



MSc Thesis Project

Diode laser based spot lighting

Introduction: Solid state lighting (SSL) is the most efficient light source for high quality white light today. SSL is based on phosphor converted blue light emitting diodes (LEDs). Even though blue LEDs have undergone tremendous development in the last decade, they still suffer from fundamental performance limitations. Most importantly, LEDs suffer from a decrease in efficiency at high input current densities, known as the "efficiency droop". This efficiency droop restricts operation to relatively low current densities, which is contrary to the desire to produce more photons per unit area and thereby reduce cost [1].

With the introduction of diode laser based lighting, high luminous flux levels and high efficiency can be achievable at the same time. Laser diodes operate in a fundamentally different regime using stimulated emission for light generation as opposed to spontaneous emission in LEDs. Stimulated emission by nature has higher efficiency at high input current densities and thus smaller chip areas are possible, potentially lowering cost.

Contents: In this project, the student(s) will investigate the possibilities of using diode laser based lighting for high luminous flux spot lighting applications. This could involve the use of blue diode lasers for excitation of different phosphor materials, investigation of efficiency and light quality of the generated light as well as optical design of optimal reflectors and diffusers for efficient distribution of the light.

The project can be tailored to the wishes and qualifications of the student(s).

The project could involve:

- Selection of optimal phosphor material based on measurement on light generated by laser illuminated phosphors
- Optical solution for guiding of laser light to remote phosphor
- Optical design of reflectors and diffusers
- Investigation of different laser sources for lighting applications

Preferred prerequisites:

- Good hands-on experimental experience.
- Knowledge on lasers and optics.

Additional information:

1. J. J. Wierer *et al.* "Comparison between blue lasers and light-emitting diodes for future solid-state lighting" *Laser Phot. Rev.*, **7**, 963-993 (2013)
<http://onlinelibrary.wiley.com/doi/10.1002/lpor.201300048/abstract>

The project is part of a large EUDP funded project called **D-Light**.

Practical details: The project is intended for 1 or 2 students with 30 ECTS-points per student.

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