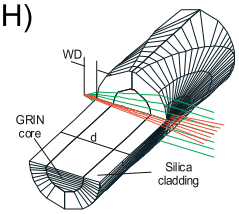
Tailored Light - Licht nach Maß

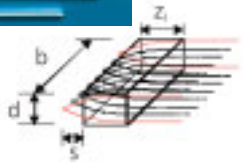
Laser => Fiber coupling - Micro-optical components

1. Fast axis collimation: High-NA cylindrical lens **with large field: GRIN lenses** (DORIC, GRINTECH)

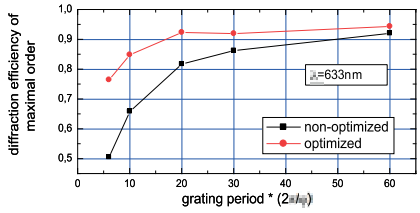
DORIC

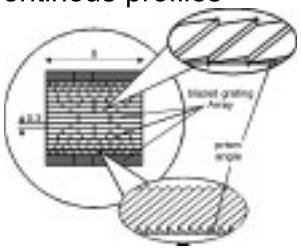


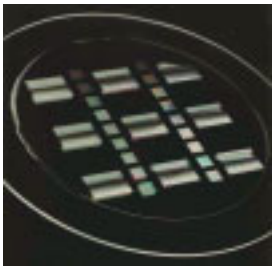
GRINTECH



2. Redirector: Blazed grating array
   - Replication of direct laser-written continous profiles







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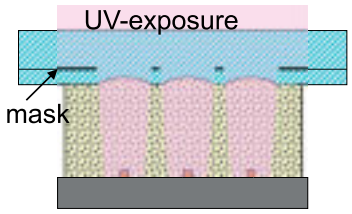
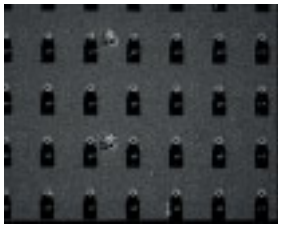
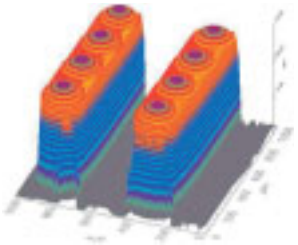
Tailored Light - Licht nach Maß

VCSEL-collimation optics on wafer scale

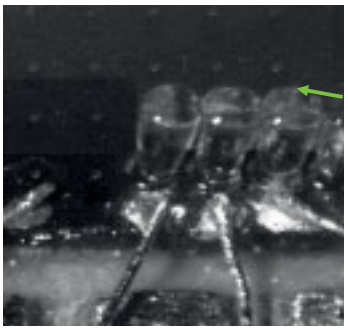




VCSEL array, x-pitch = 250µm



surface profile
Ø250µm lenses
polymer pedestals



row of
microlenses
pitch 250µm

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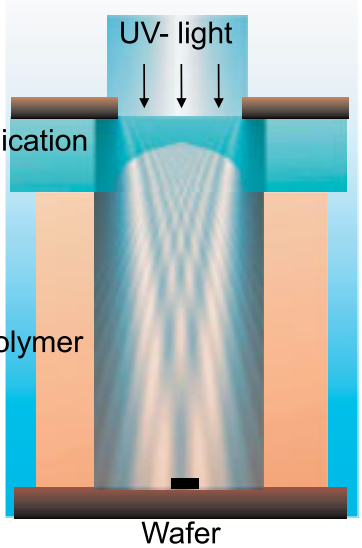
Tailored Light - Licht nach Maß

VCSEL-collimation on wafer scale

Combination of replication und selective photopolymerisation



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Tailored Light - Licht nach Maß

VCSEL-collimation on wafer scale

Selective UV- Replication !

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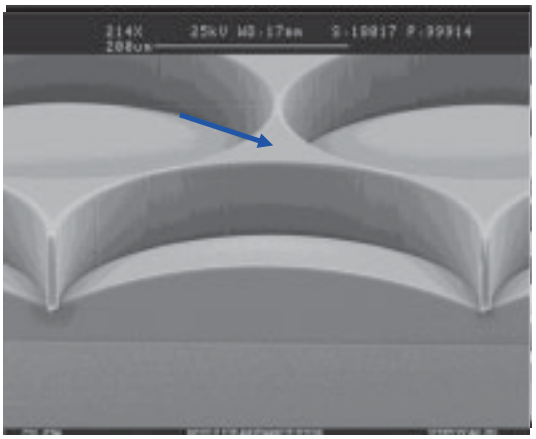
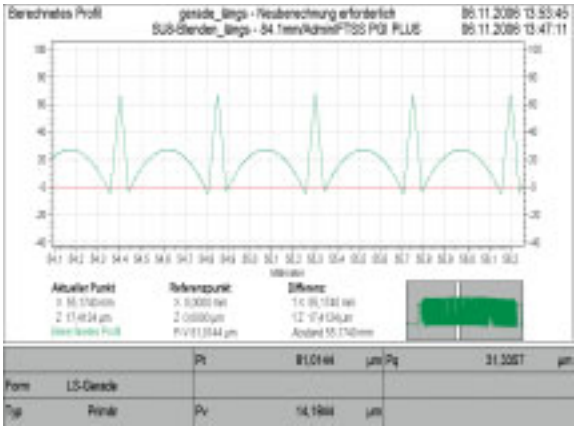
Tailored Light - Licht nach Maß

Collimation optics and holding structure (wafer scale)





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