DIEMOUNT SOLUTIONS

3mm side and end light fiber LED modules

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Overview

- **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**

Introduction

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

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R&D project “MOPF”

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:

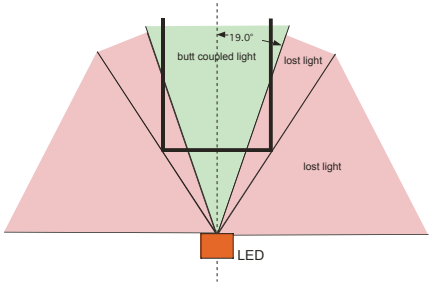
- 3mm TPU side light POF (tti GmbH),
- Microreflector based LED light sources for 3mm POF (DieMount GmbH).

LED light sources for fiber illumination

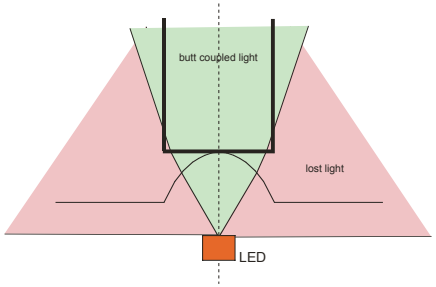
Requirements LED light sources:

- 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

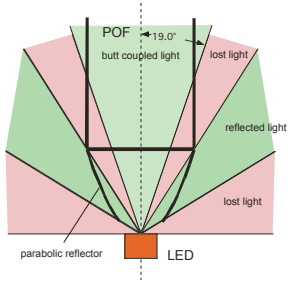
Fiber-chip coupling design



Butt coupling



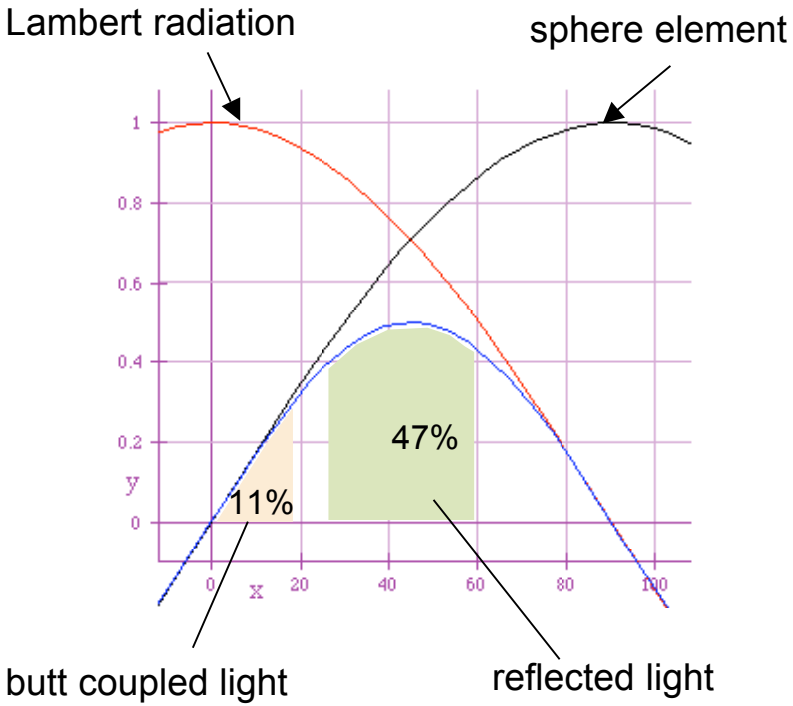
Lens coupling



Microreflector coupling

Fiber chip coupling efficiency

Qualitative consideration:



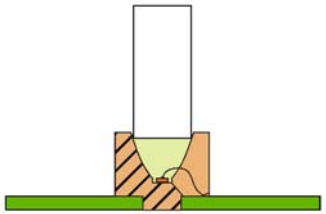
$$S = \int_0^{2\pi} \int_\theta S(\theta) \sin\theta \, d\theta d\varphi = 2\pi \int_\theta S(\theta) \sin\theta \, d\theta$$

$$S(\theta) = \cos\theta \quad (Lambert \quad radiation)$$

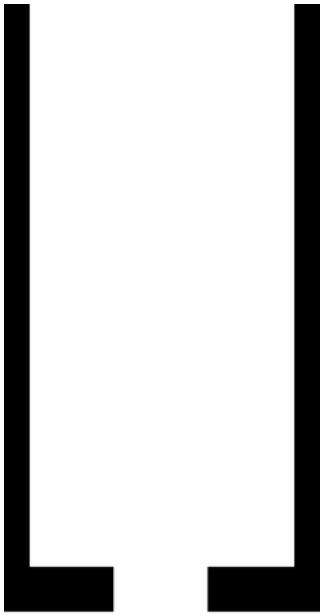
$$S = 2\pi \int_\theta \cos\theta \sin\theta \, d\theta$$

➡ Use of 45° angle region requires microreflectors.

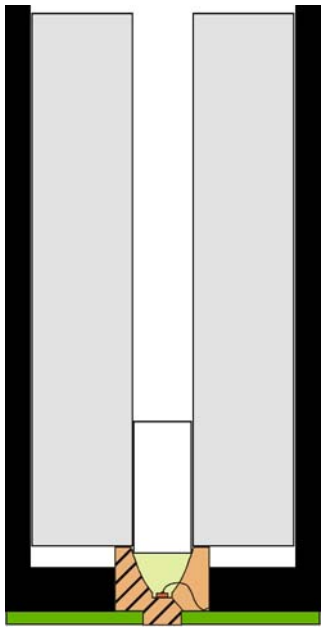
mechanical design: heat sink



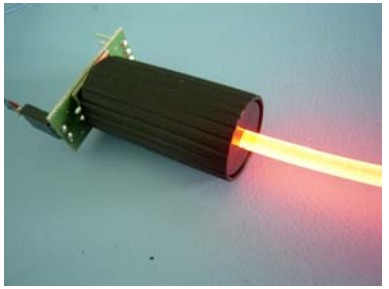
Microreflector setup



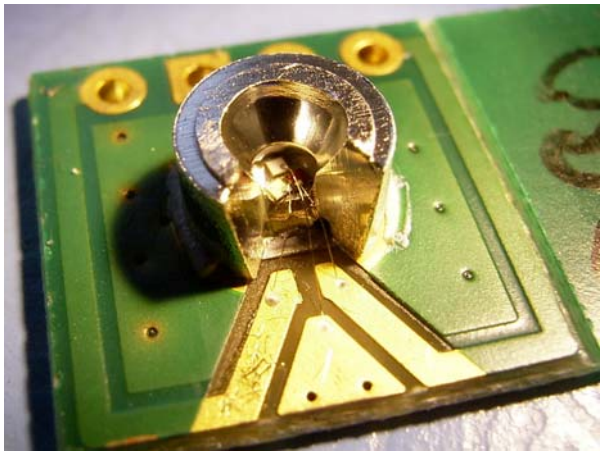
aluminium heat sink



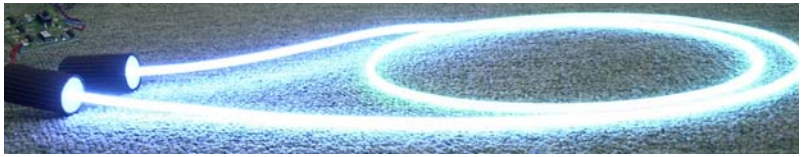
LED module

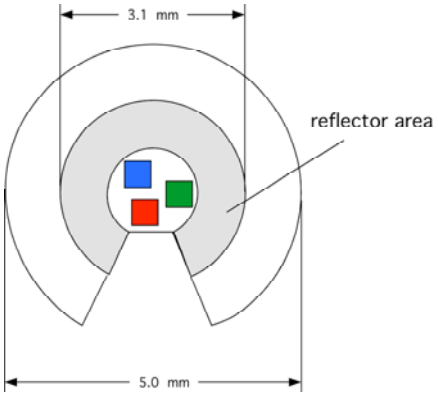


RGB LED light source

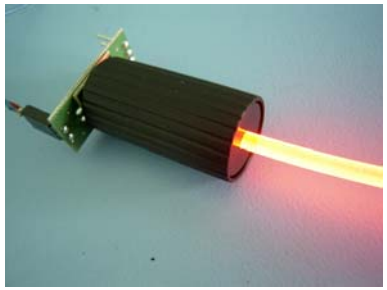


microrefletor comprises 3 20mil (500µm) LED dice



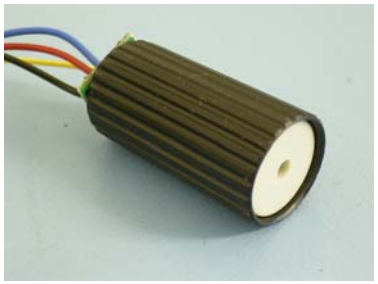


The space requirement for 3 LED dice reduces coupling efficiency.



Technical specifications for 3mm fiber powerLED modules:

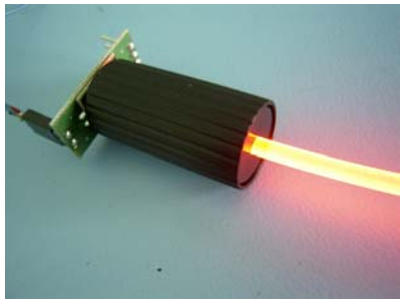
	blue	green	red	white
wavelength [nm]	460	520	633	–
Typ. optical output power @ 350 mA [mW]	105	32	65	–



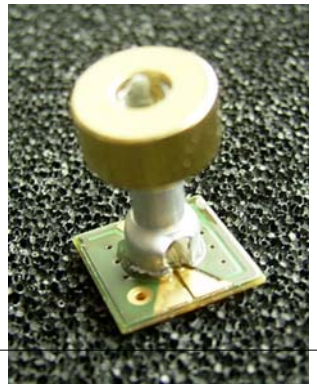
Technical specifications for 3mm fiber RGB powerLED modules:

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

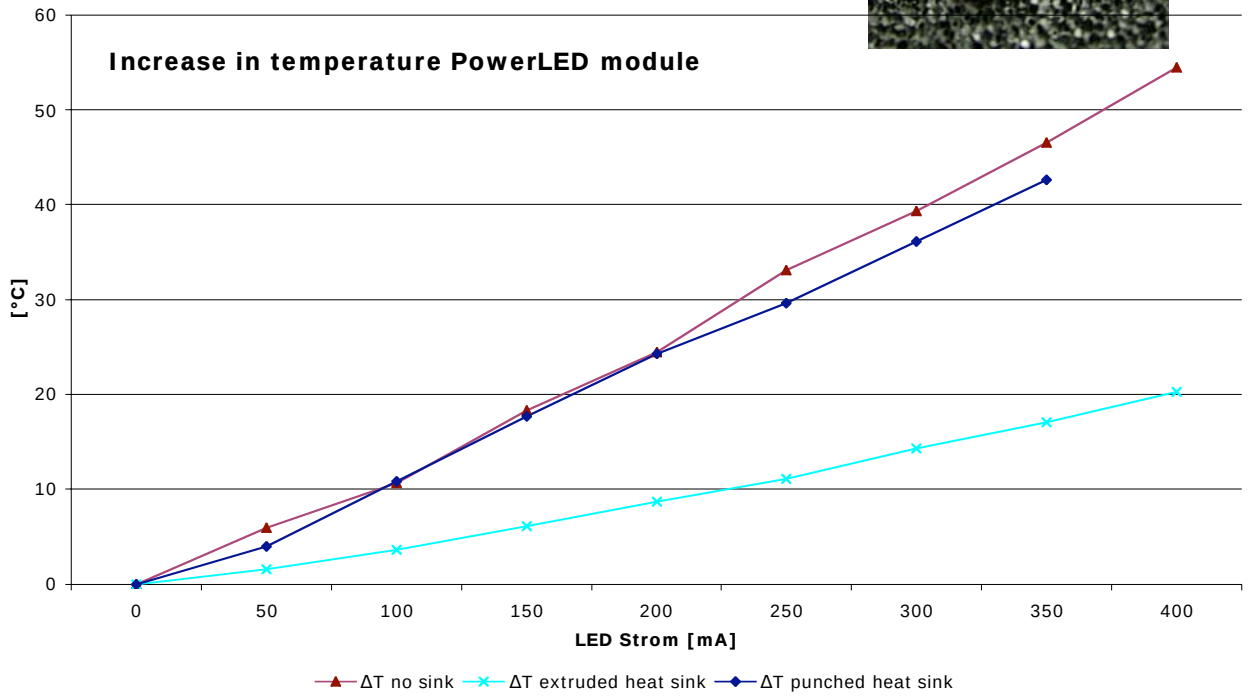
Mass volume design



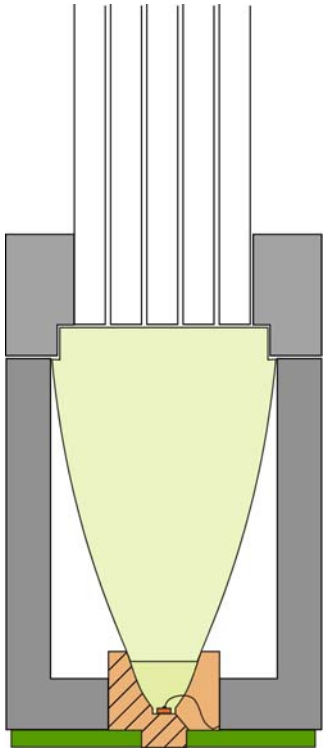
standard

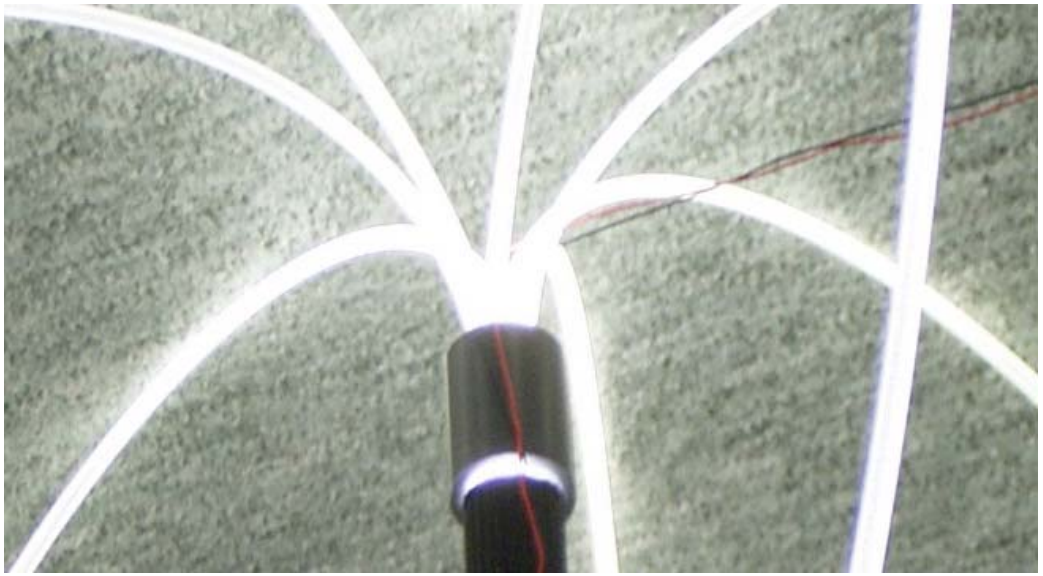


punched tube instead of extruded aluminium



Light source for many fibers





Many fibers or very thick fibers (diameter > 6mm) are coupled with plastic parabolic reflectors.

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

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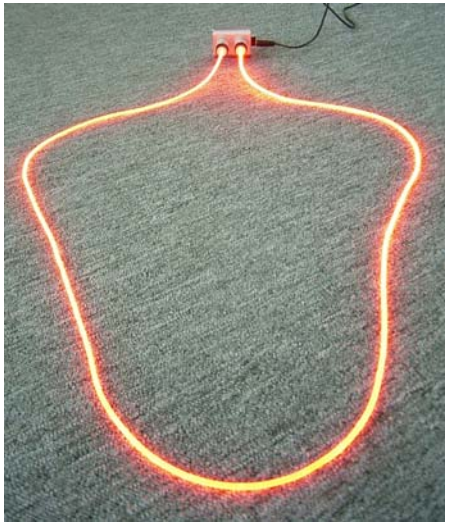
some realized prototypes

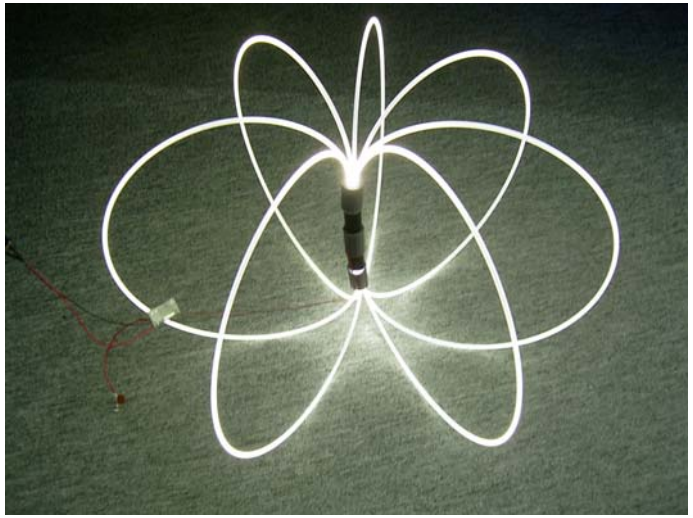


floor light

hanging lamp

art object

wall lamp



Design idea FH Magdeburg

side light fiber object

Acknowledgement:

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Thank you very much for your attention!