DTU Fotonik
Department of Photonics Engineering

BSc or MSc Thesis Project

Characterization of phosphors for laser lighting

Introduction: Solid state lighting (SSL) is the most efficient light sources 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".

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.

The high power density possible with diode lasers in contrast to LEDs puts high performance requirements on the phosphor materials to be used for laser lighting in order to maintain high light quality and efficiency at all operating conditions.

Contents: In this project, the student(s) will investigate phosphor materials for laser lighting. Materials such as single crystals, ceramics and glass are all viable for use in laser lighting as they can withstand the high laser flux. The materials will be characterized and this will form a guideline for development and selection of materials for laser lighting.

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

The project could involve:

- Investigation of phosphor materials based on measurement on light generated by laser illuminated phosphors and temperature distribution in the materials
- Modeling of light and thermal distribution in phosphor materials
- 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 Spotlase.

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

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