Occupant response to different correlated colour temperatures of white LED lighting

Correlated Colour Temperature (CCT) of lighting may affect not only occupant visual perception, but also other indoor environment perceptions, such as perceptions of the thermal environment or the air quality. This study aimed at quantifying the association between CCT of white LED lighting and subjective perceptions and performance at operative temperatures at the upper and lower borders and in the middle of the comfort range. Higher CCT was significantly associated with decreasing thermal sensation, but only at the thermally neutral condition. Female subjects responded stronger to changes in CCT than male subjects. Under all temperature conditions, CCT was clearly associated with the perceived brightness of the light, and at 22 °C also with the perceived air quality and with subjectively assessed alertness. CCT had no effect on the measured performance of a d2 task. At 22 °C, the observed decrease in thermal sensation when CCT went from 2700 K to 6200 K was equivalent to a difference in operative temperature of 1.7 °C. With an assumed neutral CCT of 4500 K (middle of range), a decreased heating set point in an office building, corresponding to an equivalent shift in CCT from 4500 K to 2700 K, resulted in a reduction of around 8% of the building’s total annual energy use. However, this assumes ideal conditions without influence from daylight, light from PC monitors, or coloured surfaces and other potentially disturbing factors.
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.51 SJR 1.998 SNIP 2.215
Web of Science (2016): Impact factor 4.053
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 4.37 SJR 2.067 SNIP 2.463
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 4.14 SJR 1.887 SNIP 2.742
Web of Science (2014): Impact factor 3.341
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.57 SJR 1.547 SNIP 2.551
Web of Science (2013): Impact factor 2.7
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 3.06 SJR 1.293 SNIP 2.857
Web of Science (2012): Impact factor 2.43
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.76 SJR 1.127 SNIP 2.279
Web of Science (2011): Impact factor 2.4
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.245 SNIP 2.058
Web of Science (2010): Impact factor 2.131
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.025 SNIP 1.889
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.938 SNIP 1.413
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.826 SNIP 1.771
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.016 SNIP 1.716
Scopus rating (2005): SJR 0.933 SNIP 1.296
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.572 SNIP 1.259
Scopus rating (2003): SJR 0.898 SNIP 0.963
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.216 SNIP 1.436
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.809 SNIP 1.065
Scopus rating (2000): SJR 0.585 SNIP 1.086
Scopus rating (1999): SJR 0.54 SNIP 1.137

Original language: English
Keywords: Illumination, Indoor environment, Lighting, Temperature, Thermal perception
DOIs:
10.1016/j.buildenv.2018.07.013
Can We Cheat The Brain And Save Energy?
Conditioning of built environments dominates global energy use and greenhouse gas emissions. If lighting can be used actively to stimulate our perception of the thermal environment, there may be a potential to expand the temperature interval that building occupants find comfortable and thereby reduce the amount of energy used to heat and cool buildings.

Development of white LED illuminants for colorimetry and recommendation of white LED reference spectrum for photometry
General lighting is undergoing a revolutionary change towards LED-based technologies. To provide firm scientific basis for the related colorimetric and photometric measurements, this paper presents the development of new white-LED-based illuminants for colorimetry, and their evaluation to recommend a new reference spectrum for calibration of photometers. Spectra of 1516 LED products were measured and used to calculate eight representative spectral power distributions for LED sources of different correlated colour temperature categories. The suitability of the calculated representative spectra for photometer calibration was studied by comparing average spectral mismatch errors with CIE Standard Illuminant A, which has been used for decades as the reference spectrum for incandescent standard lamps in calibration of photometers. It was found that in general, when compared with Standard Illuminant A, all the potential LED calibration spectra reduced spectral mismatch errors when measuring LED products. Out of the potential LED calibration spectra tested, the white LED spectrum with correlated colour temperature of 4103 K was found to be the most suitable candidate to complement Standard Illuminant A in luminous responsivity calibrations of photometers. When compared with Standard Illuminant A, employing the 4103 K reference spectrum reduced the spectral mismatch errors, on average, by approximately a factor of two in measurements of LED products and lighting. Furthermore, the new LED reference spectrum was found to reduce the spectral mismatch errors in measurements of daylight, and many types of fluorescent and discharge lamps, indicating that the proposed reference spectrum is a viable alternative to Standard Illuminant A for calibration of photometers.
Ratings:

BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.69 SJR 0.614 SNIP 1.448
Web of Science (2017): Impact factor 2.275
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.47 SJR 0.88 SNIP 1.789
Web of Science (2016): Impact factor 3.411
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.96 SJR 0.813 SNIP 1.611
Web of Science (2015): Impact factor 2.5
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.49 SJR 0.997 SNIP 2.119
Web of Science (2014): Impact factor 2.041
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.88 SJR 1.001 SNIP 1.955
Web of Science (2013): Impact factor 1.653
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.78 SJR 1.153 SNIP 1.745
Web of Science (2012): Impact factor 1.902
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.64 SJR 1.074 SNIP 1.726
Web of Science (2011): Impact factor 1.75
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.779 SNIP 1.62
Web of Science (2010): Impact factor 1.688
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.842 SNIP 1.615
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.773 SNIP 1.712
Scopus rating (2007): SJR 0.966 SNIP 1.823
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.636 SNIP 1.989
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.343 SNIP 1.866
Scopus rating (2004): SJR 0.802 SNIP 1.349
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.924 SNIP 1.786
Scopus rating (2002): SJR 0.395 SNIP 0.988
Scopus rating (2001): SJR 0.604 SNIP 0.904
Scopus rating (2000): SJR 0.636 SNIP 1.317
Direct Beam and Diffuse Spectral Irradiance Measurements in a Nordic Country Analyzed With the Average Photon Energy Parameter

One year of spectrally resolved direct normal irradiance (DNI), diffuse horizontal irradiance (DfHI) and global horizontal irradiance (GHI) measured in Roskilde, Denmark are analyzed in terms of the average photon energy (APE). We show that the APE of the GHI component is characterized by spectral distributions with low standard deviations, which is consistent with the findings of previous authors. In contrast, the APE of the DfHI and DNI components show spectral distributions with higher standard deviations, which suggests that a given APE value for DNI or DfHI can represent a wider array of spectral distributions. Finally, it is shown that the DfHI APE is characterized by high energy spectral distributions, which has particular significance in the case of building integrated photovoltaic (BIPV) applications in Nordic countries.

General information
State: Published
Organisations: Department of Photonics Engineering, Photovoltaic Materials and Systems, Diode Lasers and LED Systems, Department of Micro- and Nanotechnology, Silicon Microtechnology
Number of pages: 6
Publication date: 2018

Host publication information
Title of host publication: Proceedings of 7th World Conference on Photovoltaic Energy Conversion
Publisher: IEEE
Keywords: Average Photon Energy, BIPV
Source: PublicationPreSubmission
Source-ID: 149924505
Research output: Research - peer-review › Article in proceedings – Annual report year: 2018

Dynamiske lyskilder
Fuld spektral karakterisering som udgangspunkt for styring af farven.

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems
Contributors: Dam-Hansen, C., Corell, D. D., Thorseth, A.
Pages: 24-25
Publication date: 2018
Peer-reviewed: Unknown

Publication information
Journal: Lys
Issue number: 01-2018
ISSN (Print): 0904-7824
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: English
Source: PublicationPreSubmission
Source-ID: 144866948
Research output: Communication › Journal article – Annual report year: 2018
Interlaboratory comparison of methodologies for measuring the angle of incidence dependence of solar cells

The aim of this work is to compare angle of incidence (AOI) measurement setups for solar cells between laboratories with such capability. For the first time, we compare relative light transmission measurements among eight laboratories, whose measurement techniques include indoor and outdoor methods. We present the relative transmission measurements on three 156 mm x 156 mm crystalline-Si (c-Si) samples with different surface textures. The measurements are compared using the expanded uncertainties provided by each laboratory. Five of the eight labs showed an agreement better than ±2% to the weighted mean between AOIs from -75° to 70°. At AOIs of ±80° and ±85°, the same five labs showed a worst case deviation to the weighted mean of -3% to 5% and 0% to 18%, respectively. When measurement uncertainty is considered, the results show that measurements at the highest incidence angle of ±85° are problematic, as measurements from four out of the six labs reporting uncertainty were found non-comparable within their stated uncertainties. At 85° AOI a high to low range of up to 75% was observed between all eight laboratories.

General information
State: Published
Organisations: Photovoltaic Materials and Systems, Department of Photonics Engineering, Diode Lasers and LED Systems, Silicon Microtechnology, Department of Micro- and Nanotechnology, Physicalisch-Technische Bundesanstalt, Energy research Centre of the Netherlands - ECN, Loughborough University, National Renewable Energy Center, Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas, University of Applied Sciences and Arts of Southern Switzerland, Fraunhofer Institute for Solar Energy Systems ISE
Number of pages: 6
Publication date: 2018

Host publication information
Title of host publication: Proceedings of the 35th European Photovoltaic Solar Energy Conference and Exhibition
Electronic versions:
thorsteh.pdf
Source: PublicationPreSubmission
Source-ID: 159012452
Research output: Research - peer-review › Article in proceedings – Annual report year: 2018

LEDMET Report: Simulation and correction of stray light in spectrometers
In this report, stray light is described as a source of uncertainty in spectrometers and spectroradiometers, and through simulation of various kinds of stray light we show the effects these have on the derived quantities of the spectral measurements. The simulated stray light is then sought corrected by the method developed by Zong et al. at NIST and the derived quantities are then compared to the original data. This report is the deliverable of milestone M1.3 in project Center for LED Metrology (LEDMET).

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems
Contributors: Thorseth, A.
Number of pages: 19
Publication date: 2018

Publication information
Publisher: DTU - Department of Photonics Engineering
Original language: English
Electronic versions:
Source: PublicationPreSubmission
Source-ID: 147839707
Research output: Research › Report – Annual report year: 2018

Ny international ordbog for lys og belysning fra CIE

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems
Contributors: Thorseth, A.
Pages: 23-23
Publication date: 2018
Occupant response to controllable LED lighting
At three different ambient temperatures, human subjects were exposed to correlated colour temperatures (CCT) in the range 2750 to 6230 K at an illuminance of 1000 lux. Significant associations were found between CCT and thermal sensation and between CCT and perceived stuffiness of the air.

Outdoor Electroluminescence Acquisition Using a Movable Testbed
The experimentation with a movable outdoor electroluminescence (EL) testbed is performed in this work. For EL inspections of PV power plants, the fastest scenario will include the use of unmanned aerial vehicle (UAV) performing image acquisition in continuous motion. With this motivation, we investigate the EL image quality of an acquisition in motion and the extent of image processing required to correct scene displacement. The results show processed EL images with a high level of information even when acquired at 1 m/s camera speed and at frame rate of 120 fps.
Saturation in ceramic phosphors illuminated by a blue laser diode

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems
Publication date: 2018
Peer-reviewed: Yes

Bibliographical note
Source: PublicationPreSubmission
Source-ID: 150109165
Research output: Research - peer-review › Paper – Annual report year: 2018

Scaling up Laser Line Photoluminescence Imaging for Outdoor Inspections
As outdoor electroluminescence is implemented in the field, with several developments for automated inspection, an increasing concern rises upon the limitation that the electrical connections will bring to the inspection speed. In the effort to avoid both electrical contact and time limitations for PV inspections, here we present the progress in scaling up the well-known cell level photoluminescence imaging to a module level. The final goal is to build up a system that can perform PL excitation and image acquisition from the distance on PV modules and brought easily to the field by unmanned aerial vehicles (UAV).

General information
State: Published
Organisations: Department of Photonics Engineering, Photovoltaic Materials and Systems, Diode Lasers and LED Systems
Number of pages: 3
Publication date: 2018

Host publication information
Title of host publication: Proceedings of the 35th European Photovoltaic Solar Energy Conference and Exhibition
Keywords: Photoluminescence imaging, PV inspections, Fault detection, Laser line
Electronic versions:
5CV.3.41_Manuscript.pdf
Source: PublicationPreSubmission
Source-ID: 161978618
Research output: Research - peer-review › Article in proceedings – Annual report year: 2018

Spectrometric Instrumentation For In-Situ Monitoring Of Spectral Components
We present a spectrometric instrumentation to monitor and log the spectral characteristics of the light in hospital rooms over long term periods during a trial of the effect of controlled lighting on patients. Each room has been equipped with a dynamic lighting system enabling change of correlated colour temperature of the light over the day. The objective is to estimate and document the available light exposure to the patient including the daylight through the window. The calibrated spectral measurements allows for evaluating the stimulus intensities for all five photopigments in relation to both visual and non-visual effects of the light in the rooms.

General information
State: Published
Spectrometric Instrumentation for in Situ Monitoring of Spectral Components in Dynamic Lighting Scenarios

We present a spectrometric instrumentation to monitor and log the spectral characteristics of the light in hospital rooms over long term periods during a trial of the effect of controlled lighting on patients. Each room has been equipped with a dynamic lighting system enabling change of correlated colour temperature of the light over the day. The objective is to estimate and document the available light exposure to the patient including the daylight through the window. The calibrated spectral measurements allows for evaluating the stimulus intensities for all five photopigments in relation to both visual and non-visual effects of the light in the rooms.

1. Motivation, specific objective:
There is a growing focus on daylight and artificial light in the fields of health and psychiatry as an element that can support conventional medical treatment. In this project daylight is combined with a LED based dynamic luminaires so there is a need for documentation of the light conditions during the interventions. The objective is to provide calibrated spectral irradiance measurements in the rooms to monitor and log the spectral characteristics of the light in the long term trials and to be able to quantify the difference in lighting conditions in a dynamically controlled and not controlled room. The calibrated spectral measurements allows for evaluating the stimulus for all five photo pigments as recommended by CIE using the α-opic irradiances, i.e. cyanopic, chloropic, erythropic, melanopic and rhodopic irradiances measured in W/m². The applied spectral sensors needs to be small and unobtrusive not to be disturbing in the hospital room, they further need to be sensitive to low light conditions and they need to be inexpensive. Normal spectrometers do not comply with these requirements and for this setup new types of spectral sensors have been investigated and chosen for the measurement system.

2. Methods:
A spectral sensor of the so-called “Pancake” configuration is used for the measurements. It consists of a linearly variable filter on top of an array detector chip and allows for spectral measurements from 380 to 700 nm. The spectral resolution is around 5-9 nm. With USB connection the sensor weighs 15 g and has a size of 10x22x38 mm³. It is a low cost sensor, less than one fifth of price of handheld spectrometers, allowing for inexpensive multipoint measurements. The spectral sensor itself has a narrow acceptance angle and for the ambient light measurements a cosine response is required. Therefore, the sensors has been installed in small metal boxes with a hemispherical diffuser in front of the sensor array. Prior to the installation at the hospital these sensor boxes has been calibrated for spectral irradiance in the photometric laboratory using a 1000 W FEL standard spectral irradiance lamp at a distance of 50 cm. Further the sensors has been characterised for dark noise and spectra for the used integration times has been saved. Both dark correction and calibration is applied in the pc control program. The control program has been developed to subsequently take measurements from all the installed spectral sensors and store the measured and calibrated spectral power distributions with a timestamp and serial number for the sensor. Prior to each measurement the program automatically finds the optimal integration time for the current light conditions, ensuring no saturation and a good signal level of more than 60 % of the saturation level. The possible integration times has been restricted to 72 from 10 μs to 10 s. In each of four rooms, three sensors has been installed to monitor the light conditions. One sensor is placed at the top of the window on the end wall measuring the daylight entering the room. The two other sensors are placed on each side wall approximately 1.5 m from the end wall with the window and at a height of 1.5 m. The three sensors in a room are connected to a USB-Ethernet hub. The sensor boxes are painted white and no wires are visible, which is essential in the hospital ward. All twelve spectral sensors are connected to a pc via an Ethernet switch. The sensors are powered through the The spectral data logging system runs with no internet access to comply with patient data regulation.

3. Results:
The sensors has been installed and will be monitoring and logging spectral data in the four hospital rooms from April 2018 onwards. Data will be collected and presented to show the effect of the different lighting conditions in the rooms, e.g. on the α-opic irradiances. Test of the spectral sensors compared to calibrated spectroradiometers will also be done and presented.

4. Conclusions:
An instrumentation system to monitor and log the spectral characteristics of the light in hospital rooms over long term during a trial of the effect of controlled lighting on patients has been described. The spectral sensors applied full fills the requirements of being small and unobtrusive, and inexpensive allowing many measurement positions and continuous logging.
Spectroradiometry in PV: how inter-laboratory comparison may improve measurement accuracy

Spectroradiometry is a key metrological topic for accurate testing of photovoltaic (PV) devices, particularly relevant both for indoor testing on solar simulators and for outdoor testing. The relevance of accurate measurements of solar spectral irradiance has led the most renowned European solar PV test centres to take part to a series of International Spectroradiometer Intercomparisons that has taken place every year so far since 2011 in various localities in the Mediterranean Basin. This paper revisits the performance of participant laboratories and highlights the importance of inter-laboratory comparisons, showing the possible improvements in measurement reproducibility.
2. Methods: In a real office setting, we test the influence of three different CCT’s of 2800, 3100 and 4000 K on the workers thermal sensation and preferences. Three similar hallways and adjacent single or double offices at the Danish Technical University, Denmark (55°41’38.5”N 12°6’5.7”E) were used. These sections were equipped with LED lighting with central control of CCT and light levels. During the field study the light was on at all times starting from 7 am and onwards unless the workers purposely turned off the light. The electric lighting system was adjusted to 650lx at table height in all CCT settings and it was not possible to regulate the light intensity. The offices had windows to the outside, facing East or West. The experiment was conducted primo January 2018 and lasted for seven weeks. The period was carefully selected leaving minimal influence of the daylight as a central bias and to strengthen the influence of the electric light treatment. The settings of CCT (treatments) was changed each Sunday in a rotation between the 3 sections having 1 week in between being used as an anchor with CCT of 3100 K in all sections. In this abstract we focus on the anchor weeks and the deviation that relates to the different sections and people answering our questionnaires. A total of 48 workers were encouraged to participate in the study. The thermal sensation and visual preference were assessed by an online questionnaire with ten (10) specific questions sent out once a week. The workers were asked to rate their individual sensation of the lighting and thermal comfort while situated in their office.

Indoor climate measured as the temperature, RH and CO2 concentration in the offices during the experiment were logged every 5 minutes along with measurements of outdoor diffuse and direct radiation, temperature and humidity in order to exclude them as possible bias.

3. Results and discussion: This field study differed from (most) laboratory studies in its duration and number of biases. In real office settings, we investigate longer term effects of differences in supplemental lighting CCT on the workers. The workers and sections differed in various ways. Thus, the anchor weeks with CCT of 3100 K in all sections was imposed, to estimate the differences between sections, biases of dealing with different groups of people (sections) along with the influences of continuous changes in the outdoor radiation. The questionnaire lead to a relatively consistent response rate – resulting in between 28-31 answers the first three weeks and between 20-24 answers the last four weeks (out of 48 requests). The response rate on our questionnaire was in average around 50%, which partly reflect its’ length. A short questionnaire, opposed to a more extensive questionnaire, did not allow us to ask question, of e.g. work related distractions, tiredness, stress or sound levels, to further include and account for such biases in later findings, but we do not find that a lower response rate would have been advantageous. The differences being present between the sections were by anchor weeks measured once for each rotation and at the end. However, imposing the anchor weeks compromised the amount of answers in relations to the treatments of 2800 and 4000 K and extended the test period. Our weekly sent questionnaires (7 weeks) were answered by 19, 135 and 26 workers (180 in total), in relation to treatment settings of 2800, 3100 and 4000 K, respectively. If the study was conducted without the four anchor weeks the test period alone would have been 3 weeks. Execution within 3 weeks would have resulted in a higher response-rate and a more balanced number of answers in relation to the imposed treatments. However, this would compromise the measure of differences that relates to biases influencing the treatment effects. The need of controls for biases will depend on the treatment strength.

4. Conclusions: Field experiments are characterized by having many biases and often a weaker response rate on questionnaire surveys. Our online questionnaire of 10 questions sent out once per week in a field study resulted in an average response rate around 50%. The response rate declined slightly after 3 weeks and varied between 42% and 65%. We are unsure of the need for imposed anchor weeks, since the need for controls of biases influencing the overall result will depend on the treatment strength and survey response rates. However, we stress that differences that relate to biases should be estimated and accounted for.

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems, Department of Civil Engineering, Indoor Environment, Aalborg University
Contributors: Markvart, J., Stoffer, S., Thorseth, A., Toftum, J.
Number of pages: 2
Publication date: 2018
Peer-reviewed: Yes
Event: Abstract from CIE Expert Tutorial and Workshop on Research Methods for Human Factors in Lighting, Copenhagen, Denmark.

Bibliographical note
Source: PublicationPreSubmission
Source-ID: 152463305
Research output: Research - peer-review » Conference abstract for conference – Annual report year: 2018

Assessment of filament led bulbs with respect to temporal light artefacts
Temporal light artefacts, abbreviated TLAs (including flicker, stroboscopic effect and phantom arrays), i.e. undesired time modulation in luminance from a light source, has shown to be a threat to wider SSL adoption especially related to dimming functions and low-quality LED products. This is due to the effects that both noticeable and unperceivable TLAs have on human perception and wellbeing. In the present work a number of filament LED bulbs, currently available on the market, are assessed primarily with respect to TLAs, but also with respect to photometric, colorimetric and efficiency properties. The investigation shows that only one of the 10 investigated lamps can be considered flicker free. The rest of the lamps the TLAs are of such a magnitude that none of them fulfil the suggested recommendations currently available.
Determination of illuminants representing typical white light emitting diodes sources

Solid-state lighting (SSL) products are already in use by consumers and are rapidly gaining the lighting market. Especially, white Light Emitting Diode (LED) sources are replacing banned incandescent lamps and other lighting technologies in most general lighting applications. The aim of this work is to develop LED-based illuminants that describe typical white LED products based on their Spectral Power Distributions (SPDs). Some of these new illuminants will be recommended in the update of the CIE publication 15 on colorimetry with the other typical illuminants, and among them, some could be used to complement the CIE standard illuminant A for calibration use in photometry.

Development of outdoor luminescence imaging for drone-based PV array inspection

This work has the goal to perform outdoor defect detection imaging that will be used in a fast, accurate and automatic drone-based survey system for PV power plants. The imaging development focuses on techniques that do not require electrical contact, permitting automatic drone inspections to be perform quicker and with less manpower. The final inspection method will combine several techniques such as, infrared (IR), electroluminescence (EL), photoluminescence (PL), and visual imaging. Solar plant inspection in the future can be restricted only by imaging speed requirements, allowing an entire new perspective in large-scale PV inspection.
Development of outdoor luminescence imaging for drone-based PV array inspection
This work has the goal to examined experimentally PV module imaging methods under natural light conditions, that will be used in a fast, accurate and automatic drone-based inspection system for PV power plants.

General information
State: Published
Number of pages: 1
Publication date: 2017
Peer-reviewed: Yes
Electronic versions:
program_20172.pdf

Indoor measurement of angle resolved light absorption by antireflective glass in solar panels
In this work, we present measurements of angle resolved light absorption of antireflective (AR) glass of PV samples, performed indoors using a collimated high radiance broadband light source. This indoor method proved to be viable and offered a significant simplification compared to outdoor measurements with trackers. The experimental results showed optical responses that are stable and suitable for indoor characterization of solar cells. We find the characteristic optical response of six different antireflective glasses, and based on such measurements, we perform PVsyst simulations and present the monthly DC energy production estimates across four distinct latitudinal locations with six different glass types. The results indicated that the AR glasses present different optical effects at the angles intervals between 0 – 45° and 60 –
90° and that the Diffuse AR glass can improve monthly yields by as much as 2% relatively to a bare cell.

**Indoor Measurement of Angle Resolved Light Absorption by Black Silicon**

Angle resolved optical spectroscopy of photovoltaic (PV) samples gives crucial information on PV panels under realistic working conditions. Here, we introduce measurements of angle resolved light absorption by PV cells, performed indoors using a collimated high radiance broadband light source. Our indoor method offers a significant simplification as compared to measurements by solar trackers. As a proof-of-concept demonstration, we show characterization of black silicon solar cells. The experimental results showed stable and reliable optical responses that makes our setup suitable for indoor, angle resolved characterization of solar cells.

**Investigation of saturation effects in ceramic phosphors for laser lighting**

We report observation of saturation effects in a Ce:LuAG and Eu-doped nitride ceramic phosphor for conversion of blue laser light for white light generation. The luminous flux from the phosphors material increases linearly with the input power until saturation effects limit the conversion. It is shown, that the temperature of the phosphor layer influences the saturation power level and the conversion efficiency. It is also shown that the correlated color temperature (CCT), phosphor conversion efficiency and color rendering index (CRI) are dependent both on incident power and spot size diameter of the illumination. A phosphor conversion efficiency up to 140.8 lm/W with CRI of 89.4 was achieved. The saturation in a ceramic phosphor, when illuminated by high intensity laser diodes, is estimated to play the main role in limiting the available luminance from laser based lighting systems.
Laser driven white light source for BRDF measurement

In this paper, we will present a setup with laser driven light source (LDLS) for measuring a 2D bidirectional reflectance distribution function (BRDF). We have carried out measurements to acquire the BRDF of different samples based on our setup: which consists of a new laser driven broadband light source (UV-VIS-NIR), spectroradiometer and sample holder stepper motor in a dark UV-protected environment. Here, we introduced a special kind of light source which has a bright, stable, broad spectral range and well collimated light output to give a very good angular resolution. The experimental results show how stable and reliable is our light source in terms of spectral power distribution, and in BRDF measurement. Furthermore we have shown that we are able to get a well collimated beam and higher power output using set of off-axis parabolic mirrors.

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems
Contributors: Amdemeskel, M. W., Thorseth, A., Dam-Hansen, C.
Pages: 530-537
Publication date: 2017

Host publication information
Title of host publication: Proceedings of the Conference on "Smarter Lighting for Better Life" at the CIE Midterm Meeting 2017
Light source characterization and air movement under CIE S 025

In 2015, the International Commission on Illumination (CIE) published the standard CIE S 025/E:2015 Test Method for LED Lamps, LED Luminaires and LED Modules. This document contains a number of standard test conditions, including laboratory room preparation, environmental and electrical provisions as well as requirements for the performance of testing and measurement equipment. One of the environmental considerations is a restriction of the airflow incident on the device under test. The sensitivity of LED source based devices to airflow is important for estimating the uncertainty originating from airflow. We find that for most of the tested devices the sensitivity is on the order of 5 %/(m/s), which is consistent with CIE S 025. However, we also found an example of a device with a larger sensitivity. Additionally we study general airflow measurements and influence of turbulence.

Luminescence Imaging Strategies for Drone-Based PV Array Inspection

The goal of this work is to develop outdoor defect detection imaging and understand fully its challenges and limitations. The imaging is based on luminescence strategies that will be used for fast and accurate UAV-based inspection system for PV power plants. We studied electroluminescence (EL) acquisition under natural light conditions during several times of the day, under high sun irradiation, to unveil the sunlight noise characteristics towards an InGaAs detector. In order to bring more freedom to a drone-based inspection, we also show the preliminary results of a laser-line based photoluminescence (PL) strategy as a viable method for an outdoor module PL imaging system.

Monte Carlo analysis of a control technique for a tunable white lighting system

A simulated colour control mechanism for a multi-coloured LED lighting system is presented. The system achieves adjustable and stable white light output and allows for system-to-system reproducibility after application of the control mechanism. The control unit works using a pre-calibrated lookup table for an experimentally realized system, with a calibrated tristimulus colour sensor. A Monte Carlo simulation is used to examine the system performance concerning the
variation of luminous flux and chromaticity of the light output. The inputs to the Monte Carlo simulation, are variations of the LED peak wavelength, the LED rated luminous flux bin, the influence of the operating conditions, ambient temperature, driving current, and the spectral response of the colour sensor. The system performance is investigated by evaluating the outputs from the Monte Carlo simulation. The outputs show that the applied control system yields an uncertainty on the luminous flux of 2.5% within a 95% coverage interval which is a significant reduction from the 8% of the uncontrolled system. A corresponding uncertainty reduction in Δu’v’ is achieved from an average of 0.0193 to 0.00125 within 95% coverage range after using the control system.

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems
Contributors: Chakrabarti, M., Thorseth, A., Jepsen, J., Corell, D. D., Dam-Hansen, C.
Pages: 716-728
Publication date: 2017
Peer-reviewed: Yes

Publication information
Journal: Lighting Research and Technology
Volume: 50
Issue number: 5
ISSN (Print): 1477-1535
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.24 SJR 0.66 SNIP 1.157
Web of Science (2017): Impact factor 1.921
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.05 SJR 0.533 SNIP 1.495
Web of Science (2016): Impact factor 1.784
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.42 SJR 0.821 SNIP 1.555
Web of Science (2015): Impact factor 1.667
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.19 SJR 0.856 SNIP 1.83
Web of Science (2014): Impact factor 1.691
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.48 SJR 0.938 SNIP 1.599
Web of Science (2013): Impact factor 1.485
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 0.96 SJR 0.793 SNIP 1.786
Web of Science (2012): Impact factor 1.197
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 0.83 SJR 0.583 SNIP 1.482
Web of Science (2011): Impact factor 1.551
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.945 SNIP 1.604
Web of Science (2010): Impact factor 0.738
BFI (2009): BFI-level 1
New Light Source Setup for Angle Resolved Light Absorption measurement of PV sample
Here, we introduce measurements of angle resolved light absorption by PV cells, using broadband laser driven white light source with a bright, stable, broad spectral range and well collimated light.

General information
State: Published
Number of pages: 1
Publication date: 2017
Peer-reviewed: Yes
Keywords: Absorption, Collimated, Reproducibility, Laser
Electronic versions:
Amdemeskel_Abstract_.pdf
Research output: Research - peer-review > Conference abstract for conference – Annual report year: 2017

New Light Source Setup for Angle Resolved Light Absorption measurement of PV samples
Here, we introduce measurements of angle resolved light absorption by PV cells, using broadband laser driven white light source with a bright, stable, broad spectral range and well collimated light.

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems, Photovoltaic Materials and Systems
Number of pages: 1
Publication date: 2017
Peer-reviewed: Yes
Electronic versions:
program-20177
Research output: Research - peer-review > Paper – Annual report year: 2017

Optimizing sensitivity of Unmanned Aerial System optical sensors for low zenith angles and cloudy conditions
Satellite-based imagery in optical domains cannot provide information on the land surface during periods of cloud cover. This issue is especially relevant for high latitudes where overcast days and low solar zenith angles are common. Current
remote sensing-based models of evapotranspiration or carbon assimilation are biased towards clear sky conditions, lacking important information on biophysical processes under cloudy conditions. Unmanned Aerial Vehicle (UAV) imagery has great potential to monitor and understand surface fluxes under cloudy conditions. For instance, in Denmark 73.54% of all days are non-clear (fraction of direct radiation less than 50%). UAV multispectral imagery acquired in these conditions tends to present low brightness and dynamic ranges, and high noise levels. Another problem is the influence of land cover types on the signal. For instance, over vegetated areas, even with low irradiance, saturation is reached in the near Infrared, while visible channels have low brightness. An individual camera setting for each channel and light conditions can improve sensor sensitivity while preventing saturation. This study aims to optimize the settings and radiometric corrections of a multispectral camera to produce high quality UAV imagery under low but homogeneous irradiance conditions. Laboratory experiments were conducted to link irradiance levels to different camera settings and calibration procedures. Results were tested outdoors over homogeneous and vegetated surfaces.

The multispectral camera (Tetra Mini-MCA6) has 6 channels in the visible and near Infrared. For the laboratory calibration experiment, different camera settings and typical irradiance levels from cloudy to clear sky were designed. The light-source is based on super-continuum generation to produce a continuous solar spectrum. It allows more flexible settings in illumination levels than tungsten halogen lamps. A Li-Cor 1800 integrating sphere and an ASD spectroradiometer (FieldSpec HandHeld 2) were also used. Images were acquired under varying integration time and illumination levels from 0.005 to 0.2 W·m⁻²·nm⁻¹·sr⁻¹. Two radiometric calibration methods were applied to find gains to convert digital numbers (DN) into radiance and also to correct vignetting effects, apparent as the fall-off pixel intensity from the image center towards edges. The first is to apply a pixel-wise calibration from DN to radiance. The second performs a vignetting correction based on distance from each pixel to the highest DN pixel and then a global image calibration of averaged DN to radiance. To test calibration performance, images were acquired outdoors over (i) homogeneous targets (Teflon panels, grass and soil plots) and (ii) with UAV flight campaigns over a willow eddy covariance flux site under different cloudiness levels and solar zenith angles using varying camera settings. Radiance, reflectance, and vegetation indices were validated with ASD measurements and signal to noise metrics and dynamic ranges were assessed. Our results indicate that the spectral gains and camera settings can be tuned to allow higher signal to noise ratio and optimize the sensor sensitivity. This maximizes the image radiometric resolution and prevents sensor saturation for each channel. This paper is a step forward for UAV campaigns using optical cameras for low zenith angles and/or cloudy conditions.

General information
State: Published
Organisations: Department of Environmental Engineering, Water Resources Engineering, Department of Photonics Engineering, Diode Lasers and LED Systems, Metamaterials, DTU Danchip, National Space Institute, Geodesy, Atmospheric Environment, European Commission - Joint Research Center
Number of pages: 1
Publication date: 2017
Peer-reviewed: No
Event: Poster session presented at 10th EARSeL SIG Imaging Spectroscopy Workshop, Zurich, Switzerland.
Keywords: Sensor calibration, Unmanned aerial vehicle, Low illumination conditions
Electronic versions:
Abstract_EARSel.pdf
Earsel_poster_mgarc_sheng.pdf
Research output: Research › Poster – Annual report year: 2017

Phosphor converted laser diode light source for endoscopic diagnostics
In order to provide light sources for endourology and on-site testing of the light source, we are developing a portable endoscope light source prototype based on a phosphor converted laser diode. A small emitting area from the phosphor material excited by a laser diode enables coupling of the generated white light into thin optical fibres. The development involves designing optics for optimizing the light extraction efficiency and guiding of light to the area of interest. In this paper we compared the developed light source to the current standard in endoscopy – xenon arc lamps. Detailed spectral analysis of illuminance, CRI and CCT at two power levels and two distances for both the PC-LD and the xenon light source was performed. The obtained results verified that the developed light source is suitable for endoscopy illumination and the first pre-clinical trials will be performed shortly.

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems
Pages: 942-949
Publication date: 2017

Host publication information
Title of host publication: Proceedings of the Conference on "Smarter Lighting for Better Life" at the CIE Midterm Meeting 2017
Phosphor converted laser diode light source for endoscopic diagnostics
Highly efficient endoscopic white light sources may be enabled by use of phosphor converted blue laser diodes. This light source offers the advantages of a more compact and ergonomic design, lower cost, possibility of tailoring the spectral content and more uniform illumination in comparison with current technology, as well as providing the possibility of shadow formation within the operative field.

Photometric and Colorimetric Comparison of HDR and Spectrally Resolved Rendering Images
In this paper, we will demonstrate a comparison between measured colorimetric images, and simulated images from a physics based rendering engine. The colorimetric images are high dynamic range (HDR) and taken with a luminance and colour camera mounted on a goniometer. For the comparison, we have used a scene similar to the cornel box (CUPCG, 1998) but with a spectrally controllable LED light source, neutral grey walls and a colour checker board for colorimetric assessments. The luminance value and colour information of the HDR camera and rendering images are used for the comparison. The spectral irradiances of the light source were measured for two lighting scenarios: low and high correlated colour temperature (CCT) white lighting conditions for the modelling of the light source. Based on these measurements, we have conducted spectrally resolved renderings with a spectral renderer, Ocean. The colour differences between the camera and rendered images were calculated with the most recent CIE metric, CIEDE2000 (CIE, 2012). Our simulations have demonstrated interesting results, which confirm the accuracy of the Ocean engine. In the future, we want to consider non-Lambertian surfaces.

A comparison of goniophotometric measurement facilities.
In this paper, we present the preliminary results of a comparison between widely different goniophotometric and gonipectoradiometric measurement facilities. The objective of the comparison is to increase consistency and clarify the capabilities among Danish test laboratories. The study will seek to find the degree of equivalence between the various facilities and methods. The collected data is compared by using a three-way variation of principal component analysis, which is well suited for modelling large sets of correlated data. This method drastically decreases the number of numerical values needed to represent the data. The model shows good agreement with data, while also highlighting the differences between the measurements. We conclude that the method could be useful for comparing large sets of goniophotometric
Angle resolved performance measurements on PV glass and modules

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems, Optical Microsensors and Micromaterials, SolarLab ApS
Number of pages: 1
Publication date: 2016
Peer-reviewed: Yes
Event: Poster session presented at 32nd European Photovoltaic Solar Energy Conference and Exhibition, Munich, Germany.
Electronic versions:
Balcony_Fence.pdf
Source: PublicationPreSubmission
Source-ID: 124999371
Research output: Research - peer-review › Poster – Annual report year: 2016

Angle Resolved Performance Measurements on PV Glass and Modules.
The angular response of PV-modules has significant impact on the energy production. This is especially pronounced in BIPV where installation angles often are far from optimal. Nevertheless, a gain in energy yield may be obtained by choosing a proper glass as superstrate. In this work we present the concept of PV balconies as cost efficient and easy way of integrating PV into buildings. The experimental work consists of the fabrication of single cell mini modules with different glass covering, and characterizing their angular response in a custom made setup, where only the direct sunlight is used as a light source. As a special case we estimate the annual yield for each glass in the case of PV balconies for a specific geographical location and orientation of the module.

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems, Optical Microsensors and Micromaterials, SolarLab ApS
Contributors: Juutilainen, L. T., Thorsteinsson, S., Poulsen, P. B., Thorseth, A., Amdemeskel, M. W., Canulescu, S., Rødder, P. M., Rødder, K.
Pages: 2235-8
Publication date: 2016

Host publication information
ISBN (Print): 3936338418
Keywords: Solar Cell, Building Integrated Photovoltaic (BIPV), PV Application, Angular Performance
Source: PublicationPreSubmission
Source-ID: 124998425
Research output: Research - peer-review › Article in proceedings – Annual report year: 2016
CooLED - efficient LED bulbs with custom optics - final report

General information
State: Published
Number of pages: 33
Publication date: 2016

Publication information
Publisher: Energiteknologisk Udviklings- og Demonstrationsprogram
Original language: Danish
Electronic versions:
160131_CooLED_slutrapport_tilpasset.pdf
Source: PublicationPreSubmission
Source-ID: 120690205
Research output: Research › Report – Annual report year: 2016

Design, characterization and modelling of high efficient solar powered lighting systems

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems, Department of Electrical Engineering, Electronics, Technical University of Denmark, Out-sider A/S
Number of pages: 1
Publication date: 2016
Peer-reviewed: Yes
Event: Poster session presented at 32nd European Photovoltaic Solar Energy Conference and Exhibition, Munich, Germany.
Electronic versions:
PV_LED_Engine_Modelling.pdf
Source: PublicationPreSubmission
Source-ID: 124999826
Research output: Research - peer-review › Poster – Annual report year: 2016

OLEDs used in solar powered lighting applications is a market of the future. This paper reports the development of electronic Three-Port-Converters for PV OLED product integration in the low-power area respectively for 1-10 Wp and 10-50 Wp with a peak efficiency of 97% at 1.8 W of PV power for the 10 Wp version. Furthermore, we present measurements of state-of-the-art commercial available OLED with regards to the luminous flux, luminous efficacy, luminance homogeneity, temperature dependency and IV characteristic of the OLED panels. In addition, solar powered OLED product concepts are proposed.

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems, Department of Electrical Engineering, Electronics
Number of pages: 5
Publication date: 2016

Host publication information
Title of host publication: Proceedings of the 2016 European Photovoltaic Solar Energy Conference and Exhibition
Keywords: Stand-alone PV Systems, High-Efficiency, Design, OLEDs
Source: PublicationPreSubmission
Source-ID: 124998446
Research output: Research - peer-review › Article in proceedings – Annual report year: 2016
Glass Quality and Health in Public Housing

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems, University of Copenhagen, Ramboll Group AS, Aalborg University
Contributors: Volf, C., Svendsen, S. D., Vestergaard, S., Callesen, H., Thorseth, A., Markvart, J., Martiny, K., Petersen, P. M., Johnsen, K.
Publication date: 2016
Peer-reviewed: No
Event: Poster session presented at 28th annual SLTBR meeting, New York, United States.
Electronic versions:
poster_sltbr_2016_final_cv.pdf
Research output: Research › Poster – Annual report year: 2016

PV BALCONY FENCE - a highly esthetic cost efficient PV integrated balcony

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems, Optical Microsensors and Micromaterials, SolarLab ApS
Number of pages: 1
Publication date: 2016
Peer-reviewed: Yes
Keywords: Solar cells, PV applications, Characterization, Energy systems
Electronic versions:
Abstract_2_.pdf
Source: PublicationPreSubmission
Source-ID: 124998402
Research output: Research - peer-review › Poster – Annual report year: 2016

Saturation effects of phosphor converted laser diodes

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems
Contributors: Krasnoshchoka, A., Jensen, O. B., Thorseth, A., Dam-Hansen, C., Petersen, P. M.
Number of pages: 1
Publication date: 2016
Peer-reviewed: Yes
Electronic versions:
SATURATION_EFFECTS_OF_PHOSPHOR_CONVERTED_LASER_DIODES.pdf
Source: PublicationPreSubmission
Source-ID: 128071236
Research output: Research - peer-review › Poster – Annual report year: 2016

A color management system for multi-colored LED lighting.
A new color control system is described and implemented for a five–color LED light engine, covering a wide white gamut. The system combines a new way of using pre-calibrated look-up tables and a rule-based optimization of chromaticity distance from the Planckian locus with a calibrated color sensor. The color sensor monitors the chromaticity of the mixed light providing the correction factor for the current driver by using the generated look-up table. The long term stability and accuracy of the system will be experimentally investigated with target tolerance within a circle radius 0.0011 in the uniform chromaticity diagram (CIE 1976)

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems
Contributors: Chakrabarti, M., Thorseth, A., Jepsen, J., Corell, D. D., Dam-Hansen, C.
Number of pages: 9
An experimental investigation of a compact and portable goniospectrometer system is described. Measurements are performed in two very different conditions, in a normal office environment and in a photometry laboratory under standard environmental conditions and both are compared to reference measurements in a near-field goniophotometer. A collection of six different types of directional and non-directional integrated LED lamps with three samples of each were used as test devices. It is shown that the main uncertainty comes from the inadequate thermal stabilisation of the LED lamps. With pre-heating relative differences for total luminous flux of ±2.5% were obtained. Reliable photometric data can be obtained for use in market monitoring to identify probable non-compliance LED lamps and hence as an improved method for selecting LED lamps for accredited verification testing.

A new self-made digital slide scanner and microscope for imaging and quantification of fluorescent microspheres

Objective: A low-cost microscope slide scanner was constructed for the purpose of digital imaging of newborn piglet brain tissue and to quantify fluorescent microspheres in tissue. Methods: Using a standard digital single-lens reflex (DSLR) camera, fluorescent imaging of newborn piglet brain tissue was performed. A computer algorithm available for download was created to detect fluorescent microspheres in the brain tissue slides and to calculate regional cerebral blood flow (rCBF). The precision of the algorithm was tested by comparing with manual counting of the fluorescent microspheres. Finally, bright-field imaging was tested by adding light diffuser film. Results: Cost of the slide scanner was a fraction of the cost of a commercial slide scanner. The slide scanner was able to image a large number of tissue slides in a semiautomatic manner and provided a large field of view (FOV) of 101 mm$^2$ combined with a resolution of 2.9 μm. The mean difference (SD) between manual and automatic counts was in absolute numbers 0.32 (1.5) microspheres ranging from -5 to 5 microspheres per slide. The relative total difference between automatic and manual counts was -3.1%. Conclusions: A slide scanner was constructed and an automatic algorithm to detect fluorescent microspheres in tissue was developed and validated and showed an acceptable difference to "gold standard" manual counting. The slide scanner can be regarded as a low-cost alternative for researchers when digital slide imaging and quantification of fluorescent microspheres are needed.
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems, Department of Applied Mathematics and Computer Science, Image Analysis & Computer Graphics, University of Copenhagen, Copenhagen University Hospital
Contributors: Henning, W., Bjerglund Andersen, J., Højgaard, L., Greisen, G., Law, I., Thorseth, A., Christensen, A. N.
Pages: 33-39
Publication date: 2015
Peer-reviewed: Yes

Publication information
Journal: Journal of Biomedical Graphics and Computing
Volume: 5
Issue number: 2
ISSN (Print): 1925-4008
Ratings:
Web of Science (2015): Indexed yes
Original language: English
Keywords: Fluorescence, Slide scanner, Microspheres, Microscopy, Cerebral blood flow, Bright-field
Electronic versions:
6879_26016_1_PB.pdf
DOIs:
10.5430/jbgc.v5n2p33
Source: PublicationPreSubmission
Source-ID: 116617439
Research output: Research - peer-review › Journal article – Annual report year: 2015

Auxiliary correction in goniophotometry, simulation and measurement.
Auxiliary correction in goniophotometry, simulation and measurement

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems
Contributors: Thorseth, Å.
Pages: 6-14
Publication date: 2015

Host publication information
Title of host publication: Proceedings of CIE Expert Symposium on the CIE S 025 LED Lamps, LED Luminaires and LED Modules Test Standard
Publisher: CIE - International Commission on Illumination
ISBN (Print): 978-3-902842-28-2
Source: PublicationPreSubmission
Source-ID: 122377904
Research output: Research - peer-review › Article in proceedings – Annual report year: 2016

A white–cyan-red LED system for low correlated colour temperature lighting
A white LED complemented by cyan and red LEDs is a good candidate for achieving high colour rendering at low correlated colour temperatures. This is usually very difficult with commercially available white LEDs. In addition, the system is able to replace incandescent lighting in many applications; for example, the lighting for museum display cases. To investigate and optimize the colour and light distribution properties, both spectral and geometrical modelling are used. Mapping of the possible combinations of LEDs is used to locate the optimal solutions within the colour gamut, with emphasis on chromaticity and colour rendering indices. A geometric optical model is used to design and optimize the homogeneity of the colour and light intensity distribution as a function of angle. The resulting system produces diffused homogeneous white light with a tunable correlated colour temperature from 2000 K to 2400 K. Within this range the white light is characterized by a high general colour rendering index ($R_g > 80$), special colour rendering indices for saturated red objects ($R_2 > 85$), and low chromaticity distance ($Duv < 2 \times 10^{-3}$).

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems
Contributors: Chakrabarti, M., Thorseth, A., Corell, D. D., Dam-Hansen, C.
Number of pages: 14
Publication date: 2015
Peer-reviewed: Yes
Facility to evaluate street lightning solutions in a realistic urban setting
This paper describes a new large scale outdoor testing facility for street lighting solutions, that has been establish in Denmark for both research and demonstration purposes. The facility is fitted with lamp posts with an array of sensors and connections to allow for monitoring and control of lighting solutions under test. Initial data suggests a 75% reduction in energy usage from use of LED luminaries combined with traffic monitoring systems could be achievable.

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems
Contributors: Andersen, J. M., Thorseth, A., Dam-Hansen, C.
Pages: 223-228
Publication date: 2015

Goniometric characterization of LED based greenhouse lighting
This paper describes a demonstration of goniospectroradiometry for characterizations of new light emitting diode (LED) based luminaries for enhanced photosynthesis in greenhouses. It highlights the differences between measurement of the traditional high pressure sodium (HPS) luminaries and the LED based luminaries. The LED based luminaries are compared to traditional HPS luminaries; in terms of energy efficiency with regard to the photosynthetic photon flux, and the LED luminaries were found to be more effective than the HPS luminaries

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems
Contributors: Thorseth, A., Lindén, J., Corell, D. D., Dam-Hansen, C.
Number of pages: 9
Publication date: 2015
Monte Carlo analysis of multicolour LED light engine

A new Monte Carlo simulation as a tool for analysing colour feedback systems is presented here to analyse the colour uncertainties and achievable stability in a multicolour dynamic LED system. The Monte Carlo analysis presented here is based on an experimental investigation of a multicolour LED light engine designed for white tuneable studio lighting. The measured sensitivities to the various factors influencing the colour uncertainty for similar system are incorporated. The method aims to provide uncertainties in the achievable chromaticity coordinates as output over the tuneable range, e.g. expressed in correlated colour temperature (CCT) and chromaticity distance from Planckian locus (Duv), and colour rendering indices (CRIs) for that dynamic system. Data for the uncertainty in chromaticity is analysed in the u′, v′ (Uniform Chromaticity Scale Diagram) for light output by comparing the variations in chromaticity differences with the "n – step u′ v′ circles" as defined in CIE TN001:2014.
Comparison of stray light in spectrometer systems using a low cost monochromatic light source
We present an experimental setup that is under development for automated stray light characterization of spectrometers. The setup uses a tuneable monochromator which enables this characterization on relatively cost low equipment. We present the measured line spread functions for two spectrometers, one low-end and one mid-range.

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems
Contributors: Thorseth, A., Lindén, J., Dam-Hansen, C.
Pages: 557-564
Publication date: 2014

Host publication information
Title of host publication: Proceedings of CIE 2014 : Lighting Quality and Energy Efficiency
Publisher: International commision on illumination
ISBN (Print): 978-3-902842-49-7
Keywords: Spectroradiometry, Line spread functions, Stray light correction
Source: PublicationPreSubmission
Source-ID: 93299824
Research output: Research - peer-review › Article in proceedings – Annual report year: 2014

CopenHybrid - Udvikling af CO2 neutralt byrumsarmatur - Fase 1.5 - Slutrapport

General information
State: Published
Number of pages: 27
Publication date: 2014

Publication information
Original language: English
Source: PublicationPreSubmission
Source-ID: 117015570
Research output: Research › Report – Annual report year: 2015

Energy Efficient Task Light: Final report for PSO 344-059
The objectives of this work is to develop a task light for office lighting that fulfils the minimum requirements of the European standard EN12464 - 1 : Light and lighting – Lighting of work places, Part 1: Indoor workplaces and the Danish standard DS 700 : Lys og belysning i arbejdsmiljø, or more specifically the requirements that apply to the work area and the immediate surrounding area. By providing a task light that fulfills the requirements for task lighting and the immediate surrounding area, the general lighting only needs to provide the illuminance levels required for background lighting and thereby a reduction in installed power for general lighting of about 40 % compared to the way illuminance levels are designed in an office environment in Denmark today. This lighting strategy is useful when the placement of the task area is not defined in the space before the lighting is designed and the strategy also allows for the task area to be redefined in the space. The task lighting follows the task area as the developed task light is designed to be placed on the desktop of an office desk. The work carried out within this project is the architectural design of the task light, the optical design of the light distribution, prototype production and user tests for comparison between the prototype and traditional task lighting luminaries. The architectural design and user friendliness of the task light was a high priority within the project in order to promote market penetration of such a product. The height of the lamp head is aligned with respect to distribution and glare, which are two conflicting parameters. The broad distribution of the light requires a flat lamp head with the light source close to the bottom edge, while the desire to minimize glare is met by raising the lamp head and placing the light source as far from the bottom edge as possible. The main results of the project show opportunities for energy savings in an office environment by reducing the installed power for the general lighting by applying a task light with a wide light distribution across the desk area, providing high illuminance uniformity. There is still work to be done on the prototype to optimize the energy consumption of the task light and measures need to be taken to minimize glare from the task light as well as reflected glare. The lamp head adjustment possibilities regarding tilting and turning result in problems with glare and these adjustment possibilities should be eliminated in the final product. In general, the adjustment possibilities for
height, length ways and sideways are important aspects for task lights, however they become less important when the light distribution is as wide as for the prototype. Using only standard components in the prototype, the optimal light distribution for the purpose of meeting the requirements could not be obtained. The light distribution was approximated to the requirements by using combinations of different beam shaping lenses. A final product would benefit from custom made lenses, capable of providing the desired light distribution. The user test shows that when working with general lighting of 100 lx in the room the developed task light with its wide light distribution provides flexibility in choosing a reading task area on the desk and provides more visibility to all objects on the desk than the two traditional reference task lights with LED retrofit light bulbs. By utilising this new type of task light, the energy consumption by general lighting can be reduced by approximately 40 % by fully exploiting the lower illuminance levels required by lighting standards for the background lighting. The energy consumption of the task lights should be optimized for a wide light distribution while minimizing problems with glare.

**General information**

State: Published  
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems, Aalborg University, Lundgaard & Tranberg Arkitekter, Fagerhult AS  
Contributors: Logadottir, A., Ardkapan, S. R., Johnsen, K., Baadsgaard, S., Dam-Hansen, C., Thorseth, A., Johansson, H.  
Publication date: 2014

**Luminous flux and colour maintenance investigation of integrated LED lamps**

This article will present an investigation of the luminous flux and colour maintenance of white LED based retrofit lamps. The study includes 23 different types of integrated LED lamps, covering 18 directional and 5 non-directional. Luminous flux and colour data for operation up to 20000 h has been measured, and will be presented. Data for the first 6000 h of operation is used for studying extrapolation method and results are compared with experimental data for operation over 19000 h. It has been further examined when catastrophic failures occurred.

**General information**

State: Published  
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems  
Contributors: Corell, D. D., Thorseth, A., Dam-Hansen, C.  
Pages: 408-414  
Publication date: 2014

**Slutrapport for Hybrid belysning på skolebænken**

Denne rapport indeholder en beskrivelse af arbejdet udført i og resultaterne af forsknings- og udviklingsprojektet "Hybrid belysning på skolebænken" og udgør slutrapportering for dette projekt.
Værktøjer til fremme af energibesparende LED belysning i underholdningsindustrien

Comparing the light quality of retrofit LED products

95 % rigtigt eller 100 % forkert?
Comparison of user satisfaction with four different lighting concepts
This study aims at comparing user satisfaction for different lighting concepts in an office environment. The lighting concepts being compared are a conventional static lighting concept from ceiling mounted luminaires against three different types of dynamic task lighting concepts, the first providing occupant controlled task illuminance, the second concept providing occupant controlled CCT and the third providing automatically controlled CCT. Another aim is to identify which of the four lighting concepts is rated as most preferred by the test subjects. Subjects tested all four lighting concepts and questionnaires were used for rating of the concepts. Adjustable CCT of the task light was the most preferred lighting concept followed by adjustable task illuminance. Automatically controlled task CCT and conventional lighting were the least preferred. User satisfaction ratings for the lighting concepts are in the following order; Adjustable task CCT, adjustable task illuminance, automatic control of task CCT and conventional lighting.

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems, Aalborg University
Pages: 159-168
Publication date: 2013

Host publication information
Title of host publication: Proceedings of CIE Centenary Conference „Towards a New Century of Light“ : CIE x038:2013
Publisher: CIE - International Commission on Illumination
ISBN (Print): 978-3-902842-44-2
Keywords: User satisfaction, Office lighting concepts, Occupant control

Bibliographical note
Paper: OP23
Research output: Research - peer-review › Article in proceedings – Annual report year: 2013

CopenHybrid – Development of a CO2 neutral hybrid street lighting system for the Danish municipalities’ illumination classes
In the present work a group of the leading researchers in Wind Energy, Solar Energy, LED and optics in Denmark have been working together with the relevant industrial technology partners and a wide range of the Danish municipalities with Gate 21 and Copenhagen Municipality in front to investigate the potential for use of hybrid street lighting in the Danish illumination classes in the municipalities and develop a specialized solution based on the specific needs of the municipalities.

General information
State: Published
Number of pages: 3
Publication date: 2013
Peer-reviewed: Yes
Event: Abstract from 4th World Summit for Small Wind (WSSW 2013), Husum, Germany.
Keywords: Hybrid luminary, Street lamp, CO2 neutral, Small wind turbine, Savonius, Urban wind energy

URLs:
Source: dtu
Source-ID: u::6973
Research output: Research - peer-review › Conference abstract for conference – Annual report year: 2013

**CopenHybrid – Development of a CO2 Neutral Hybrid Street Lighting System for the Danish Municipalities’ Illumination**

**Classes**

A mathematical model has been developed for the energy system of the hybrid street lighting making it possible to simulate a given configuration (solar panel performance data, size and orientation - wind turbine performance data, projected area and height - battery data) over a year in an urban environment of a given configuration based on measured wind/solar/temperature data from nearby meteorological station or other relevant weather data. The simulation can show if it is possible to cover the consumption by the light source over the year. The model can be used to evaluate both commercial hybrid systems and to dimension new systems for use in given environments where the weather data are known. Since weather and day/night length are varying a lot around the world the systems should be dimensioned very differently depending on the place of use. By using the simulation tool it is shown that it is possible to create a hybrid street lighting for an urban environment with a maximum of 2 floor height buildings which governs >70% of the luminaires in Copenhagen (the Capital of Denmark) fulfilling the requirements of 2.5 lux on the street over the year. Furthermore the tool is powerful to evaluate hybrid systems on the market (if all the technical data is known) for use in a given urban placement.

**General information**

State: Published

Number of pages: 6
Pages: 5DO.13.1
Publication date: 2013

**Host publication information**

Title of host publication: Proceedings of the 28th EU PVSEC
Electronic versions:
5DO.13.1.pdf
Source: dtu
Source-ID: u::9384
Research output: Research - peer-review › Article in proceedings – Annual report year: 2013

**Dynamic miniature lighting system with low correlated colour temperature and high colour rendering index for museum lighting of fragile artefacts**

Illumination of fragile and irreplaceable historical objects exhibited to the public presents challenges with regards to: good colour rendering, low photochemical degradation of sensitive materials and general energy consumption. We present a dynamic tri-colour LED lighting system for illumination of historical artefacts in display cases at museums and other exhibitions, which can replace 3-5 Watt incandescent light bulbs with a correlated colour temperature (CCT) from 2000 K to 2400 K. The solution decreases the energy consumption by up to 80 %, while maintaining colour rendering indices (Ra) above 90 and important special colour rendering indices R9 between 50 and 90, while decreasing the level of harmful short wavelength radiation by between 20 - 30 %.

**General information**

State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems
Contributors: Thorseth, A., Corell, D. D., Poulsen, P. B., Dam-Hansen, C., Petersen, P. M.

Pages: 777-782
Publication date: 2013

**Host publication information**

Title of host publication: Proceedings of CIE Centenary Conference „Towards a New Century of Light“ : CIE x038:2013
Publisher: CIE - International Commission on Illumination
ISBN (Print): 978-3-902842-44-2
Keywords: Colour rendering index, Correlated colour temperature, Museum lighting, Dynamic light source, Photochemical damage, Energy saving, Incandescent replacement
Experimental investigation of small wind turbines on hybrid street lamps

General information
State: Published
Publication date: 2013

Host publication information
Title of host publication: Proceedings of 12th World Wind Energy Conference & Renewable Energy Exhibition (WWEC 2013)
Publisher: World Wind Energy Association (WWEA)

Intelligent styring af dynamisk LED belysning

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems
Contributors: Thorseth, A., Corell, D. D., Hansen, S. S., Dam-Hansen, C., Petersen, P. M.
Number of pages: 8
Publication date: 2013

Publication information
Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark (DTU)
Original language: Danish
Electronic versions: Bilag_8_Slutrapport_fra_DTU.pdf

Kombineret dagslys og intelligent LED belysning - få dagslys ind i bygningerne: Slutrapport for PSO 342-044 og PSO 344-007

This report contains a description of the work carried out and the results of the research and development project "Combined daylight and Intelligent LED lighting - getting the daylight into the buildings" and form the final report for this project.
The project is carried out in cooperation between the following partners: DTU Fotonik, Statens Byggeforsknings-institut, Rambøll Danmark, Energirådgiveren and Philips Lighting Denmark. The project has been led by DTU Fotonik, Senior scientist, Ph.d. Carsten Dam-Hansen
The project was financed by the Danish Energy Association through Elforsk’s PSO program, under actions 1. Buildings, 3. Lighting and 5. Power and control electronics. The project has no. PSO 342-044 and PSO 344-007. It was initiated in February 2010 and was ended in March 2013. In the first part of the report a short resume of the project is given, describing the background and aim of the project, the work and results together with future perspectives of the results of the project. The report contains an overview of dynamic lighting systems and a description of the development of a new intelligent dynamic lighting system based on color mixing LED technology. The system, which has been developed for research purposes, is described in the last part of the report together with a description of the research user test done with the system. Finally the work on communicating the results of the project is described.

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems, Aalborg University
Number of pages: 28
Publication date: 2013

Publication information
Publisher: DTU Fotonik
Original language: Danish
Light quality and efficiency of consumer grade solid state lighting products

The rapid development in flux and efficiency of Light Emitting Diodes (LED) has resulted in a flooding of the lighting market with Solid State Lighting (SSL) products. Many traditional light sources can advantageously be replaced by SSL products. There are, however, large variations in the quality of these products, and some are not better than the ones they are supposed to replace. A lack of quality demands and standards makes it difficult for consumers to get an overview of the SSL products.

Here the results of a two year study investigating SSL products on the Danish market are presented. Focus has been on SSL products for replacement of incandescent lamps and halogen spotlights. The warm white light and good color rendering properties of these traditional light sources are a must for lighting in Denmark and the Nordic countries. 266 SSL replacement lamps have been tested for efficiency and light quality with respect to correlated color temperature and color rendering properties.

This shows a trade-off between high color rendering warm white light and energy efficiency. The lumen and color maintenance over time has been investigated and results for products running over 11000 h will be presented. A new internet based SSL product selection tool will be shown. Here the products can be compared on efficiency, light quality parameters, thus providing a better basis for the selection of SSL products for consumers.
In this paper, we study the origin of a strong wavelength dependence of the quantum efficiency of InP/ZnS nanocrystals. We find that while the average size of the nanocrystals increased by 50%, resulting in longer emission wavelength, the quantum efficiency drops more than one order of magnitude compared to the quantum efficiency of the small nanocrystals. By correlating this result with the time-resolved photoluminescence we find that the reduced photoluminescence efficiency is caused by a fast growing fraction of non-emissive nanocrystals while the quality of the nanocrystals that emit light is similar for all samples. Transmission electron microscopy reveals the polycrystalline nature of many of the large nanocrystals, pointing to the grain boundaries as one possible site for the photoluminescence quenching defects.
Simulation Tool for Designing off-Grid PV Applications for the Urban Environments

A barrier for exploiting use of standalone solar lighting for the urban environment seem to be lack of knowledge and lack of available tools for proper dimensioning. In this work, the first part of the development of powerful dimensioning tool is described and initial measurements are presented.

General information
User evaluation of eight LED light sources with different special colour rendering indices R9

In this study we evaluated the influence of the special colour rendering index R9 on subjective red colour perception and Caucasian skin appearance among untrained test subjects. The light sources tested are commercially available LED based light sources with similar correlated colour temperature and general colour rendering index, but with varying R9. It was found that the test subjects in general are more positive towards light sources with higher R9. The shift from a majority of negative responses to a majority of positive responses is found to occur at R9 values of ~20.

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems, Aalborg University
Pages: 496-505
Publication date: 2013

Host publication information
Title of host publication: Proceedings of CIE Centenary Conference „Towards a New Century of Light” : CIE x038:2013
Publisher: CIE - International Commission on Illumination
ISBN (Print): 978-3-902842-44-2
Keywords: Photometry, Colour Rendering, R9, Skin colour appearance

Bibliographical note
Research output: Research › peer-review › Article in proceedings – Annual report year: 2013

Wind Turbines on CO2 Neutral Luminaries in Urban Areas

In the present work, an overview of three different wind turbines used in hybrid luminaries is presented. The turbines are: vertical-axis twisted Savonius, three-blade horizontal-axis, and vertical-axis three-blade helical H-rotor. The considered luminaries are also equipped with photovoltaic panels and batteries, detailed investigation of which is outside the scope of the present manuscript. Analysis of the turbines’ performance based on producer-supplied power curves is presented together with an estimation of the wind climate in Copenhagen district comprising 1-2 story single family buildings. A new vertical-axis twisted Savonius rotor is proposed for a luminary being designed for such a district within the “Development of CO2 neutral urban luminary” project.

General information
State: Published
Contributors: Skrzypinski, W. R., Bak, C., Beller, C., Thorseth, A., Bühler, F., Poulsen, P. B., Andresen, C.
Publication date: 2013

Event information
Event: European Wind Energy Conference & Exhibition 2013
Location: Vienna, Austria
Electronic versions:
Wind_Turbines_on_CO2_Neutral_presentation.pdf
Research output: Research › Sound/Visual production (digital) – Annual report year: 2013
Wind Turbines on CO2 Neutral Luminaries in Urban Areas

General information
State: Published
Contributors: Skrzypinski, W. R., Bak, C., Beller, C., Thorseth, A., Bühler, F., Poulsen, P. B., Andresen, C.
Number of pages: 1
Publication date: 2013
Peer-reviewed: Yes
Event: Poster session presented at European Wind Energy Conference & Exhibition 2013, Vienna, Austria.
Keywords: Hybrid luminary, Street lamp, CO2 neutral, Small wind turbine, Savonius, Urban wind energy
Electronic versions:
Wind_Turbines_on_CO2_Neutral_poster.pdf
Research output: Research - peer-review › Poster – Annual report year: 2013

CO2 neutralt armatur – CopenHybride

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems, Department of Wind Energy, Aeroelastic Design
Contributors: Poulsen, P. B., Dam-Hansen, C., Corell, D. D., Thorsteinsson, S., Thorseth, A., Petersen, P. M., Bak, C., Skrzypinski, W. R.
Publication date: 2012
Media of output: Power Point Presentation

Event information
Event: By Land Lys
Location: MusikTeatret, Albertslund, Denmark
Electronic versions:
ELFORSK_CO2n.pdf

Bibliographical note
Oral presentation.
Number of pages: 63
Research output: Research - peer-review › Sound/Visual production (digital) – Annual report year: 2012

Dansk LED - Museumsbelysning

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems
Contributors: Poulsen, P. B., Dam-Hansen, C., Thorseth, A., Corell, D. D., Petersen, P. M.
Number of pages: 1
Publication date: 2012
Peer-reviewed: Yes
Event: Poster session presented at By Land Lys, Albertslund, Denmark.
Electronic versions:
dansk_lys_a2_poster_2012_dansk_LED_ppt.pdf
Research output: Research - peer-review › Poster – Annual report year: 2012
Fremtidens bæredygtige solcelle-drevne LED system i øjenhøjde

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems
Contributors: Poulsen, P. B., Dam-Hansen, C., Thorseth, A., Corell, D. D., Thorsteinsson, S.
Number of pages: 1
Publication date: 2012
Peer-reviewed: Yes
Event: Poster session presented at By Land Lys, Albertslund, Denmark.
Electronic versions:
dansk lys-fotovoltaisk_lysdiode_motor-2012-xx.pdf
Source: dtu
Source-ID: u::5635
Research output: Research - peer-review › Poster – Annual report year: 2012

LED lighting quality

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems
Contributors: Dam-Hansen, C., Corell, D. D., Thorseth, A., Poulsen, P. B.
Publication date: 2012
Peer-reviewed: Yes
Research output: Research - peer-review › Conference abstract for conference – Annual report year: 2012

LED til væksthuse

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems, University of Copenhagen
Contributors: Dam-Hansen, C., Thorseth, A., Rosenqvist, E.
Pages: 24-25
Publication date: 2012
Peer-reviewed: Unknown

Publication information
Journal: Gartner Tidende
Volume: 128
Issue number: 9
ISSN (Print): 0106-8393
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: English
URLs:
http://www.gartneribladene.dk/GartnerTidende/Gartner_Tidende_medieplan.htm
Research output: Communication › Journal article – Annual report year: 2012

Museum lighting for golden artifacts, with low correlated color temperature, high color uniformity and high color rendering index, using diffusing color mixing of red, cyan, and white-light-emitting diodes

Museum lighting presents challenges mainly due to the demand for precise color rendering and the damaging effects of radiation. Golden objects must normally be illuminated by the non-standard CCT of 2200 K. An LED system that conforms to these requirements has been developed and implemented at the Royal Danish Collection at Rosenborg Castle. Color mixing of red, cyan, and white LEDs was employed to achieve the spectral power distribution needed for the required CCT and a CRI above 90. Color uniformity is achieved by the use of a highly diffusing reflector. The system has shown energy saving above 70%.

General information
Optimization of light quality from color mixing light-emitting diode systems for general lighting

To address the problem of spectral light quality from color mixing light-emitting diode systems, a method for optimizing the spectral output of multicolor LED system with regards to standardized quality parameters has been developed. The composite spectral power distribution from the LEDs are simulated using radiometrically measured single LED spectra. The method uses electrical input powers as input parameters and optimizes the resulting spectral power distribution with regard to color rendering index, correlated color temperature and chromaticity distance. The results indicate Pareto optimal boundaries mapping the capabilities of the simulated lighting system.

General information
State: Published
Organisations: Diode Lasers and LED Systems, Department of Photonics Engineering
Contributors: Thorseth, A.
Pages: 82781O
Publication date: 2012
Peer-reviewed: Yes

Publication information
Journal: Proceedings of SPIE, the International Society for Optical Engineering
Volume: 8278
ISSN (Print): 0277-786X
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 0.43 SJR 0.243 SNIP 0.289
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.42 SJR 0.226 SNIP 0.258
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 0.3 SJR 0.212 SNIP 0.239
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 0.3 SJR 0.217 SNIP 0.249
Characterization, Modeling, and Optimization of Light-Emitting Diode Systems

This thesis explores characterization, modeling, and optimization of light-emitting diodes (LED) for general illumination. An automated setup has been developed for spectral radiometric characterization of LED components with precise control of the settings of forward current and operating temperature. The automated setup has been used to characterize commercial LED components with respect to multiple settings. It is shown that the droop in quantum efficiency can be approximated by a simple parabolic function. The investigated models of the spectral power distributions (SPD) from LEDs are the strictly empirical single and double Gaussian functions, and a semi empirical model using quasi Fermi levels and other basic solid state principles. The models are fitted to measured SPDs, using the free parameters. The result show a high correlation between the measured LED SPD and the fitted models. When comparing the chromaticity of the measured SPD with the fitted models, the deviation is found to be larger than the lower limit of human color perception. A method has been developed to optimize multicolored cluster LED systems with respect to light quality, using multi objective optimization. The results are simulated SPDs similar to traditional light sources, and with high light quality. As part of this work the techniques have been applied in practical illumination applications. The presented examples are historical artifacts and illumination of plants to increase photosynthesis.

General information
State: Published
Organisations: Diode Lasers and LED Systems, Department of Photonics Engineering
Contributors: Thorseth, A.
Number of pages: 121
Publication date: 2011

Publication information
Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark (DTU)
Original language: English
Electronic versions:
Kvalitetstest af belysningsprodukter med LED: To nye projekter skal gøre der nemmere at vurdere og vælge LED-belysningsprodukter

General information
State: Published
Organisations: Diode Lasers and LED Systems, Department of Photonics Engineering
Contributors: Dam-Hansen, C., Corell, D. D., Thorseth, A., Poulsen, P. B.
Pages: 10-11
Publication date: 2011
Peer-reviewed: No

Publication information
Journal: Lys
Volume: 2
ISSN (Print): 0904-7824
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: Danish
URLs:
http://www.centerforlys.dk/lys.php
Source: orbit
Source-ID: 277858
Research output: Research › Journal article – Annual report year: 2011

Spectral design of new dynamic LED light sources
The use of LED technology in lighting applications, termed Solid State Lighting, is increasing drastically these years due to increasing flux and efficiency of LED components. The advantages of using Solid State Lighting is not only energy savings but the possibility to create new dynamic light sources that can be varied in color temperature and achieving color rendering properties. New LED light sources are constructed as clusters of colored LEDs. Modeling and optimization of the control of the light from the individual LEDs is a necessity for the desired operation of the new dynamic light source. Detailed knowledge of the spectral power distribution as a function of operating current and temperature is required for the modeling and optimization. Examples of new high color quality dynamic white light sources that can be tuned from warm white light at 2700 K to cold white light at 6500 K are presented.

General information
State: Published
Organisations: Diode Lasers and LED Systems, Department of Photonics Engineering
Contributors: Thorseth, A.
Publication date: 2011
Peer-reviewed: Yes
Event: Abstract from Danish Optical Society, Roskilde, Denmark.
URLs:
http://www.dops.dk/?id=585
Source: orbit
Source-ID: 283914
Research output: Research - peer-review › Conference abstract for conference – Annual report year: 2011

Slutrapport for ELFORSK projekt nr. 341-009, Den CO2 neutrale arbejdsplads – hovedprojekt
As the world develops, the requirement for more electrical equipment in everyday life is increasing rapidly. The power consumption of electrical appliances both in operation and in standby mode therefore greatly contributes to our total energy consumption. When regarding the energy lifetime of an electrical product, the amount of energy used for standby cannot be neglected and will in many cases exceed the power used in operation. The potential of PVs used indoor to supply the standby power is a fairly unexploited field, but can have a revolutionary effect on the total energy consumption worldwide. This paper presents the results gained in the ongoing project ‘The CO2 neutral work space’, which was started up in 2008. The objective of the project is focused on elucidating and uncovering the great potential for usage of PVs in indoor applications to power the standby electricity consumption. To integrate solar cells into a design object has proved to
be challenging. Throughout the development process it has been extremely important with the coherence between technology and design in a close dialogue between all parties. The project team has made three distinctive designs, where design solutions are created in cooperation between the PV-technology and a user-friendly approach based on the observations of the secretaries have shown that the desk is often covered by electronic devices and paper material. The final three design concepts adapt to Montanas existing aesthetics and design as a transparent screen, a desk integration and a flexible solution. All three design concepts are displayed in either 1:1 or functioning prototypes, depending on allowance and performance in the chosen PV-technologies. The prototypes have been shown at various design shows and scientific conferences internationally and nationally. A LED based solar simulator has been build and follows the IEC904-9 requirements for a Class A solar simulator though at an irradiation level of about 100 W/m². It is more advanced and flexible than traditional artificial sun simulators based on a Xenon light source since because of the flexibility in light spectrum and intensity made available by the LED setup. The system has been tested on several solar cells and panels for IV characterization and obtaining the spectral response of cells at different levels of irradiation.

General information
State: Published
Organisations: Diode Lasers and LED Systems, Department of Photonics Engineering, Factor3 A/S
Number of pages: 135
Publication date: 2010

Publication information
Original language: Danish
Electronic versions:
Den CO2 neutrale arbejdsplads_Slutrapport_31 03 10_BB_PP_FINAL.pdf
Source: orbit
Source-ID: 263590
Research output: Research - peer-review › Report – Annual report year: 2010

Slutrapport for Implementering af energibesparelser ved benyttelse af højkvalitets LED belysning PSO 339-025
This report describes the research and development project “Energysavings by implementation of high quality LED illumin ation”. The project is carried out in cooperation between DTU Fotonik, Teknologisk Institut, De Danske Kongers Kronologiske Samling (DKKS), Lumodan, Oeram, Thermex and DONG Energy, headed by Carsten Dam-Hansen, DTU Fotonik. The project is financed by the Danish Energy Association through Elforsk’s PSO program, under 3a . LED illumination. The project has no. PSO 339-025 and was initiated in February 2007 and was ended in March 2010. The first part of the report describes the background and aim of the project, the work and results together wit h future perspectives of the results of the project. The report further contains two sections about the work on design and development of two new energyefficient and high quality LED illumination systems for display case and cooker hood illumin ation. Finally the work on communicating the results of the project is described.

General information
State: Published
Organisations: Diode Lasers and LED Systems, Department of Photonics Engineering
Contributors: Dam-Hansen, C., Thorseth, A., Poulsen, P. B.
Publication date: 2010

Publication information
Original language: Danish
URLs:
Source: orbit
Source-ID: 263734
Research output: Research › Report – Annual report year: 2010

Towards a CO2 neutral urban environment - cutting the wire
The project aims at investigating the potential for exploiting PV cells under non-optimum light conditions in urban space, ie at less than 1,000 W/m² under optimum light conditions.

General information
State: Published
Organisations: Diode Lasers and LED Systems, Department of Photonics Engineering, Factor3 A/S, Danish Technological Institute
Publication date: 2010
New light with diodes: light for a brighter future

General information
State: Published
Organisations: Diode Lasers and LED Systems, Department of Photonics Engineering
Contributors: Thstrup Nielsen, B., Thorseth, A., Jensen, O. B., Petersen, P. M., Dam-Hansen, C., Chi, M., Kardynal, B., Ou, H.
Number of pages: 267
Pages: 169-187
Publication date: 2009

Host publication information
Title of host publication: Beyond optical horizons: today and tomorrow with photonics
Place of publication: Kgs. Lyngby
Publisher: DTU Fotonik
Edition: 1
ISBN (Print): 87-92062-34-2
Source: orbit
Source-ID: 255188
Research output: Communication » Book chapter – Annual report year: 2009

Characterization of a magnetic trap by polarization dependent Zeeman spectroscopy
This paper demonstrates a detailed experimental study of our cloverleaf magnetic trap for sodium atoms. By using polarization dependent Zeeman spectroscopy of our atomic beam, passing the magnetic trap region, we have determined important trap parameters such as gradients, their curvatures and corresponding trap frequencies. Experimental findings are compared to theoretical calculations as well as complementary methods of characterizing the trap.

General information
State: Published
Organisations: Department of Photonics Engineering, Fiber Optics, Devices and Non-linear Effects, Niels Bohr Institute
Contributors: Nielsen, C. V., Lyngsøe, J. K., Thorseth, A., Galouzis, M., Therkildsen, K., Ooijen, E. D. V., Thomsen, J. W.
Pages: 111-119
Publication date: 2008
Peer-reviewed: Yes

Publication information
Journal: The European Physical Journal D: Atomic, Molecular, Optical and Plasma Physics
Volume: 48
Issue number: 1
ISSN (Print): 1434-6060
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 1.05 SJR 0.387 SNIP 0.663
Web of Science (2017): Impact factor 1.393
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 0.94 SJR 0.392 SNIP 0.558
Optimization of spectral characteristics of LED clusters for lighting

General information
State: Published
Organisations: Laser Systems and Optical Materials, Optics and Plasma Research Department, Risø National Laboratory for Sustainable Energy
Contributors: Thorseth, A., Dam-Hansen, C., Thstrup Nielsen, B.
Publication date: 2007
Global SSL quality requirements and test - IEA-4E-SSL

The aim of the project is to increase the use of high quality and energy efficient lighting on a Danish as well as global level, which can provide a significant contribution to reduction of the consumption of fossil energy and meeting climate challenges. IEA 4E has established a group of SSL experts dealing especially with LED and gradually also the new technologies like OLED and laser based lighting. Danish participation in this work has the benefit that Denmark is in the forefront of setting harmonized global requirements for efficiency and quality, as well as development and testing of measurement methods to ensure the requirements are met. For the period 2019 - 2024, the main overall goals for IEA SSL Annex are:

- Restrict the market access for "bad" products worldwide by updating/revising the existing tiers for efficiency and quality with the addition of new requirements for new features and products
- Help solve the existing problems with the appropriate measurement methods for the test of flicker and life time including testing in the participating laboratories and international comparison
- Manufacturers are investing heavily in developing Connected/Smart lighting, where the lighting system adds a lot of control and comfort, and where the lighting system serve as a communication system for various IoT products, guidance in shopping centres, museums and much more. The IEA SSL is to continue its leading role at the forefront raising attention to additional energy consumption associated with the new features, setting up measurement methods, executing measurements in laboratories, proposals for minimizing the consumption and proposing requirements.
- Study the impact on health and environment as well as requirements to minimize the influence.

An important part of the project is to disseminate the results and discussions of the Annex to Danish lighting industry and bring the industry feedback to the Annex.

Dam-Hansen, C., PI, Diode Lasers and LED Systems, Department of Photonics Engineering
Thorseth, A., Project Participant, Diode Lasers and LED Systems, Department of Photonics Engineering
Bay, A., Project Participant, Dansk Center for Lys
Kofod, C., Project Participant, Energy Piano

01/09/2019 → 01/08/2024
Nature of activity type: Practical Project
Collaborators: International Energy Agency, National Institute of Standards and Technology, Dansk Center for Lys, Energy Piano, Centre Scientifique et Technique du Bâtiment
Project: Consultancy › Practical Project

LASIC: Laser-driven white light source employing fluorescent silicon carbide (LASIC)
Light-emitting diode-based white light sources are penetrating into the lighting market thanks to its energy efficiency. However, the brightness of such light source is limited by the droop effect, triggering exploration in the laser-driven white lighting because lasers have even higher efficiency without droop effect in addition to the compact size and small spot size. In this project, a new type of wavelength conversion material i.e. fluorescent silicon carbide (f-SiC) is explored as a laser-driven white light source, aiming to provide a better solution than the commercial phosphor solution in terms of brightness, thermal conductivity, and lifetime.

Ou, H., Project Manager, Department of Photonics Engineering, Diode Lasers and LED Systems, Centre of Excellence for Silicon Photonics for Optical Communications
Tarekegne, A. T., Project Manager, Department of Photonics Engineering, Diode Lasers and LED Systems
Jensen, O. B., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Dam-Hansen, C., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Chi, M., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Thorseth, A., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems

External Project ID: 8022-00294B
01/07/2018 → 01/07/2020
Project: Research

JensenLED: Energibesparende LED Smart Tube i intelligente løsninger
Corell, D. D., Project Manager, Department of Photonics Engineering, Diode Lasers and LED Systems
Dam-Hansen, C., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Thorseth, A., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems

01/10/2017 → 01/09/2019
Project: Research
OLED Academy: OLED Academy - prospects for energy saving and design

The project will, through training in and testing of OLEDs (organic light-emitting diodes) prepare the ground for a development where the OLED can be a driver for energy savings from innovative design solutions created by Danish lighting technology companies. OLED Academy kick-starts the exploration of the possibilities the OLED technology brings about.

Lindén, J., Project Manager, Department of Photonics Engineering, Diode Lasers and LED Systems
Dam-Hansen, C., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Thorseth, A., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Corell, D. D., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Bay, A., Project Participant, Dansk Center for Lys

Keywords: OLED, Lighting, Education

Collaborators: Dansk Center for Lys

Project ID: 71012
External Project ID: 349-032
01/04/2017 → 31/03/2019

SpotLASE: Energy Efficient Laser Enhancement of Stage Spotlights

The project aims at bringing novel energy efficient laser lighting technology to the entertainment lighting industry by developing and demonstrating two new types of laser based light engines. They are designed to replace high intensity discharge (HID) lamps used in high power stage spot lamps, leading to significant reductions in energy consumption and dramatic increase in lamp lifetime and reduction of the environmental impact. This cannot be achieved using Light emitting diode (LED) technology alone, due to the limited luminance of LEDs. The project team unifies all the necessary competences and experimental facilities to the project work from laser diode and LED systems, spectroradiometric testing, materials handling, thermal management, product design and production, electronic control to market/user knowledge within the entertainment lighting industry. The project will bring the two companies in front within laser lighting technology and many new applications are anticipated within the lighting industry. The general perspectives and results of the development work will be made publically available, e.g. to the scientific and industrial communities.

Thorseth, A., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Dam-Hansen, C., Project Manager, Department of Photonics Engineering, Diode Lasers and LED Systems
Lindén, J., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Jensen, O. B., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems

Project ID: 71043
EUDP
01/10/2017 → 01/10/2020
Collaborators: Brother, Brother & Sons ApS
Award relations: Energy Efficient Laser Enhancement of Stage Spotlights

Characterization, Modeling, and Optimization of Light-Emitting Diode Systems

Thorseth, A., PhD Student, Department of Photonics Engineering, Diode Lasers and LED Systems

Improved light measurement system for the international market

Thorseth, A., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems

D-Light, Energibesparende diodelaser belysning

DronEL

The purpose of this project is to develop and bring to market an aerial drone based automated solution (DronEL) used for a full PV plant survey for more accurate survey in less time. The automatic drone-based inspection method combines IR, EL and PL imaging, and visual images.

Sundhed som driver for energioptimering af LED-lysstyring

Energibesparende dynamisk LED-lys kan anvendes terapeutisk i psykiatrien. Projektet forsøger at få svar på, hvor stor effekten af dynamisk LED-kunstlys er på mennesker indlagt med depression i forhold til konventionelt lys (CFL), og hvilken indflydelse dette helbredsfremmende lys har på energiforbruget. Specifiktt undersøges, om patienter med depression får en kortere indlæggelse, mindre medicinforbrug og hurtigere bedring, samtlig med at LED-styring sparer energi. Et tidligere projekt viste, at patienter indlagt i sengestuer med begrænset adgang til sollys (nordvest-vendte stuer) havde en statistisk signifikant længere indlæggelsestid end patienter i stuer med adgang til solslyst (sydøst-vendte). Derfor vil det ansøgte projekt søge at optimere belysningsforholdene på de mørke nordvest-vendte sengestuer, se om det har en terapeutisk effekt og hvad konsekvenserne er for energiforbruget.

EMPIR 15SIB07 PhotoLED, Future photometry based on solid-state lighting products

Solid-state lighting, which uses light-emitting diodes (LEDs), is globally replacing traditional incandescent lighting, due to lower power consumption and greater durability. Photometers are used to measure the performance of lights, and are calibrated using standard lamps to ensure the accuracy and consistency of measurements. However, the standard lamps used for calibration are currently based on incandescent lights, not LEDs. This project will develop new standard lamps based on LEDs and new measurement techniques for defining the properties of solid-state lights. The results will be used by National Measurement Institutes and test laboratories to accurately calibrate solid-state light photometers and will give European industry an advantage in the development of new commercial standard lamps. These outputs will result in a more reliable classification of the energy efficiency of solid-state lighting, increasing consumer confidence in this new greener technology.

EMPIR
Compressed sensing for material characterization and simulation
Amidemeshkel, M. W., PhD Student, Department of Photonics Engineering
Dam-Hansen, C., Main Supervisor
Soreze, T. S. C., Supervisor
Thorseth, A., Supervisor
Schou, J., Examiner
Fontoynont, M., Examiner
Martinsons, C., Examiner
Forskningsrådsfinansiering
01/04/2015 → 21/09/2018
Award relations: Compressed sensing for material characterization and simulation
Project: PhD

Daylight as a Driver for Healthier Energy Optimization
Renovations of existing buildings have primarily focused on the energy consumption and thermal comfort. This project involves health as a priority design parameter, and through an exemplary case study, the project examines how essential health aspects are better served. The project focuses on facade design. The project involves daylight quality as a design parameter and focuses on the clearest glass quality on the market. Through a major housing, the study documents how aspects of health and energy are influenced by the quality of daylight/glass quality.
Volf, C., Project Manager, volfdesign.dk
Petersen, P. M., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Thorseth, A., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Markvart, J., Project Participant
Martiny, K., Project Participant
01/03/2016 → 30/06/2018
Collaborators: volfdesign.dk, Danish Building Research Institute, Region Hovedstaden
Project: Research

Warm or Cold, Lights influence on thermal comfort
Various indicators point out that a connection exists between the ambient temperature and the correlated color temperature that users prefer for the lit environment. In warm climate the use of cooler lighting is much more common than in a colder climate where people use warmer light sources. Presumably the use of different colored light sources is due to the experience of cooler climate at cooler light sources and the impression of warmth follows a warmer looking light source. With new LED technology the correlated color temperature (warm white to cool white) is easily controllable. The goal of the project is to demonstrate how controllable LED lighting can be used to expand the temperature interval that users find comfortable. The project is founded on previous research on colored light. It will lead to a decrease in the energy consumption of buildings.
Logadóttir, Á., Project Manager, Aalborg University
Markvart, J., Project Participant, Aalborg University
Thorseth, A., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Dam-Hansen, C., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Toftum, J., Project Participant, Department of Civil Engineering, Section for Indoor Climate and Building Physics
01/03/2016 → 31/12/2018
Collaborators: Aalborg University
Project: Research

Solar powered OLED solutions for the urban environment
OLED technology is seen by many as one of the competitors to the inorganic LED technology, which is starting to dominate the lighting market these days. The material forming the active part (light source) in the OLED is based on organic dyes, which basically are very cheap and are compatible with inkjet and other printing technologies that make the
possibilities of how to think light sources in the future endless. The OLED technology is in a significantly less mature stage of development than the inorganic LED variant and it is in a rather far future that we will see OLEDs become a competitive source for the mass market taking over from the LED. So in the beginning, the OLED industry agrees that the market penetration must be based on niche applications which are less price sensitive than standard light sources. In this project we use OLED technology’s unique capabilities as transparent light source having a very high energy efficiency and light quality in combination with solar cells capable of creating efficient autonomous lighting products to the urban space. Furthermore, OLEDs can be realized in a pixelated configuration so that each pixel can be addressed separately e.g., RGB, providing entirely new opportunities for communicating light sources. The project seeks further to address and lowers the barriers for the use of OLED lighting which is in a phase where producers lack the specific applications to come to market with their products, which is something we are known for being excellent at in Denmark.

The purpose of the project is to actively utilize the national expertise on LED technology and Solid State Lighting (SSL) and the new test facilities, which were established as a part of a global network of test laboratories, in the continued international collaboration under the IEA 4E-SSL Annex. The member countries, including Denmark, have chosen to continue the work, which is still highly relevant in a fast growing global market of SSL products. The aim of the SSL Annex is to assist member governments in promoting SSL rapidly as an effective means to reduce energy consumption worldwide. In the SSL Annex this will be done through recommendations for performance tiers, evaluation of test methods and test laboratories, SSL product benchmarking, and new tools for SSL market monitoring and control.

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Global Test of SSL Products - IEA-4E-SSL

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The PV LED Engine – a new generation of intelligent solar powered LED lighting

The objective of the project is to realize the most intelligent high-end platform seen on the market today for autonomous solar energy powered lighting application.

Thorseth, A., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Dam-Hansen, C., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Poulsen, P. B., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Thorsteinsson, S., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Lindén, J., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems

Project ID: 70709
01/01/2012 → 31/12/2014

Smart Grid Ready Energy Efficient Lighting System for Green House Horticulture

The project aims to develop an energy-cost-effective artificial light management system, which optimizes plant growth in relation to energy costs and also integrates greenhouse horticulture with the grid through DONG Energy's Power Hub concept, which enables the growers to deliver GRID-system performance by dynamically regulate their consumption. This is part of a joint proposal for GUDP and EUDP.

Thorseth, A., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Dam-Hansen, C., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems

Project ID: 70746
01/08/2012 → 01/07/2015

CooLED: CooLED - a new generation LED light source for the timeless high-end market.

The project aims to develop and demonstrate an optical flexible LED bulb using the energy efficient technology of LEDs optimally when applying it to the timeless exclusive classical lamps such as the PH5 by Poul Henningsen, the Flowerpot and the Globe by Verner Panton etc. When inserting traditional LED light sources in these lamps most of the energy is deposited in the lamps' shade units due to the way the light source emits its light. By directing the light correctly out through the lamp shade it is possible to gain up to 90% in energy reduction. Due to a new and highly innovative thermal management design separating the LEDs from the transformer electronics it is possible to minimize the changing cost of the light source due to the improved longevity. The thermal management design is made possible by the use of piezoelectric transformer technology converting 40W/cm² with 98% efficiency making it geometrically possible to fit in the socket. The outcome of this project will settle with the increase of light sources by introducing an optically flexible retrofit LED solution. By applying low cost, tailored lenses that are interchangeable this solution could give the light a geometrical suitability for the application at hand.

Dam-Hansen, C., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Thorseth, A., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Poulsen, P. B., Project Manager, Department of Photonics Engineering, Diode Lasers and LED Systems

Project ID: 70751
01/01/2013 → 01/12/2014

Tests and standards for SSL products - IEA-4E-SSL

Increase of the Danish participation in IEA's Solid State Lighting, SSL annex with expertise on LED technology, light measurements and experience on SSL products shall provide influence for Denmark on international demands and standards and secure Danish test facilities to comply with new test standards. This is to benefit political promotions of quality SSL products and growth of Danish industry.

Dam-Hansen, C., Project Manager, Department of Photonics Engineering, Diode Lasers and LED Systems
Thorseth, A., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Corell, D. D., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Hansen, S. S., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Kofod, C., Project Participant, Energy Piano

Project ID: 70708
Energiteknologisk Udviklings- og Demonstrationsprogram, EUDP
01/01/2012 → 31/12/2014
Keywords: Solid state lighting, LED
Collaborators: DELTA - a Part of FORCE Technology, Energy Piano
Award relations: Tests and standards for SSL products - IEA-4E-SSL
Project: Research
EDAL: Energieffektiv dynamisk arbejds lampe

Dam-Hansen, C., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Thorseth, A., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Hansen, S. S., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems

Project ID: 70722
External Project ID: 344-059
01/03/2012 → 30/04/2014
Collaborators: Lundgaard & Tranberg Arkitekter, Danish Building Research Institute, COWI AS, Fagerhult AS
Project: Research

Væksthuskoncept 2017 - teknologiudvikling til bæredygtig væksthusproduktion
Thorseth, A., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Dam-Hansen, C., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Corell, D. D., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Hansen, S. S., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems

Project ID: 70810
01/10/2008 → 31/12/2012
Keywords: green house lighting, LED, Lighting, plant lighting
Documents:
Væksthuskoncept 2017 – Teknologiudvikling til bæredygtig væksthusproduktion
Project: Research

Light engine V8 - a green revolution for colored light
LIGHT ENGINE V8 er et unikt LED baseret optisk system, der adskiller sig fra eksisterende systemer ved at anvende multipel farveblanding med mindst 5 farvede højeffekts lysdioder. V8 vil bane vejen for den næste generation af energibesparende effektbelysning til underholdningsindustrien ved både at bryde RGB-begrænsningen, og møde det kritiske niveau af præcıs kontrol af lysets sammensætning, fokusering og styrke. V8 udvikles i tæt samarbejde mellem den internationalt anerkendte udviklingsvirksomhed BB&amp;S og landets førrende LED optiske eksperter, DTU Fotonik, og skal resultere i det nye omkring effektive optiske systemer til multipel farveblanding. Der udvikles et nyt optisk system, som effektivt kombinerer lyset fra et stort antal farvede højeffekts LED arrays, således at der opnås et energieffektivt, højkvalitet LED system, der kan erstatte halogenlysikler i krævende anvendelser. Det implementeres med avanceret driverelekttronik, nødvendig termisk køling og softwarestyring til en integreret spotlightlyskilde.

Dam-Hansen, C., Project Manager, Department of Photonics Engineering, Diode Lasers and LED Systems
Ramanujam, P., Project Participant, Department of Photonics Engineering, Optical Microsensors and Micromaterials
Hanson, S. G., Project Participant, Department of Photonics Engineering, Optical Sensor Technology
Pedersen, H. C., Project Participant, Department of Photonics Engineering, Optical Microsensors and Micromaterials
Jensen, O. B., Project Participant, Department of Photonics Engineering, Optical Sensor Technology
Plesner, P., Project Participant, Brother, Brother & Sons ApS
Brockmann, T., Project Participant, Brother, Brother & Sons ApS
Poulsen, C., Project Participant, Brother, Brother & Sons ApS
Flensburg, H., Project Participant, Brother, Brother & Sons ApS
Thorseth, A., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Chakrabarti, M., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems

Project ID: 70710
Højteknologifonden /The Danish National Advanced technology Foundation: DKK3,962,840.00
01/09/2011 → 30/06/2014
Collaborators: Brother, Brother & Sons ApS
Award relations: Light engine V8 - a green revolution for colored light
Project: Research
**Energibesparende LED farveblandings belysningssystem med høj lyskvalitet**

Formålet med projektet er at videreudvikle og optimere et nyt patentanmeldt LED optisk system til blanding af lys fra forskelligt farvede LEDer, som sikrer optimal farvegengivelse- og -homogenitet samt lav blænding. Første udgave af systemet blev installeret i Skatankerret på Rosenborg Slot i foråret 2011.

- Dam-Hansen, C., Project Manager, Department of Photonics Engineering, Optics and Plasma Research Department, Diode Lasers and LED Systems, Laser Systems and Optical Materials
- Petersen, P. M., Project Participant, Department of Photonics Engineering, Optics and Plasma Research Department, Diode Lasers and LED Systems, Laser Systems and Optical Materials
- Poulsen, P. B., Project Participant, Department of Photonics Engineering, Risø National Laboratory for Sustainable Energy, Diode Lasers and LED Systems
- Hansen, S. S., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
- Thorseth, A., Project Participant, Department of Photonics Engineering, Optics and Plasma Research Department, Diode Lasers and LED Systems, Laser Systems and Optical Materials
- Corell, D. D., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
- Jensen, P., Project Participant, Department of Photonics Engineering, Optics and Plasma Research Department, Diode Lasers and LED Systems, Laser Systems and Optical Materials

**Project ID:** 70578

**DTU - projekt Proof of Concept:** DKK750,000.00

01/01/2012 → 31/12/2013

**Project:** Research

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**Værktøjer til fremme af energibesparende LED belysning i underholdningsindustrien**

Formålet med projektet er gennem nye værktøjer at nedbryde barrierer og fremme brugen af energieffektive løsninger i fremtidens udendørsbelysning. I denne smelter lysbehov, æstetik og informationsmuligheder sammen i ét og energieffektiv LED teknologi, der muliggør intelligent styring af såvel lysstyrke og farve af lyset er udgangspunktet for nye belysningsløsninger i dette projekt. Forskningsmæssigt ses der på 3D visualisering af nye belysningsløsninger som et nyt effektivt værktøj i design og udviklingsprocessen, og som grundlag for brugeraccept forud for en testopstilling eller egentlig installation. Nye test og karakteriseringssværktøjer skal generere de nødvendige data for lysudstrålingen fra de enkelte lamper og armaturer til at kunne lave en 3D-rendering af lysforholdene i specifikke opsætninger og omgivelser. I projektet fokuseres der på udendørsbelysning i underholdningsindustrien og der forskes i fremtidens løsninger som designes til og testet i udvalgte miljøer på Roskilde Festival og i Tivoli.

- Dam-Hansen, C., Project Manager, Department of Photonics Engineering, Optics and Plasma Research Department, Diode Lasers and LED Systems, Laser Systems and Optical Materials
- Poulsen, P. B., Project Participant, Department of Photonics Engineering, Risø National Laboratory for Sustainable Energy, Diode Lasers and LED Systems
- Corell, D. D., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
- Jensen, P., Project Participant, Department of Photonics Engineering, Optics and Plasma Research Department, Diode Lasers and LED Systems, Laser Systems and Optical Materials
- Thorseth, A., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems

**Project ID:** 70715

**ELFORSK - Dansk Energi:** DKK1,226,225.00

01/03/2012 → 31/05/2014

**Collaborators:** Kultur & kommunikation ApS, Gunver Hansen Tegnestue, Foreningen Roskilde Festival, Tivoli A/S, Dansk Center for Lys, Brother, Brother & Sons ApS

**Project:** Research

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**Etablering af LED-belysning i Rosenborg Skatammer**

- Nyström, H., Project Manager, De Danske Kongers Kronologiske Samlinger, Rosenborg Slot
- Markussen, B., Contact Person, Lumodan ApS
- Petersen, P. M., Project Participant, Department of Photonics Engineering
- Dam-Hansen, C., Project Participant, Department of Photonics Engineering
- Poulsen, P. B., Project Participant, Department of Photonics Engineering
- Thorseth, A., Project Participant, Department of Photonics Engineering

**Project ID:** 70635

**Forsk. Private danske - Fonde:** DKK93,337.50

01/02/2010 → 31/12/2010

**Collaborators:** De Danske Kongers Kronologiske Samlinger, Rosenborg Slot, Lumodan ApS, I-NO, Kvorning Design & Kommunikation

**Award relations:** Etablering af LED-belysning i Rosenborg Skatammer

**Project:** Research

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**LED Montrer - : 1705129-01 PSO 339-025**

- Dam-Hansen, C., Project Manager, Department of Photonics Engineering
- Thorseth, A., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
LED lighting quality program
The aim of the project is to establish a quality program for LED lighting products available on the Danish market, with focus on light quality and energy consumption. A transparent overview of the products, price, light quality and energy efficiency will be the result and thus providing a better basis for the selection of products for professional buyers, as well as ordinary consumers. The project will: - Define relevant quality parameters of LED lighting products, including introducing understandable labels - Provide measurement facilities and develop procedures for the measurement of quality parameters - Establish a quality program of selected groups of LED lighting products with a categorization of quality parameters and price - Communicate knowledge on LED lighting products - Participate in international standardization of the test and characterization of LED light sources. The project will result in the construction of a self-sustaining quality program for LED lighting products that go beyond the project period.

Dam-Hansen, C., Project Manager, Department of Photonics Engineering
Poulsen, P. B., Project Participant, Department of Photonics Engineering
Stubager, J., Project Participant, Department of Photonics Engineering
Corell, D. D., Project Participant, Department of Photonics Engineering
Hansen, S. S., Project Participant, Department of Photonics Engineering
Thorseth, A., Project Participant, Department of Photonics Engineering
Traberg-Borup, S., Project Participant, Danish Building Research Institute
Munck, K., Project Participant, Dansk Center for Lys
Pedersen, J. E., Project Participant, Energiraadgiveren
Løfqvist, S., Project Participant, DANLED ApS
Vig, M., Project Participant, Rafa Lys ApS
Hansen, A. F., Project Participant, Dioder-Online ApS
Olsen, S. M., Project Participant, Dioder-Online ApS
Nielsen, J., Project Participant, Flash Light A/S
Aaløse, P., Project Participant, Flash Light A/S
Markussen, B., Project Participant, Lumodan ApS
Nielsen, E., Project Participant, LED-TEK A/S

Project ID: 70630
Forsk. Andre offentlige og private - Nordiske 11/03/2008 → 01/01/2012
Collaborators: ELFORSK
Award relations: LED Montrer - : 1705129-01 PSO 339-025
Project: Research

Intelligent styring af dynamisk LED belysning
Målet er at skabe en intelligent og avanceret styring af LED belysning, der evner at optimere brugerens lysforhold i en given situation eller i relation til en opgave. Ud fra en række kendte parametre af såvel personlige som demografisk karakter vil systemet kunne regulere lyssætningen således, at der til enhver tid skabes optimale lysforhold med anvendelse af mindst mulig elektrisk energi.

Laursen, F., Contact Person, Lighten ApS
Pedersen, S., Project Manager, Lighten ApS
Petersen, P. M., Contact Person, Department of Photonics Engineering
Dam-Hansen, C., Project Participant, Department of Photonics Engineering
Corell, D. D., Project Participant, Department of Photonics Engineering
Poulsen, P. B., Project Participant, Department of Photonics Engineering
Hansen, S. S., Project Participant, Department of Photonics Engineering
Thorseth, A., Project Participant, Department of Photonics Engineering
Logadóttir, Á., Project Participant, Danish Building Research Institute
Sjælland, B., Project Participant, Rockwool International

Project ID: 70670
Forsk. EU - Andre EU-midler: DKK1,312,766.00 01/01/2011 → 31/12/2012
Collaborators: Rockwool International, Lighten ApS, Danish Building Research Institute
Award relations: Intelligent styring af dynamisk LED belysning
Project: Research
Combined daylight and Intelligent LED lighting: Getting the daylight into the buildings

The project aims to develop and demonstrate a new concept of intelligent LED lighting which complements and follows the rhythm of daylight and thus bringing "daylight" into buildings. It is based on LED technology's unique color characteristics and high efficiency, allowing a concept which provides both high-quality lighting and can be energy saving. New LED lighting systems and combined with a new color sensor system for control are developed. LED light source placement and control strategies are analyzed and optimized through model calculations that include the daylight contribution. User experience of the concept will be examined through demonstration setups and the potential energy savings specified through measurements on these setups.

Dam-Hansen, C., Project Manager, Department of Photonics Engineering
Poulsen, P. B., Project Participant, Department of Photonics Engineering
Corell, D. D., Project Participant, Department of Photonics Engineering
Hansen, S. S., Project Participant, Department of Photonics Engineering
Thorseth, A., Project Participant, Department of Photonics Engineering

Project ID: 70631
Forsk. Private danske - Andre: DKK1,397,852.00
01/01/2010 → 01/03/2013
Collaborators: Philips Lighting A/S, Danish Building Research Institute, Ramboll Group AS, Energiraadgiveren
Award relations: Combined daylight and Intelligent LED lighting: Getting the daylight into the buildings
Project: Research

Danish LED Network

LED-teknologien er i kraftig vækst og i de kommende år vil der opstå mange muligheder for at danske virksomheder kan udvikle nye forretningsområder inden for LED-teknologi og tilstødende områder. Hvis danske virksomheder skal være konkurrencedygtige inden for LED-teknologien, er det nødvendigt med en national koordinerende indsats, der katalyserer vidensdeling og matchmaking. Energipolitisk er der et stigende krav om lavere energiforbrug i bygninger, og i Danmark lægger bygningsreglementet op til skærpede krav i 2010 med yderligere 25 % og igen i 2015. Energiforbruget til belysning udgør en stor andel af det samlede forbrug på omkring 15-16 % og er derfor et vigtigt sted at se på nye elementer, systemer og metoder til reduktion af energiforbruget.

Petersen, P. M., Project Manager, Department of Photonics Engineering
Dam-Hansen, C., Project Participant, Department of Photonics Engineering
Poulsen, P. B., Project Participant, Department of Photonics Engineering
Corell, D. D., Project Participant, Department of Photonics Engineering
Hansen, S. S., Project Participant, Department of Photonics Engineering
Thorseth, A., Project Participant, Department of Photonics Engineering

Project ID: 70624
Forsk. Andre statslige danske i øvrigt: DKK250,125.00
15/02/2010 → 31/12/2011
Collaborators: Osram A/S, Dansk Center for Lys
Award relations: Danish LED Network
Project: Research

Development of a carbon neutral luminaire for the urban environment


Bluhme, N. C., Project Manager, Gate 21
Sandholt, H., Project Participant, Gate 21
Levholt, K., Project Participant, Gate 21
Lundgaard, J., Project Participant, Gate 21
Seerup, E., Project Manager, Arkitektfirmaet Ark-Unica
Dam-Hansen, C., Project Participant, Department of Photonics Engineering
Poulsen, P. B., Project Participant, Department of Photonics Engineering
Hansen, S. S., Project Participant, Department of Photonics Engineering
Jensen, P., Project Participant, Department of Photonics Engineering
Bak, C., Project Participant, Riso National Laboratory for Sustainable Energy, Wind Energy Division
Harboe, R. K., Project Participant, Factor3 A/S
Bentzen, B., Project Participant, Factor3 A/S
Kehler, R., Project Participant, Factor3 A/S
Falk, L., Project Participant, Philips Lighting A/S
Maare, T., Project Participant, Københavns Kommune
Halden, S., Project Participant, Københavns Kommune
Bluhme, N. C., Project Participant, Albertslund kommune
Fristrøm, E., Project Participant, Egedal kommune
Thorseth, A., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems

Project ID: 70673
Forsk. Private danske - Andre: DKK1,599,658.00
01/01/2011 → 31/12/2012
Collaborators: Gate 21, Albertslund kommune, Arkitektfirmaet Ark-Unica, Philips Lighting A/S, Københavns Kommune, Factor3 A/S, Egedal kommune
Award relations: Development of a carbon neutral luminaire for the urban environment
Project: Research

Combined daylight and intelligent LED lighting : Getting the daylight into the buildings
The project aims to develop and demonstrate a new concept of intelligent LED lighting which complements and follows the rhythm of daylight and thus bringing 'daylight' into buildings. It is based on LED technology's unique color characteristics and high efficiency, allowing a concept which provides both high-quality lighting and can be energy saving. New LED lighting systems and combined with a new color sensor system for control are developed. LED light source placement and control strategies are analyzed and optimized through model calculations that include the daylight contribution. User experience of the concept will be examined through demonstration setups and the potential energy savings specified through measurements on these setups.

Dam-Hansen, C., Project Manager, Department of Photonics Engineering
Poulsen, P. B., Project Participant, Department of Photonics Engineering
Petersen, P. M., Project Participant, Department of Photonics Engineering
Corell, D. D., Project Participant, Department of Photonics Engineering
Hansen, S. S., Project Participant, Department of Photonics Engineering
Thorseth, A., Project Participant, Department of Photonics Engineering
Traberg-Borup, S., Project Participant, Danish Building Research Institute
Logadóttir, Á., Project Participant, Danish Building Research Institute
Orton, I. W., Project Participant, Ramboll Group AS
Pedersen, J. E., Project Participant, Energirådgiveren
Skovsgaard, T., Project Participant, Philips Lighting A/S

Project ID: 70631
Forsk. Andre statslige danske i øvrigt: DKK527,411.00
15/02/2010 → 31/12/2011
Collaborators: Philips Lighting A/S, Danish Building Research Institute, Ramboll Group AS, Energirådgiveren
Award relations: Combined daylight and intelligent LED lighting : Getting the daylight into the buildings
Project: Research

Hybrid lighting goes to school
Fiberoptiske belysningssystemer som benytter en kombination af sollys og LED belysning har et energibesparelsespotential, der er større end de mest effektive belysningsteknologier, som i dag benyttes til indendørsbelysning. På trods af det store energi- og CO2- besparelses potentiale er der en række problemstillinger, som skal løses før teknologien kan udvikles til et kommersielt produkt. De væsentlige problemer med eksisterende hybride fiberoptiske systemer er, at lyskvaliteten stadigvæk er for dårlig til at opnå en bred accept hos forbrugerne, ligesom kompleksiteten og prisen på belysningssystemerne er for høj. I projektet sigtes specifikt mod at teste og videreudvikle en prototype, som er baseret på et nyt koncept for prisspillige optiske komponenter og som har forbedret lyskvalitet i forhold til eksisterende fiberoptiske systemer. Der vil, som en vigtig del af projektet, blive indgået et partnerskab mellem Stevns Kommune, RUC og DTU Fotonik med det formål at nedsætte energiforbruget til belysning i kommunen. De nye belysningssystemer skal i projektet testes i fire skolelokaler samt gangarealer på Høtherskolen i Hårlev, hvor der vurderes både kvantitative og kvalitative aspekter indenfor kontrolstyring, energiforbrug, forbrugstid, lyskvalitet samt tilsyn af de nye systemer.

Petersen, P. M., Project Manager, Department of Photonics Engineering
Dam-Hansen, C., Project Manager, Department of Photonics Engineering
Stubager, J., Project Manager, Department of Photonics Engineering
Poulsen, P. B., Project Participant, Department of Photonics Engineering
Corell, D. D., Project Participant, Department of Photonics Engineering
Hansen, S. S., Project Participant, Department of Photonics Engineering
Thorseth, A., Project Participant, Department of Photonics Engineering
Bjarklev, A., Project Participant, Roskilde University
Kjær, T., Project Participant, Roskilde University
Andersen, J., Project Participant, Roskilde University
Laursen, K., Project Participant, Designskolen Kolding
Ibsen, P., Project Participant, Ibsen el-anlæg A/S
Nielsen, B., Project Participant, Stevns kommune
Activities:

**Measuring and Comparing Waveforms of Temporal Light Modulation**
Period: 17 Jun 2019 → 22 Jun 2019
Anders Thorseth (Speaker)
Diode Lasers and LED Systems
Department of Photonics Engineering
Degree of recognition: International

**Related event**
**CIE 2019 29th Quadrennial Session**
14/11/2018 → 22/11/2018
Washington DC, United States
Activity: Talks and presentations › Talks and presentations in private or public companies and organisations

**Glare, uncomfortable and dangerous, how to avoid it?**
Period: 22 May 2019
Anders Thorseth (Invited speaker)
Diode Lasers and LED Systems
Department of Photonics Engineering
Degree of recognition: National
Links:
https://www.tilmeld.dk/vejbelysningsdagen2019/program.html

**Related event**
**Vejbelysningsdagen**
22/05/2019 → …
Odense, Denmark
Activity: Talks and presentations › Talks and presentations in private or public companies and organisations
**Illuminating Engineering Society (External organisation)**
Period: 12 Feb 2019 → ...
Anders Thorseth (Member)
Diode Lasers and LED Systems
Department of Photonics Engineering

**Description**
IES Testing Procedures Committee
Degree of recognition: International

**Related external organisation**
**Illuminating Engineering Society**
Illuminating Engineering Society, 120 Wall St. Fl 17, NY 10005-4026, New York, , United States
Activity: Membership › Membership of commitees, commissions, boards, councils, associations, organisations, or similar

**CIE 2019 29th Quadrennial Session (Event)**
Period: 3 Jan 2019 → 5 Feb 2019
Anders Thorseth (Reviewer)
Department of Photonics Engineering
Diode Lasers and LED Systems

**Description**
Member of the international scientific review panel
Degree of recognition: International

Links:
http://washington2019.cie.co.at/review-panel (Review Panel)

**Related event**
**CIE 2019 29th Quadrennial Session**
14/11/2018 → 22/11/2018
Washington DC, United States
Activity: Research › Peer review of manuscripts

**Laser lighting as replacement of high intensity dischage lamps**
Period: 13 Dec 2018
Carsten Dam-Hansen (Guest lecturer)
Anders Thorseth (Guest lecturer)
Department of Photonics Engineering
Diode Lasers and LED Systems
Degree of recognition: National
Links:

**Related event**
**LED seminar**
13/12/2018 → ...
Copenhagen, Denmark
Activity: Talks and presentations › Talks and presentations in private or public companies and organisations

**OLED Teknologi**
Period: 11 Dec 2018
Anders Thorseth (Guest lecturer)
Related event

OLED Academy, Final Exhibition
11/12/2018 → …
Copenhagen, Denmark
Activity: Talks and presentations › Talks and presentations in private or public companies and organisations

Electrical Measurements of SSL Lamps and Luminaires
Period: 7 Nov 2018
Anders Thorseth (Lecturer)

Related event

CIE Tutorial and Practical Workshop on CIE S025
05/10/2018 → 07/10/2018
Moscow, Russian Federation
Activity: Talks and presentations › Guest lectures, external teaching and course activities at other universities

CIE Practical Workshop on Goniophotometry under CIE S 025
Period: 6 Nov 2018
Anders Thorseth (Lecturer)
Tony Bergen (Lecturer)

Related event

CIE Tutorial and Practical Workshop on CIE S025
05/10/2018 → 07/10/2018
Moscow, Russian Federation
Activity: Talks and presentations › Guest lectures, external teaching and course activities at other universities

CIE Tutorial and Practical Workshop on CIE S025
Period: 5 Nov 2018 → 7 Nov 2018
Anders Thorseth (Lecturer)

Related event

CIE Tutorial and Practical Workshop on CIE S025
05/10/2018 → 07/10/2018
Moscow, Russian Federation
Activity: Talks and presentations › Guest lectures, external teaching and course activities at other universities

Links:
Introduction to CIE S 025, Introduction to the Standard
Period: 5 Nov 2018
Anders Thorseth (Lecturer)
Diode Lasers and LED Systems
Department of Photonics Engineering
Degree of recognition: International

Related event
CIE Tutorial and Practical Workshop on CIE S025
05/10/2018 → 07/10/2018
Moscow, Russian Federation
Activity: Talks and presentations › Guest lectures, external teaching and course activities at other universities

Building and Environment (Journal)
Period: 25 Sep 2018 → …
Anders Thorseth (Reviewer)
Department of Photonics Engineering
Diode Lasers and LED Systems
Degree of recognition: International

Related journal
Building and Environment
0360-1323
Central database
Activity: Research › Peer review of manuscripts

Stewart Bergen
Start date: 17 Sep 2018 → 28 Sep 2018
Anders Thorseth (Host)
Carsten Dam-Hansen (Host)
Dennis Dan Corell (Host)
Department of Photonics Engineering
Diode Lasers and LED Systems
Degree of recognition: International
Activity: Hosting a guest lecturer

Seminar on photometric measurements and color performance of solid state lighting
Period: 16 Aug 2018
Anders Thorseth (Organizer)
Carsten Dam-Hansen (Organizer)
Yoshi Ohno (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems

Description
Seminar on photometric measurements and color performance of solid state lighting
Degree of recognition: Local

Related event
Seminar on photometric measurements and color performance of solid state lighting
16/08/2018 → …
Roskilde, Denmark
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

CIE Expert Tutorial and Workshop on Research Methods for Human Factors in Lighting
Period: 13 Aug 2018 → 14 Aug 2018
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems
Degree of recognition: International

Related event
CIE Expert Tutorial and Workshop on Research Methods for Human Factors in Lighting
13/08/2018 → 14/08/2018
Copenhagen, Denmark
Activity: Attending an event › Participating in or organising a conference

CIE TC 2-90 (External organisation)
Period: 10 Aug 2018 → ...
Anders Thorseth (Member)
Department of Photonics Engineering
Diode Lasers and LED Systems

Description
LED Reference Spectrum for Photometer Calibration

The purpose of this TC is to investigate and publish an LED Reference spectrum to complement the Standard Illuminant A. The TC will investigate and decide the spectral shape, wavelength range and the format to be used for publishing the reference spectrum. In addition a metric for the quality of the match of spectral distribution of real sources to the reference spectrum will be defined for the purpose of photometric calibrations.
Degree of recognition: International
Links:
http://www.cie.co.at/technicalcommittees/led-reference-spectrum-photometer-calibration

Related external organisation
CIE TC 2-90
Babenbergerstraße 9/9A, 1010, Vienna, Austria
Activity: Membership › Membership of committees, commissions, boards, councils, associations, organisations, or similar

Yoshi Ohno
Start date: 9 Aug 2018 → 17 Aug 2018
Carsten Dam-Hansen (Host)
Anders Thorseth (Host)
Department of Photonics Engineering
Diode Lasers and LED Systems

Description
DTU Fotonik is hosting NIST Fellow and CIE President Yoshi Ohno for the "CIE Expert Tutorial and Workshop on Research Methods for Human Factors in Lighting"
Degree of recognition: International
Activity: Hosting a guest lecturer

CIE RF-02, Matters relating to temporal light modulation (External organisation)
Period: 3 Jul 2018 → ...
Anders Thorseth (Member)
Diode Lasers and LED Systems
Department of Photonics Engineering

Description
This research forum follows the CIE Stakeholder Workshop for Temporal Light Modulation Standards for Lighting Systems and is one of the tasks specified in the road map in TN 008:2017. The RF will provide a discussion and information- and data-sharing platform for all aspects of temporal light modulation of lighting systems. These can include discussions relating to the measurement of TLM waveforms (informal discussions in support of TC 2-89), visual performance, or health effects of TLM, prediction of these effects from metrics that may be proposed, and application-specific considerations related to lighting systems used in any setting. It is intended to use this platform to involve other stakeholders, bringing in all experts with a genuine interest in the topic so that CIE builds on its leadership in this topic area.
Degree of recognition: International

Related external organisation
CIE RF-02, Matters relating to temporal light modulation
CIE Central Bureau Babenbergerstraße 9/9A, 1010, Vienna, Austria
Activity: Membership › Membership of research networks or expert groups

IEA 4E SSL Annex 2017 Interlaboratory Comparison of Goniophotometer Measurements (IC 2017)
Period: 30 Jun 2018 → 10 Aug 2018
Carsten Dam-Hansen (Other)
Anders Thorseth (Other)
Dennis Dan Corell (Other)
Johannes Lindén (Other)
Department of Photonics Engineering
Diode Lasers and LED Systems
Degree of recognition: International
Links:

Related event
IEA 4E SSL Annex 2017 Interlaboratory Comparison of Goniophotometer Measurements (IC 2017)
30/06/2017 → 01/09/2018
Activity: Other

CIE Division 2 Annual Meeting 2018
Period: 12 Jun 2018 → 15 Jun 2018
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems

Description
Division 2 Annual Meeting 2018
Degree of recognition: International

Related event
CIE Division 2 Annual Meeting 2018
12/06/2018 → 15/06/2018
Eindhoven, Netherlands
Activity: Attending an event › Participating in or organising a conference

Division 2 Annual Meeting 2018
Period: 12 Jun 2018 → 15 Jun 2018
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems

Description
Division 2 Annual Meeting 2018
Degree of recognition: International
Links:
http://cie.co.at/news/division-2-annual-meeting-2018

Related event
Division 2 Annual Meeting 2018
12/06/2018 → 15/06/2018
Eindhoven, Netherlands
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

International Commission on Illumination (CIE) (External organisation)
Period: 1 Jun 2018
Anders Thorseth (Member)
Department of Photonics Engineering
Diode Lasers and LED Systems

Description
Country member of CIE Division 2 for Denmark
Degree of recognition: International

Related external organisation
International Commission on Illumination
Austria
Activity: Membership › Board duties in companies, associations, or public organisations

Xu Jian
Start date: 1 Jun 2018 → 1 Mar 2019
Ole Bjarlin Jensen (Host)
Carsten Dam-Hansen (Host)
Anders Thorseth (Host)
Department of Photonics Engineering
Diode Lasers and LED Systems

Description
Degree of recognition: International
Activity: Hosting a guest lecturer

CIE TC 2-89 Measurement of Temporal Light Modulation of Light Sources and Lighting Systems (External organisation)
Period: 1 Apr 2018 → …
Anders Thorseth (Member)
Department of Photonics Engineering
Diode Lasers and LED Systems

Description
Degree of recognition: International
Links:

Related external organisation
CIE TC 2-89 Measurement of Temporal Light Modulation of Light Sources and Lighting Systems
Vienna, Austria
Activity: Membership › Membership of committees, commissions, boards, councils, associations, organisations, or similar
Seminar on phosphor converted laser lighting
Period: 20 Mar 2018
Anders Thorseth (Organizer)
Department of Photonics Engineering
Diode Lasers and LED Systems
Degree of recognition: International

Related event
Seminar on phosphor converted laser lighting
20/03/2018 → …
Roskilde, Denmark
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

LED possibilities and challenges
Period: 2 Jan 2018
Anders Thorseth (Guest lecturer)
Department of Photonics Engineering
Diode Lasers and LED Systems
Degree of recognition: National

Related event
33480 High-Tech Entrepreneurship
02/01/2018 → 21/01/2018
Lyngbt, Denmark
Activity: Talks and presentations › Guest lectures, external teaching and course activities at other universities

Activities in the standardisation of light sources and spectroradiometer calibration
Period: 15 Dec 2017
Anders Thorseth (Invited speaker)
Department of Photonics Engineering
Diode Lasers and LED Systems
Degree of recognition: International

Related event
6th PV-Outdoor-Spectral Measurement Mini Workshop: Dissemination of the Spectroradiometer and Broadband Intercomparison 2017
15/12/2017 → …
Vienna, Austria
Activity: Talks and presentations › Conference presentations

CIE Division 2 Annual Meeting 2017
Period: 26 Oct 2017
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems
Degree of recognition: International

Related event
CIE Division 2 Annual Meeting 2017
26/10/2017 → …
Jeju, Korea, Republic of
Activity: Attending an event › Participating in or organising a conference
CIE DR 2-80, CIE Division 2 Reportership, on metrology of laser based lighting
Period: 26 Oct 2017 → …
Anders Thorseth (Advisor)
Department of Photonics Engineering
Diode Lasers and LED Systems
Degree of recognition: International

Related external organisation
International Commission on Illumination
Austria
Activity: Public and private sector consultancy › Consultancy

Laser Driven White Light Source for BRDF Measurement
Period: 24 Oct 2017
Anders Thorseth (Guest lecturer)
Department of Photonics Engineering
Diode Lasers and LED Systems
Degree of recognition: International

Related event
CIE 2017 Mid-term meeting Jeju Island
20/10/2017 → 28/10/2017
Korea, Republic of
Activity: Talks and presentations › Conference presentations

Light source characterization and air movement under CIE S 025
Period: 23 Oct 2017
Anders Thorseth (Speaker)
Department of Photonics Engineering
Diode Lasers and LED Systems
Degree of recognition: International

Related event
CIE 2017 Mid-term meeting Jeju Island
20/10/2017 → 28/10/2017
Korea, Republic of
Activity: Talks and presentations › Conference presentations

General Assembly of the CIE 2017 (Event)
Period: 22 Oct 2017
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems

Description
General Assembly of the CIE 2017
Degree of recognition: International

Related event
General Assembly of the CIE 2017
22/10/2017 → …
Jeju, Korea, Republic of
Activity: Membership › Board duties in companies, associations, or public organisations
CIE 2017 Mid-term meeting Jeju Island
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems

Description
CIE 2017 Mid-term meeting Jeju Island, Republic of Korea
Degree of recognition: International

Related event
CIE 2017 Mid-term meeting Jeju Island
20/10/2017 → 28/10/2017
Korea, Republic of
Activity: Attending an event › Participating in or organising a conference

Lysets dag 2017
Period: 14 Sep 2017
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems
Degree of recognition: National

Related event
Lysets dag 2017: LED mæder virkeligheden
14/09/2017 → …
København, Denmark
Activity: Attending an event › Participating in or organising a conference

Værdisætning af nordisk lys
Period: 19 Aug 2017 → 20 Aug 2017
Anders Thorseth (Organizer)
Department of Photonics Engineering
Diode Lasers and LED Systems
Degree of recognition: National

Related event
Værdisætning af nordisk lys
19/08/2017 → 20/08/2017
Roskilde, Denmark
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Applied Optics (Journal)
Period: 21 Jun 2017 → …
Anders Thorseth (Reviewer)
Department of Photonics Engineering
Diode Lasers and LED Systems
Degree of recognition: International

Related journal
Applied Optics
1559-128X
DALI Designer 5 programming
Period: 15 Jun 2017
Anders Thorseth (Participant)
Finn Aage Christensen Pedersen (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems
Optical Sensor Technology
Degree of recognition: Local

Related event
DALI Designer 5 programming: Starter
15/06/2017 → …
Brøndby, Denmark
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

7th International SpectroRadiometer Comparison (ISRC 2017)
Period: 10 Jun 2017 → 14 Jun 2017
Anders Thorseth (Participant)
Nicholas Riedel (Participant)
Peter Behrensforff Poulsen (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems

Description
Instrument comparison of outdoor spectroradiometers
Degree of recognition: International
Links:

Related event
7th International SpectroRadiometer Comparison (ISRC 2017)
12/06/2017 → 16/06/2017
Catania, Italy
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Vejbelysningsdagen 2017
Period: 31 May 2017
Anders Thorseth (Organizer)
Dennis Dan Corell (Organizer)
Johannes Lindén (Organizer)
Department of Photonics Engineering
Diode Lasers and LED Systems

Description
DOLL exhibition of measurement facilities
Degree of recognition: National

Related event
Vejbelysningsdagen 2017
31/05/2017 → 31/05/2017
Odense, Denmark
Activity: Attending an event › Participating in or organising a conference

**IEEE Transactions on Industrial Electronics (Journal)**
Period: 26 May 2017 → …
Anders Thorseth (Reviewer)
Department of Photonics Engineering
Diode Lasers and LED Systems
Degree of recognition: International

Related journal
**IEEE Transactions on Industrial Electronics**
0278-0046
ISI indexed (2013): ISI indexed yes
Central database
Activity: Research › Peer review of manuscripts

**CIE Tutorial and Practical Workshop on LED Lamp and Luminaire Testing to CIE S 025**
Period: 8 May 2017 → 11 May 2017
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems

**Description**
CIE Tutorial and Practical Workshop on LED Lamp and Luminaire Testing to CIE S 025
May 08 – 11, 2017, METAS Bern-Wabern, Switzerland

**Related event**
**CIE Tutorial and Practical Workshop on LED Lamp and Luminaire Testing to CIE S 025**
08/05/2017 → 11/05/2017
Bern, Switzerland
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

**Training in luminance imaging**
Period: 5 Apr 2017 → 6 Apr 2017
Anders Thorseth (Organizer)
Dennis Dan Corell (Participant)
Mekbib Wubishet Amdemeskel (Participant)
Johannes Lindén (Participant)
Thierry Silvio Claude Soreze (Participant)
Carsten Dam-Hansen (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems

**Description**
Course lecturer: Tobias Porsch
Degree of recognition: Local

**Related event**
**Training in luminance imaging**
05/04/2017 → 06/04/2017
Roskilde, Denmark
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

**Lighting Research and Technology (Journal)**  
Period: 28 Feb 2017 → …  
Anders Thorseth (Reviewer)  
Department of Photonics Engineering  
Diode Lasers and LED Systems  
Degree of recognition: International

**Related journal**  
**Lighting Research and Technology**  
1477-1535  
Central database

Activity: Research › Peer review of manuscripts

**LED possibilities and challenges**  
Period: 2 Jan 2017  
Anders Thorseth (Lecturer)  
Department of Photonics Engineering  
Diode Lasers and LED Systems

**Related event**  
**33480 High-Tech Entrepreneurship**  
02/01/2017 → 21/01/2017  
Lyngby, Denmark  
Activity: Talks and presentations › Conference presentations

**LED Conference 2016**  
Period: 7 Nov 2016  
Anders Thorseth (Organizer)  
Department of Photonics Engineering  
Diode Lasers and LED Systems

**Description**  
Coordinating organizer of LED conference  
Links:  
http://conferencemanager.events/ledmet2016/

**Related event**  
**LED Conference 2016**  
07/11/2016 → …  
Roskilde, Denmark  
Activity: Attending an event › Participating in or organising a conference

**41792 Measurement uncertainty estimation using statistical methods**  
Period: 29 Aug 2016 → 30 Sep 2016  
Anders Thorseth (Participant)  
Department of Photonics Engineering  
Diode Lasers and LED Systems

**Description**  
41792 Measurement uncertainty estimation using statistical methods
CIE TC 2-85: Recommendation on the geometrical parameters for the measurement of the Bidirectional Reflectance Distribution Function (BRDF)

To provide geometrical recommendations for the BRDF measurement according to the type of sample under investigation, in order to allow better comparison between the different instruments, to improve the traceability of the measurements, and to help the user to choose the right angular configuration.

Body type: Technical committee
Degree of recognition: International

Related external organisation

International Commission on Illumination
Austria
Activity: Membership › Membership of committees, commissions, boards, councils, associations, organisations, or similar

CIE TC 2-79: Integrating Sphere Photometry and Spectroradiometry

Terms of reference: To create a technical report on the photometry and spectroradiometry of sources in integrating spheres by updating the relevant parts of CIE 084-1989 and incorporating new techniques and practices.
Body type: Technical committee under CIE
Degree of recognition: International
Links:
http://www.cie.co.at/index.php/Technical+Committees (Technical committees under CIE)

Related external organisation

International Commission on Illumination
Austria
Activity: Membership › Membership of committees, commissions, boards, councils, associations, organisations, or similar

DTU Fotonik, SSL activities, DOLL green lab
Period: 17 Mar 2016
Anders Thorseth (Lecturer)
Department of Photonics Engineering
Diode Lasers and LED Systems
Documents:
Amg2016-03-16-2445-2
Links:
http://www.jlma.or.jp/en/

Related event

Japan Lighting Manufactures Association visit to DOLL labs
17/03/2016 → …
Roskilde, Denmark
Activity: Talks and presentations › Conference presentations

Annual meeting of CIE Division 2 "Physical Measurement of Light and Radiation"
Period: 7 Mar 2016
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems
Description
Annual meeting of CIE Division 2 "Physical Measurement of Light and Radiation"
Links:
http://div2.cie.co.at/

Related event

Annual meeting of CIE Division 2 "Physical Measurement of Light and Radiation"
07/03/2016 → …
Melbourne, Australia
Activity: Attending an event › Participating in or organising a conference

CIE Lighting Quality & Energy Efficiency Conference
Anders Thorseth (Speaker)
Department of Photonics Engineering
Diode Lasers and LED Systems
Description
CIE 2016
Links:
http://melbourne2016.cie.co.at/ (Conference website)
**Related event**

**CIE Lighting Quality & Energy Efficiency Conference**  
03/03/2016 → 09/03/2016  
Melbourne, Australia  
Activity: Talks and presentations › Conference presentations

**2nd Stakeholder Workshop of EMRP ENG62 MESaIL**  
Period: 26 Nov 2015  
Anders Thorseth (Participant)  
Department of Photonics Engineering  
Diode Lasers and LED Systems  
**Description**  
2nd Stakeholder Workshop of EMRP ENG62 MESaIL  
Links:  

**Related event**

**2nd Stakeholder Workshop of EMRP ENG62 MESaIL**  
26/11/2015 → …  
Braunschweig, Germany  
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

**Auxiliary correction in goniophotometry, simulation and measurement**  
Period: 25 Nov 2015  
Anders Thorseth (Lecturer)  
Department of Photonics Engineering  
Diode Lasers and LED Systems  
Links:  
http://div2.cie.co.at/?i_ca_id=974

**Related event**

**CIE Tutorial and Expert Symposium on the CIE S025 LED Lamps, LED Luminaires and LED Modules Test Standard**  
23/11/2015 → 26/11/2015  
Braunschweig, Germany  
Activity: Talks and presentations › Conference presentations

**LED teknologi og smarte energibesparelser**  
Period: 11 Nov 2015  
Anders Thorseth (Lecturer)  
Department of Photonics Engineering  
Diode Lasers and LED Systems  
Documents:  
20151029 - KlimaKlar møde om LED 11. november 2015  
DSC04257  
DSC04255  
Links:  
http://www.gladsaxe.dk/kommunen/erhverv/miljoe-_klima_og_affald/klima/klimaklar_netvaerk_for_virksomheder (KlimaKlar Netværk for Virksomheder)

**Related event**

**KlimaKlar Gladsaxe, møde om belysning**  
11/11/2015 → …  
Søborg, Denmark
International Commission on Illumination (External organisation)
Period: 23 Oct 2015 → …
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems

Description
CIE TC 2-78: The Goniophotometry of Lamps and Luminaires

Terms of reference: To update CIE 121-1996, CIE 070-1987 and the relevant parts of CIE 064-1989 and combine these into the one technical report, incorporating new techniques and the absolute goniophotometry of lamps in their own right.

Body type: Technical Committee
Degree of recognition: International

Related external organisation
International Commission on Illumination
Austria

Lysets dag
Period: 30 Sep 2015
Anders Thorseth (Organizer)
Department of Photonics Engineering
Diode Lasers and LED Systems

Documents:
LEDMET_Lysets_Dag_webteaser

Links:
http://www.conferencemanager.dk/lysetsdag2015/

Related event
Lysets dag: Lys & Menneske
30/09/2015 → …
København, Denmark
Activity: Attending an event › Participating in or organising a conference

LED possibilities and challenges
Period: 3 Aug 2015
Anders Thorseth (Lecturer)
Department of Photonics Engineering
Diode Lasers and LED Systems

Links:
http://www.kurser.dtu.dk/courses/33480/default.aspx

Related event
Højteknologisk iværksættering
03/08/2015 → 21/08/2015
Lyngby, Denmark
Activity: Talks and presentations › Conference presentations

Goniometric Characterization of LED Based Greenhouse Lighting
Period: 29 Jun 2015
Anders Thorseth (Speaker)
Related event

28th Session of the International Commission on Illumination
29/06/2015 → 04/07/2015
Manchester, United Kingdom
Activity: Talks and presentations › Conference presentations

Smart City belysning & applikationer
Period: 19 Mar 2015
Anders Thorseth (Organizer)
Department of Photonics Engineering
Diode Lasers and LED Systems
Links:
http://www.conferencemanager.dk/ledconf

Related event

Smart City belysning & applikationer
19/03/2015 → …
København, Denmark
Activity: Attending an event › Participating in or organising a conference

CIE Tutorial and Expert Symposium on Measurement Uncertainties in Photometry and Radiometry for Industry
Period: 9 Sep 2014 → 10 Sep 2014
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems

Description
CIE offers a one-day tutorial on measurement uncertainty concepts in photometry and radiometry. Invited experts will present lectures from basic concepts to advanced techniques in photometric and colorimetric measurements, aimed at engineers, testing-laboratory staff and researchers in LED and solid state lighting measurement and other fields. Special emphasis is given to applied concepts.

On the following day, a scientific symposium will feature contributed papers.

The event is organized by CIE Division 2. It will be held in conjunction with meetings of several Technical Committees of CIE Division 2 (Sept 9-10, 2014)
Links:
http://div2.cie.co.at/?i_ca_id=939 (CIE Tutorial and Expert Symposium on Measurement Uncertainties in Photometry and Radiometry for Industry)

Related event

CIE Tutorial and Expert Symposium on Measurement Uncertainties in Photometry and Radiometry for Industry
Vienna, Austria
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

International Commission on Illumination (External organisation)
Period: 25 Jun 2014
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems

**Description**
CIE TC 2-80: Spectroradiometric measurement of light sources

Terms of reference: To specify current procedures for the spectroradiometry of continuous, line and mixed sources of optical radiation. Such procedures apply to measurements of irradiance, radiance and radiant flux in the near ultraviolet, visible and near infrared regions of the spectrum.

Body type: Technical Committee
Degree of recognition: International

**Related external organisation**
International Commission on Illumination
Austria
Activity: Membership › Membership of commitees, commissions, boards, councils, associations, organisations, or similar

**Energiens Topmøde 2014**
Period: 11 Jun 2014
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems

**Description**
Energiens Topmøde blev afholdt onsdag den 11. juni 2014.

**Related event**
Energiens Topmøde 2014: Ny energi Nye muligheder
11/06/2014 → …
København, Denmark
Activity: Attending an event › Participating in or organising a conference

**CIE 2014**
Period: 23 Apr 2014 → 26 Apr 2014
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems

**Description**
List of Topics

1 Right Lighting and Energy Efficiency
International energy saving initiatives
National and regional energy saving programs
Cost effectiveness of lighting installations
Ecological footprint of lighting

2 Interior applications
Efficiency and visual perception quality
Day lighting
Visual comfort

3 Exterior applications
Glare
Adaptability
Public acceptance
4 Light and Vision

Mesopic vision
Lighting for the elderly and visually impaired
Colour rendering

5 Photobiological Effects

Circadian photoreception
Circadian responsivity
Photobiological effects of light
Lighting and photobiological safety

6 Photometry and Measurements

Measurement and testing of SSL products with special focus on OLEDs
Luminance measurement with emphasis on imaging measurement devices
Mesopic photometry
Measurements of photobiological effects
Colorimetry

Links:
http://malaysia2014.cie.co.at/ (CIE Malaysia 2014, Conference homepage)

Related event

CIE 2014: Lighting Quality & Energy Efficiency
23/04/2014 → 26/04/2014
Kuala Lumpur, Malaysia
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Museum Lighting and LED
Period: 19 Mar 2014
Anders Thorseth (Organizer)
Department of Photonics Engineering
Diode Lasers and LED Systems

Description
Museum Lighting and LED
Links:
http://www.ledconf.dk

Related event

Museum Lighting and LED
19/03/2014 → ...
Copenhagen, Denmark
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Kultur-, naturhistorisk og kunstfagligt orienteringsmøde
Period: 15 Nov 2013
Anders Thorseth (Invited speaker)
Department of Photonics Engineering
Diode Lasers and LED Systems

Links:
http://www.dkmuseer.dk/content/kultur-naturhistorisk-og-kunstfagligt-orenteringsm%C3%B8de-0

Related event

Kultur-, naturhistorisk og kunstfagligt orienteringsmøde
14/11/2013 → 16/11/2013
Kolding, Denmark
Activity: Talks and presentations › Conference presentations

**SusTrans Workshop “Belysning i omstilling”**
Period: 7 Nov 2013
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems
Links:
http://www.sustrans.dk/

Related event

**SusTrans Workshop “Belysning i omstilling”**
07/11/2013 → …
København, Denmark
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

**CIE Expert Workshop on Advanced Methods for Photometry**
Period: 8 Oct 2013 → 9 Oct 2013
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems
Links:
http://www.sdr.si/sl/div2.html

Related event

**CIE Expert Workshop on Advanced Methods for Photometry: Measurement Uncertainty in Photometric Testing of SSL products and Sampling Theory in Photometry and Spectroradiometry**
08/10/2013 → 09/10/2013
Bled, Slovenia
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

**CIE Division 2 Technical Committee Meetings**
Period: 7 Oct 2013
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems

Related event

**CIE Division 2 Technical Committee Meetings**
07/10/2013 → …
Bled, Slovenia
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

**International Commission on Illumination (External organisation)**
Period: 26 Sep 2013
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems

Description
Technical comittee CIE TC 2-51

Terms of reference: To produce a technical report for the calibration of detector array spectroradiometers primarily for the
determination of colorimetric and photometric quantities, including performance characteristics, evaluation of these characteristics, calibration methods and guidance in the application of methods for the determination of uncertainty.

Body type: Technical Committee
Degree of recognition: International

Related external organisation
International Commission on Illumination
Austria
Activity: Membership › Membership of committees, commissions, boards, councils, associations, organisations, or similar

Metrology for Efficient and Safe Innovative Lighting (External organisation)
Period: 13 Sep 2013
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems

Description
Metrology for Efficient and Safe Innovative Lighting
DTU Fotonik is among the stakeholders in the project

Stakeholder
Body type: EMRP Project
Degree of recognition: International

Related external organisation
European Association of National Metrology Institutes
Germany
Activity: Membership › Membership of research networks or expert groups

LED belysning nu og i fremtiden ved Carbon20 Netværksmøde om LED belysning
Period: 5 Sep 2013
Anders Thorseth (Invited speaker)
Department of Photonics Engineering
Diode Lasers and LED Systems
Links:
http://www.carbon20.dk

Related event
Netværksmøde om LED belysning
05/09/2013 → …
Allerød, Denmark
Activity: Talks and presentations › Conference presentations

CIE Centenary Conference
Period: 15 Apr 2013
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems

Related event
CIE Centenary Conference: Towards a New Century of Light
12/04/2013 → 19/04/2013
Paris, France  
Activity: Attending an event › Participating in or organising a conference

**LED konference 2013**  
**Period:** 20 Mar 2013  
Anders Thorseth (Organizer)  
Department of Photonics Engineering  
Diode Lasers and LED Systems  
Links:  
http://www.lednet.dk

**Related event**

**LED konference 2013: LYS SUNDHED & SUNDHEDSVÆSEN**  
20/03/2013 → …  
København, Denmark  
Activity: Attending an event › Participating in or organising a conference

Lyngby, Denmark

**2nd Annual Workshop on Research and Development of Light-Emitting Diodes**  
**Period:** 15 Mar 2013  
Anders Thorseth (Speaker)  
Department of Photonics Engineering  
Diode Lasers and LED Systems  

**Related event**

**2nd Annual Workshop on Research and Development of Light-Emitting Diodes**  
15/03/2013 → …  
Lyngby, Denmark  
Activity: Talks and presentations › Conference presentations

San Francisco, California, United States

**SPIE Photonics West : Light-Emitting Diodes: Materials, Devices, and Applications for Solid State Lighting XVII**  
**Period:** 6 Feb 2013  
Anders Thorseth (Speaker)  
Department of Photonics Engineering  
Diode Lasers and LED Systems  

**Description**  
The rapid development in flux and efficiency of Light Emitting Diodes (LED) has resulted in a flooding of the lighting market with Solid State Lighting (SSL) products. Many traditional light sources can advantageously be replaced by these SSL retrofit products. There are however large variations in the quality of the available products, and some are not better than the ones they are supposed to replace. Here the results of a two year study investigating SSL products on the Danish market are presented. The light sources have been tested for luminous flux and spectral power distribution. Focus has been on SSL products for replacement of incandescent lamps and halogen spotlights. More than 300 SSL replacement lamps have been tested for efficiency and light quality with respect to correlated color temperature and color rendering properties. The warm white light and good color rendering properties of these traditional light sources are a must for lighting in Denmark and the Nordic countries. We compare the test results with the requirements in the EU LED quality charter, and find many products with light inferior light quality and efficiency. The lumen and color maintenance over time has been investigated by non-accelerated lifetime tests and results for products running over 8000 h will be presented. A new internet based SSL product selection tool will be shown. Here the products can be compared on efficiency, light quality parameters and price, thus providing a better basis for the selection of SSL products for consumers.

**Related event**

**SPIE Photonics West : Light-Emitting Diodes: Materials, Devices, and Applications for Solid State Lighting XVII**  
02/02/2013 → 07/02/2013  
San Francisco, California, United States  
Activity: Talks and presentations › Conference presentations
Perspektiver på LED lys og om igangværende projekter
Period: 7 Nov 2012
Anders Thorseth (Lecturer)
Department of Photonics Engineering
Diode Lasers and LED Systems

Related event
Gå-hjem-møde for Roskilde Håndværkerforening
07/11/2012 → …
Roskilde, Denmark
Activity: Talks and presentations › Conference presentations

Illustrations to the educational site www.lysviden.dk: Chromaticity diagrams
Period: 1 Oct 2012
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems
Links:
http://lysviden.dk/grundviden/emne/farvetemperatur/artikler/korreleret-farvetemperatur/ (www.lysviden.dk on correlated color temperature)
Activity: Other

Technical challenges regarding LED lighting in greenhouses
Period: 12 Sep 2012
Anders Thorseth (Lecturer)
Department of Photonics Engineering
Diode Lasers and LED Systems
Links:
http://agrotech.dk/arbejdsomraader/aktiviteter-og-kurser/vaekstlys-led-kontra-son-t

Related event
Vækstlys: LED kontra SON-T
12/09/2012 → …
Odense, Denmark
Activity: Talks and presentations › Conference presentations

Overview of research at DTU Fotonik related to lighting for municipalities
Period: 8 Jun 2012
Anders Thorseth (Lecturer)
Department of Photonics Engineering
Diode Lasers and LED Systems
Links:
http://www2.cm-evora.pt/mecine/Default.htm (MECINE Network)

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Meijo-DTU workshop on research and development of light-emitting diodes
Period: 22 Mar 2012
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems

**Description**
Program
9:00~9:15
Introduction
Haiyan Ou, DTU
9:15~9:45
LED innovation at DTU Fotonik
Paul Michael Petersen, DTU
9:45~10:15
Physics of fluorescent SiC for white LED application
Prof. Satoshi Kamiyama, Meijo
10:15~10:45
Nitride-based-semiconductors-research at Meijo University
Prof. Motoaki Iwaya, Meijo
10:45~11:15
Coffee break and discussion
11:15~11:45
Observation of GaInN strain relaxation using in situ X-ray diffraction monitoring during metalorganic apour phase epitaxy growth
Dr. Daisuke Iida, Meijo
11:45~12:15
Diffractive effects of periodic plasmonic structures on the light emitting diode
Yuntian Chen, DTU
12:15~13:15
Lunch
13:15~13:45
Nanostructuring on fluorescent SiC for the luminescence enhancement
Yiyu Ou, DTU
13:45~14:15
Characterization and optimization of LED systems
Anders Thorseth, DTU
14:15~14:45
Spectral design flexibility of LEDs bring better life
Haiyan Ou, DTU
14:45~15:15
Coffee break and discussion
15:15~17:00
Lab and cleanroom tour

**Related external organisation**

**Technical University of Denmark**
Kemitorvet, building 202, 2800, Kgs. Lyngby, Denmark
Activity: Other

**LED Udendørsbelysning 2012**
Period: 20 Mar 2012
Anders Thorseth (Organizer)
Department of Photonics Engineering
Diode Lasers and LED Systems
Links:
http://lednet.dk/index.php?option=com_content&view=article&id=51&Itemid=63 (Conference program)

**Related event**

**LED Udendørsbelysning 2012**
20/04/2012 → …
København, Denmark
Activity: Attending an event › Participating in or organising a conference
**Phenics West 2012**  
Period: 22 Jan 2012  
Anders Thorseth (Participant)  
Department of Photonics Engineering  
Diode Lasers and LED Systems  

**Description**  
Introduction to Lens Design  

**Related event**

**Phenics West 2012**  
20/01/2012 → 28/01/2012  
San Francisco, CA, United States  
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Period: 11 Jan 2012  
Anders Thorseth (Speaker)  
Department of Photonics Engineering  
Diode Lasers and LED Systems  

**Description**  
An automated setup has been developed for spectral radiometric characterization of LED components with precise control of the settings of forward current and operating temperature. The automated setup has been used to characterize commercial LED components with respect to multiple settings. It is shown that the droop in quantum efficiency can be approximated by a simple parabolic function. The investigated models of the spectral power distributions (SPD) from LEDs are the strictly empirical single and double Gaussian functions, and a semi empirical model using quasi Fermi levels and other basic solid state principles. The models are fitted to measured SPDs, using the free parameters. The result show a high correlation between the measured LED SPD and the fitted models. When comparing the chromaticity of the measured SPD with fitted models, the deviation is found to be larger than the lower limit of human color perception. A method has been developed to optimize multicolored cluster LED systems with respect to light quality, using multi objective optimization.  
The results are simulated SPDs similar to traditional light sources, and with high light quality. As part of this work the techniques have been applied in practical illumination applications. The presented examples are historical artifacts and illumination of plants to increase photosynthesis.  

**Related external organisation**

**Unknown external organisation**  
Activity: Talks and presentations › Conference presentations  

**Euroluce 2011 International Lighting Exhibition**  
Period: 12 Apr 2011 → 17 Apr 2011  
Anders Thorseth (Participant)  
Department of Photonics Engineering  
Diode Lasers and LED Systems  

**Description**  
Euroluce 2011  

**Related event**

**Euroluce 2011 International Lighting Exhibition**  
12/04/2011 → 17/04/2011  
Milano, Italy  
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.
Energy efficient and high quality LED illumination in display cases: New lighting – New LEDs
Period: 16 Mar 2010 → 17 Mar 2010
Anders Thorseth (Speaker)
Department of Photonics Engineering
Diode Lasers and LED Systems

Description
Place: Stockholm, Sweden

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Industrial Photonics Day: LED technology
Period: 13 Jan 2010
Anders Thorseth (Speaker)
Department of Photonics Engineering

Description
An overview of the research done at DTU Fotonik on optimization of multicolored LED systems.
Place: Oticon Hall, DTU

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

LED Lighting: Research and development - Opportunities and challenges today and tomorrow
Period: 12 Jan 2010
Anders Thorseth (Lecturer)
Department of Photonics Engineering
Diode Lasers and LED Systems

Related event
11126 Lighting Systems in Buildings
04/01/2010 → 20/04/2012
Lyngby, Denmark
Activity: Talks and presentations › Conference presentations

LED - fremtidens belysning
Period: 3 Dec 2009 → 4 Dec 2009
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems
Optics and Plasma Research Department
Laser Systems and Optical Materials
Links:

Related event
LED - fremtidens belysning
03/12/2009 → 04/12/2009
København, Denmark
Activity: Attending an event › Participating in or organising a conference

**Workshop - Fra idé til LED system: LED - Termisk design**
Period: 3 Dec 2009 → 4 Dec 2009
Anders Thorseth (Speaker)
Department of Photonics Engineering
Diode Lasers and LED Systems

**Description**
Place: Ingeniørhuset, København, DK

**Related external organisation**

**Unknown external organisation**
Activity: Talks and presentations › Conference presentations

**Electromagnetism (EM1): Laboratory exercises, bachelor level**
Period: 23 Apr 2009 → 15 Jun 2009
Anders Thorseth (Lecturer)
Department of Photonics Engineering
Diode Lasers and LED Systems

**Links:**
http://sis.ku.dk/kurser/viskursus.aspx?knr=131043

**Related external organisation**

**Niels Bohr Institute**
Copenhagen, Denmark
Activity: Talks and presentations › Guest lectures, external teaching and course activities at other universities

**Foreign research institution**
Period: 1 Feb 2008 → 1 Jun 2008
Anders Thorseth (Visiting researcher)
Optics and Plasma Research Department
Laser Systems and Optical Materials
Department of Photonics Engineering
Diode Lasers and LED Systems

**Description**
Ph.D. student visit at foreign research institution
Activity: Visiting an external institution › Visiting another research institution

**LED research at Risø**
Period: 14 Jan 2008
Anders Thorseth (Lecturer)
Department of Photonics Engineering
Optics and Plasma Research Department
Laser Systems and Optical Materials

**Related event**

**Belysningsteknik**
07/01/2008 → 25/01/2008
Lyngby, Denmark
Activity: Talks and presentations › Conference presentations

**Lysets Dage**
Period: 12 Sep 2007 → 13 Sep 2007
Anders Thorseth (Participant)
Optics and Plasma Research Department
Laser Systems and Optical Materials
Department of Photonics Engineering
Diode Lasers and LED Systems

**Related event**

**Lysets Dage**
12/09/2008 → 13/09/2008
København, Denmark
Activity: Attending an event › Participating in or organising a conference

**EuroLED 2007**
Period: 4 Jun 2007 → 8 Jun 2007
Anders Thorseth (Participant)
Department of Photonics Engineering
Diode Lasers and LED Systems
Optics and Plasma Research Department
Laser Systems and Optical Materials

**Related event**

**EuroLED 2007**
04/06/2007 → 08/06/2007
Birmingham, United Kingdom
Activity: Attending an event › Participating in or organising a conference

**Prizes:**

**Best Poster Award at 44th IEEE Photovoltaic Specialists Conference**
Gisele Alves dos Reis Benatto (Recipient), Sune Thorsteinsson (Recipient), Nicholas Riedel (Recipient), Peter Behrensdorff Poulsen (Recipient), Anders Thorseth (Recipient), Carsten Dam-Hansen (Recipient), Claire Mantel (Recipient) & Søren Forchhammer (Recipient)
Department of Photonics Engineering, Diode Lasers and LED Systems, Coding and Visual Communication, Centre of Excellence for Silicon Photonics for Optical Communications

**Description**
Area 5: Characterization II

**Details**
Awarded date: 29 Jun 2017
Degree of recognition: International
Granting Organisations: IEEE
event: 2017 IEEE 44th Photovoltaic Specialists Conference
Prize: Prizes, scholarships, distinctions

**Invited paper for SPIE newsroom**
Anders Thorseth (Recipient)
Department of Photonics Engineering, Diode Lasers and LED Systems

**Details**
Awarded date: 12 Feb 2013
Degree of recognition: International
Granting Organisations: SPIE
Prize: Prizes, scholarships, distinctions

Legal fra Otto Møntsteds Fond til konferencedeltagelse
Anders Thorseth (Recipient)
Department of Photonics Engineering, Diode Lasers and LED Systems

Details
Awarded date: 21 Jan 2012
Granting Organisations: Otto Mønsteds Fond
Prize: Prizes, scholarships, distinctions

Paper selected for "Light and Culture: key papers on museum & art gallery lighting": Light and Culture: The latest must-reads from Lighting Research & Technology
Anders Thorseth (Recipient)
Department of Photonics Engineering, Diode Lasers and LED Systems

Description
Paper selected for special mention in connection with the 5th Professional Lighting Design Convention

Details
Awarded date: 27 Oct 2015
Prize: Prizes, scholarships, distinctions

Second Place Award at NREL PV Reliability Workshop 2018
Gisele Alves dos Reis Benatto (Recipient), Nicholas Riedel (Recipient), Adrian Alejo Santamaria Lancia (Recipient), Sune Thorsteinsson (Recipient), Peter Behrensdorff Poulsen (Recipient), Anders Thorseth (Recipient), Carsten Dam-Hansen (Recipient), Claire Mantel (Recipient), Søren Forchhammer (Recipient), Frederiksen Kenn H. B. (Recipient), Jan Vedde (Recipient), Harsh Parikh (Recipient), Sergiu Spataru (Recipient) & Dezso Sera (Recipient)
Department of Photonics Engineering, Photovoltaic Materials and Systems, Diode Lasers and LED Systems, Coding and Visual Communication

Description
Poster Section II

Details
Awarded date: 28 Feb 2018
Degree of recognition: International
Granting Organisations: National Renewable Energy Laboratory
event: PV Reliability Workshop
Prize: Prizes, scholarships, distinctions

SPIE 2013 Green Photonics Award for Solid State Lighting and Displays
Carsten Dam-Hansen (Recipient), Dennis Dan Corell (Recipient), Anders Thorseth (Recipient) & Peter Behrensdorff Poulsen (Recipient)
Department of Photonics Engineering, Diode Lasers and LED Systems

Description
The SPIE Green Photonics Award for Solid State Lighting and Displays recognizes outstanding contributions that enable efficient new light sources that will provide long-lived and economical illumination for human activities and information display. The paper Light quality and efficiency of consumer grade solid state products is recognized for pioneering contributions in the development of advanced technologies for the possible applications in infrared excited LED, lighting, lasers and displays.

Details
Awarded date: 5 Feb 2013
Granting Organisations: SPIE
event: SPIE Photonics West : Green Photonics
Prize: Prizes, scholarships, distinctions
The Danish Lighting Innovation Network travel grant 2013
Anders Thorseth (Recipient)
Department of Photonics Engineering, Diode Lasers and LED Systems

Details
Awarded date: 25 Sep 2013
Prize: Prizes, scholarships, distinctions

Travel grant from Otto Mønsteds Fondation
Anders Thorseth (Recipient)
Department of Photonics Engineering, Diode Lasers and LED Systems

Details
Awarded date: 2 Feb 2013
Granting Organisations: Otto Mønsteds Fond
Prize: Prizes, scholarships, distinctions

Travel grant from The Otto Mønsted Foundation
Anders Thorseth (Recipient)
Department of Photonics Engineering, Diode Lasers and LED Systems

Details
Awarded date: 6 Oct 2017
Granting Organisations: Otto Mønsteds Fond
Prize: Prizes, scholarships, distinctions

Travel stipend for participation in CIE 2014 conference
Anders Thorseth (Recipient)
Department of Photonics Engineering, Diode Lasers and LED Systems

Details
Awarded date: 5 Apr 2014
Granting Organisations: Otto Mønsteds Fond
Prize: Prizes, scholarships, distinctions

Travel stipend for participation in CIE 2015 conference
Anders Thorseth (Recipient)
Department of Photonics Engineering, Diode Lasers and LED Systems

Details
Awarded date: 30 May 2015
Degree of recognition: National
Granting Organisations: Otto Mønsteds Fond
Prize: Prizes, scholarships, distinctions

Travel stipend from Otto Mansted Foundation to participate in Photonics West 2012
Anders Thorseth (Recipient)
Department of Photonics Engineering, Diode Lasers and LED Systems

Details
Awarded date: 8 Jan 2012
Degree of recognition: National
Granting Organisations: Otto Mønsteds Fond
Prize: Prizes, scholarships, distinctions

Press clippings:

DTU-forskere vil være først med globalt standardmål for LED-lys
Anders Thorseth
20/08/2018
Department of Photonics Engineering, Diode Lasers and LED Systems
DTU-forskere vil være først med globalt standardmål for LED-lys
20/08/2018
www.forskningsformidling.dk (National), Denmark, Web
Bjørn Wessel-Tolvig
https://forskningsformidling.dk/dtu-forskere-vil-vaere-forst-med-globalt-standardmal-for-led-lys/
Anders Thorseth

Relations
Projects:
EMPIR 15SIB07 PhotoLED, Future photometry based on solid-state lighting products
Activities:
CIE TC 2-90 (External organisation)
Press/Media: Press / Media

Koldt LED-lys truer nordisk hygge
Anders Thorseth & Carsten Dam-Hansen
26/05/2017
Department of Photonics Engineering, Diode Lasers and LED Systems

Relations
Projects:
LEDMET: Center for LED metrology
Global Test of SSL Products - IEA-4E-SSL
Warm or Cold, Lights influence on thermal comfort
Activities:
LED Conference 2016
Press/Media: Press / Media

LED-pæren er blevet boligeget
Anders Thorseth
28/02/2016
Department of Photonics Engineering, Diode Lasers and LED Systems

Relations
Projects:
LEDMET: Center for LED metrology
Global Test of SSL Products - IEA-4E-SSL
Press/Media: Press / Media
Forskere tænder nyt lys for glødepæren
Anders Thorseth
01/02/2016
Department of Photonics Engineering, Diode Lasers and LED Systems

Media contribution (1)

Forskere tænder nyt lys for glødepæren
01/02/2016
Politiken, Print
JP/Politikens Hus
http://politiken.dk/viden/ECE3043335/forskere-taender-nyt-lys-for-gloe depaeren/
Anders Thorseth
Department of Photonics Engineering, Diode Lasers and LED Systems

Relations
Projects:
LEDMET: Center for LED metrology

Press/Media: Press / Media

Advances in Sustainable Photonics On List Of Solutions To Celebrate on Earth Day
Anders Thorseth
22/04/2013
Department of Photonics Engineering, Diode Lasers and LED Systems

Media contribution (1)

Advances in Sustainable Photonics On List Of Solutions To Celebrate on Earth Day
22/04/2013
laserfocusworld.com, Web
Laser focus world article
Anders Thorseth
Department of Photonics Engineering, Diode Lasers and LED Systems

Relations
Research outputs:
Comparing the light quality of retrofit LED products
Projects:
LED lighting quality program
Press/Media: Press / Media

SPIE counts advances in sustainable photonics on list of solutions to celebrate on Earth Day
Anders Thorseth
18/04/2013
Department of Photonics Engineering, Diode Lasers and LED Systems

Media contribution (1)

SPIE counts advances in sustainable photonics on list of solutions to celebrate on Earth Day
18/04/2013
SPIE, Web
Amy Nelson
SPIE counts advances in sustainable photonics on list of solutions to celebrate on Earth Day (Press release)
Anders Thorseth
Department of Photonics Engineering, Diode Lasers and LED Systems

Relations
Research outputs:
Comparing the light quality of retrofit LED products
Light quality and efficiency of consumer grade solid state lighting products

Projects:

LED lighting quality program

Press/Media: Press / Media