

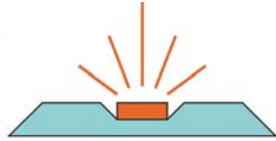
3mm side and end light fiber LED modules

Hans Kragl

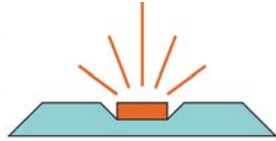
DieMount GmbH
Giesserweg 3
38855 Wernigerode

www.diemount.com

FGT 5.4.1 Meeting, Wernigerode, April 16th, 2009



- **Introduction**
- **R&D project “MOPF”**
- **Requirements: LED light sources for fiber illumination**
- **Design LED light sources:**
 - **optimum coupling efficiency**
 - **heat dissipation**
 - **mass volume design**
- **Realized modules**
- **Prototypes side light fiber systems**

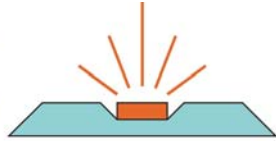


Fiber optic illumination is an established technique in many fields, e.g.:

- microscopy illumination, machine vision, medical endoscopes (endlight fiber),
- artificial starry sky illumination (endlight fiber),
- illuminated parking light rings (side light fiber),
- in room, in house, in-restaurant, in-vehicle illumination (side light fiber)

Typical fiber diameter: 1mm to 14mm

Light sources: 200 Watt tungsten halogen lamp to 50mW LED light source



MOPF = Multifunctional optical polymer fiber, objective:

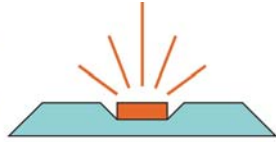
development of **polymeric side light fiber illumination systems**

Partners:

- tti Technologietransfer und Innovationsförderung Magdeburg GmbH,
- HarzOptics GmbH,
- DieMount GmbH.

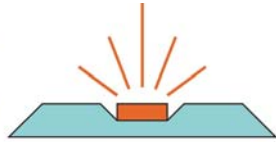
Technical approach:

- 3mm TPU side light POF (tti GmbH),
- Microreflector based LED light sources for 3mm POF (DieMount GmbH).

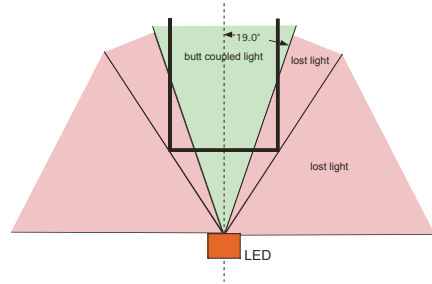


Requirements LED light sources:

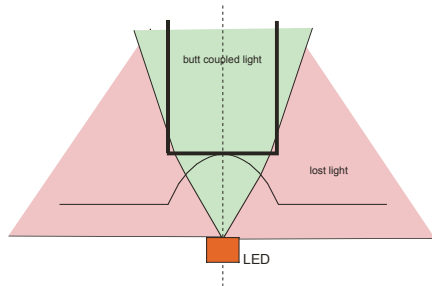
- suitable for 3mm POF
- powerLED dice (1mm edge length), ~1W electrical power
 - i.e., fiber diameter/die edge length = 3, and
 - heat dissipation means
- high coupling efficiency
- RGB version available



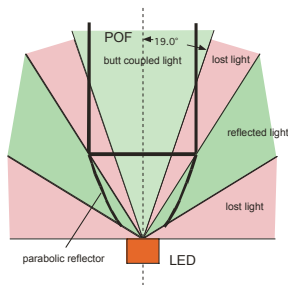
Fiber-chip coupling design



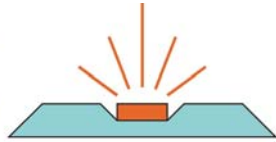
Butt coupling



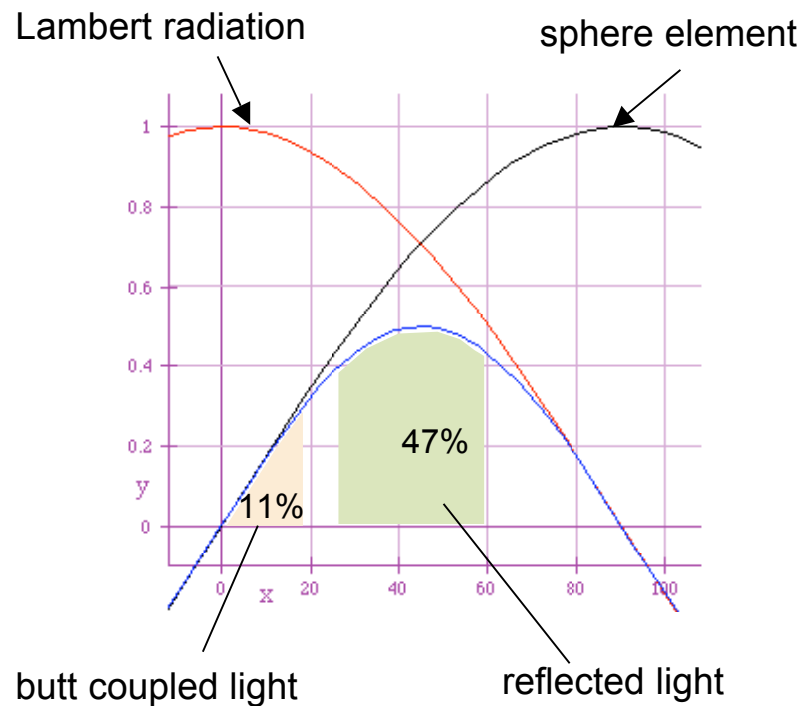
Lens coupling



Microreflector coupling



Qualitative consideration:

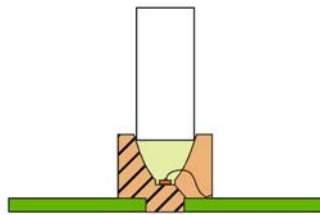
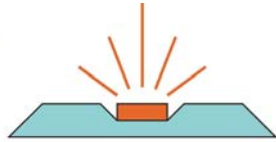


$$S = \int_0^{2\pi} \int_{\theta} S(\theta) \sin \theta d\theta d\varphi = 2\pi \int_{\theta} S(\theta) \sin \theta d\theta$$

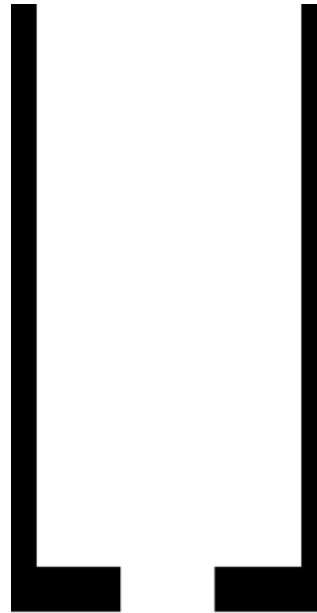
$$S(\theta) = \cos \theta \text{ (Lambert radiation)}$$

$$S = 2\pi \int_{\theta} \cos \theta \sin \theta d\theta$$

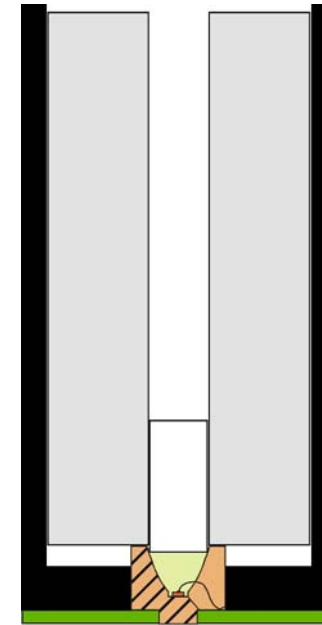
➔ Use of 45° angle region requires microreflectors.



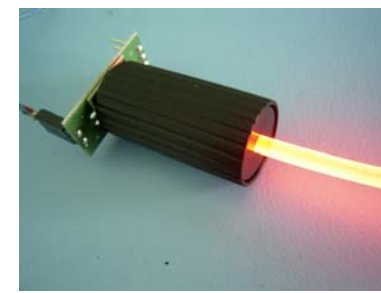
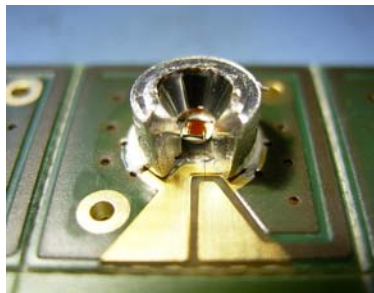
Microreflector setup

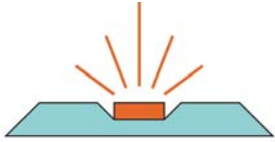


aluminium heat sink

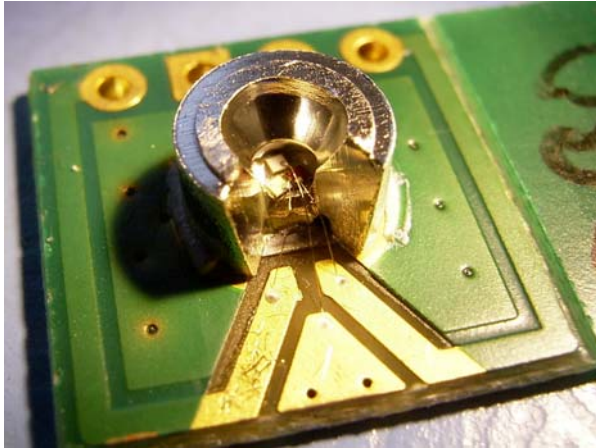


LED module

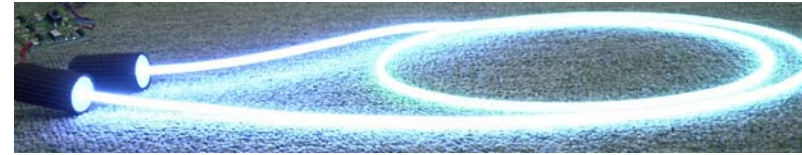
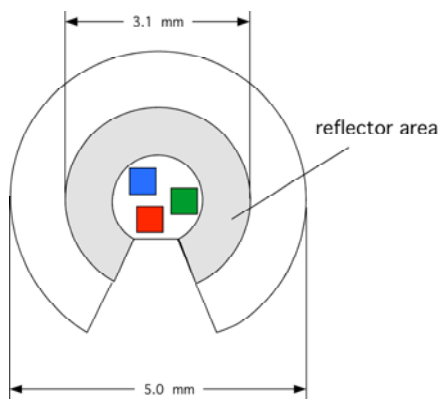




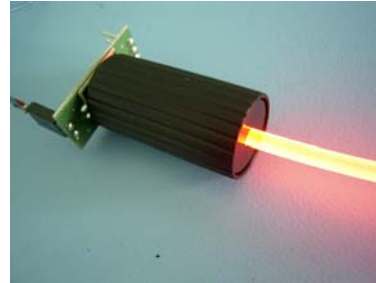
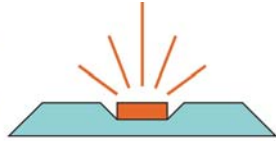
RGB LED light source



microreflector comprises 3
20mil (500 μ m) LED dice

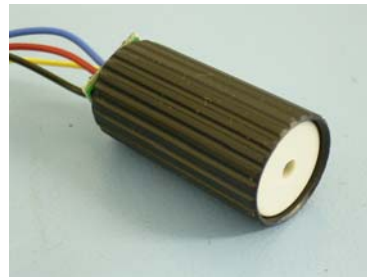


The space requirement for 3 LED
dice reduces coupling efficiency.



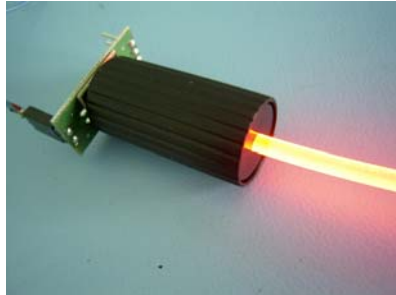
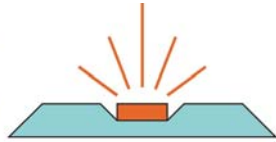
Technical specifications for 3mm fiber powerLED modules:

	blue	green	red	white
wavelength [nm]	460	520	633	–
Typ. optical output power @ 350 mA [mW]	105	32	65	–



Technical specifications for 3mm fiber RGB powerLED modules:

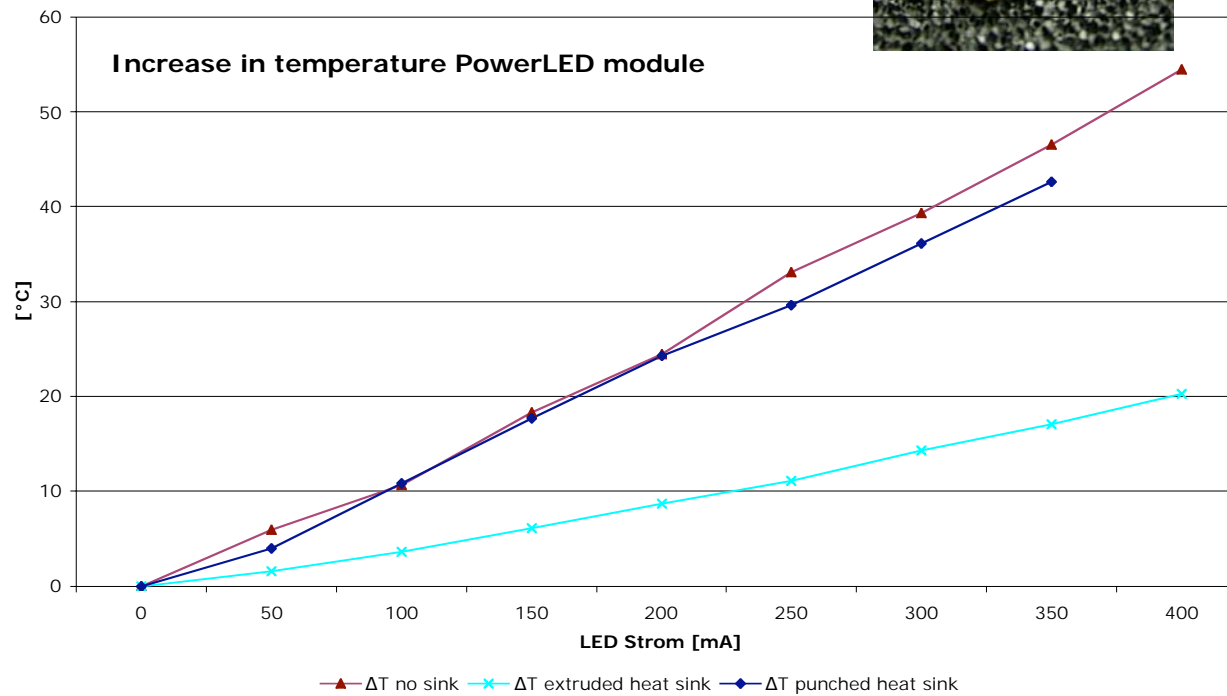
	blue	green	red
wavelength [nm]	460	520	620
Typ. optical output power @ 150 mA [mW]	25	10	20

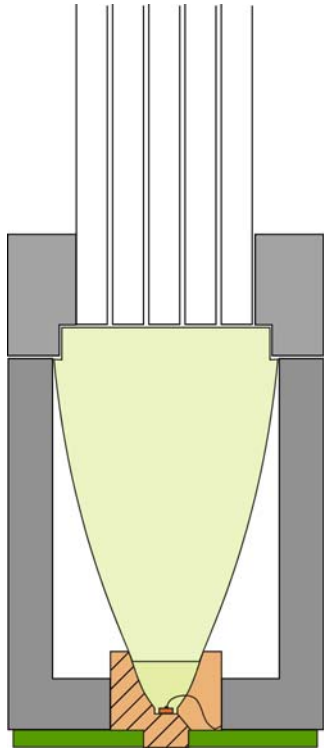
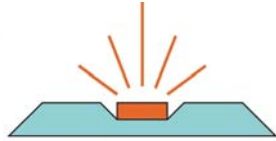


standard



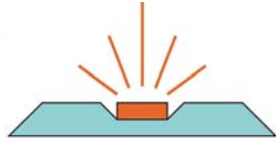
punched
tube instead
of extruded
aluminium



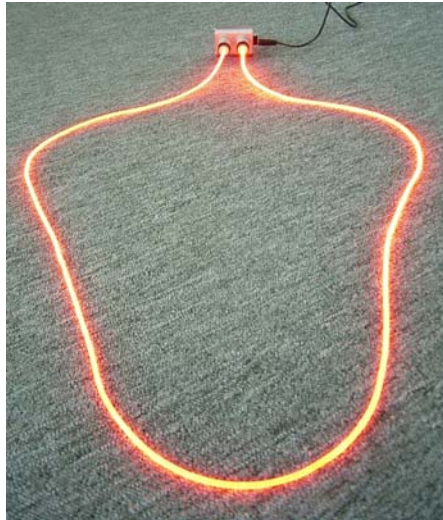


Many fibers or very thick fibers (diameter $> 6\text{mm}$) are coupled with plastic parabolic reflectors.

The fiber coupled optical power is not maximal, but economic.



some realized prototypes



floor light

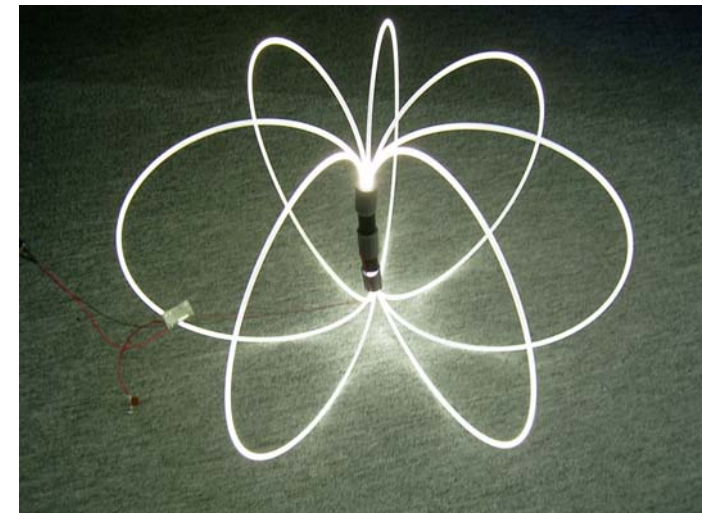


hanging lamp

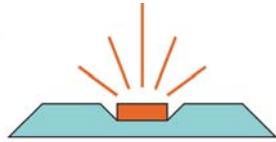


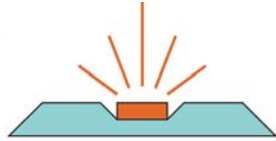
wall lamp

art object



Design idea FH Magdeburg





Acknowledgement:

This work done in this project is financially supported by Sachsen-Anhalt, FuEul-Förderung/6003334700.

**Thank you very much for your
attention!**