EPIC Members Event Report

Large-area Solid State Lighting

30 October 2014
Muttenz, Switzerland
www.swissphotonics.net/workshops.html?736

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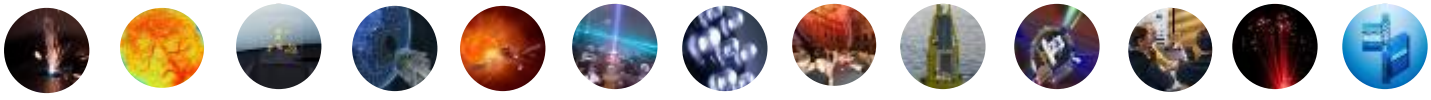
About the EPIC Members Event Reports

Initiated by the founder of EPIC Dr. Thomas Pearsall in 2003, these reports are prepared by members of EPIC to the benefit of the wider community. If you did not have a chance to attend the event but would like to know some key highlight, this report is for you. Emphasis is placed on exploring technical and business opportunities for the members of EPIC.



The Large-area Solid State Lighting workshop, held on October 30 2014 in the Pantheon in Muttenz (Switzerland) aimed to give an overview of both the state of the art of lighting class LED technologies and their integration into the current and future market with a focus on large-area illumination. The event was organized by EPIC member Swiss Photonics which regularly organizes workshops that bring together people from the photonics community.

After a short welcome given by morning-session chair **Dr. Christian Bosshard**, Vice-President Thin-Film Optics at CSEM SA and Managing Director at Swissphotonics, **Dr. Thierry Dreyfus**, Head of Technology at Regent Lighting AG based in Basel (Switzerland) gave us a lighting company point of view on SSL lighting for architectural applications combined with the challenges a professional lighting company faces when trying to standardize LED lighting components. Regent is convinced that the new Zhaga standard will make it easier for both lighting component suppliers to create high performance SSL lighting products while at the same time minimizing the risks for the luminaire manufacturer when a component supplier ceases production of a critical part.

Prof. Dr. Mönch of TH George Simon Ohm in Nürnberg (Germany) tackled some interesting issues when using small inorganic LEDs to illuminate large areas. He showed the differences in cost and efficiency between two common light spreading methods: direct backlighting and edge lighting. While direct backlighting is clearly simpler and more cost effective than injecting light into the edges of a transparent light guide, the thickness of the former makes it a challenge to integrate direct backlighting solutions into a compact SSL luminaire. His conclusion: at the moment there is no game-changer.

The talk of **Dr. Konrad Sell** concluded the first session focusing on perspectives and requirements from the lighting industry by moving our focus form inorganic LEDs to OLEDs. Dr. Sell works at the Philips Business centre of OLED lighting and is responsible for optical and electrical interfacing of OLEDs. While the price of OLEDs is still the largest issue preventing wide market integration, other attributes such as efficacy are rising. Current commercial OLEDs reach efficacy values of 65lm/W if their temperature is controlled properly. Philips believes that it will take another 5 to 10 years before OLEDs will be fully competitive with other lighting technologies.

Session 2, discussing new trends in SSL, took off with an interesting talk about circadian lighting by **Prof. Dr. Jean-Louis Scartezzini** of EPFL Lausanne (Switzerland). Dr. Scartezzini managed to show through different experimental results that light enriched in wavelengths between 460-480nm greatly influences our sleep-wake cycle due to the stimulation of non-visual receptors in the retina of our eye. Light levels as low as 100lx at night-time disrupt our sleep cycle while higher CCT lighting (CCT = 17000K) results in better alertness during the day.

The morning sessions concluded with a breath-taking photo slideshow of light-art guru **Daniel Schlaepfer**. Daniel, based in Lausanne, discussed the different materials and tools he uses to create stunning scenes where art interacts with light.

The presentations can be downloaded from http://www.swissphotonics.net/workshops.html?736

After an amazing lunch with, I have to mention this, colour-themed food such as a cyan soup and bright green mousses the afternoon session chaired by **Dr. Rolando Ferrini** started. Dr. Ferrini of CSEM, Muttenz is coordinator of the LASSIE-FP7 project. LASSIE aims to develop an LED-based module for professional and architectural lighting. The consortium uses a matrix of mid-power blue LEDs attached on a special flexible substrate to pump a custom engineered wavelength converter foil. This foil converts monochromatic blue light into a large area, broadband white light emission with excellent colour rendering and efficacy properties. Dr. Ferrini discussed the challenges of coupling light in and out of a light guide, thermal problems associated with LEDs and long thermal colour stability of the system. To combat chromaticity shifts LASSIE has developed a special 16-channel colorimetric sensor to provide a feedback loop to the light module.

Prof. Dr. Beat Ruhstaller of the Zurich University of Applied Sciences (Switzerland) presented his company Fluxim. Fluxim provides reference hardware and software to simulate the behaviour of OLEDs. He discussed the problem of light extraction, which is the main reason why current OLEDs do not reach the efficiency of inorganic LEDs. Including carefully calculated scattering layers can double the efficacy of an OLED stack.

Dr. Peter Chabrecek of Sefar AG introduced a novel fabric based substrate for OLED fabrication. This polymer mesh with integrated conductive wires has a much lower sheet resistance than currently used ITO conductors. This allows the fabrication of larger area OLED devices with higher efficacies.

Wavelength conversion is a hot topic. Both LEDs and OLED devices use phosphor materials and luminescent dyes to convert one wavelength range to another or to generate broadband white light from monochromatic sources. **Dr. Adrian van Mühlenen**, senior innovation manager at BASF Schweiz AG gave an interesting overview of BASF's Lumogen dyes. One experimental application used a red dye to convert the green part of the daylight spectrum entering a greenhouse to photosynthetically useable red light. The results showed a large increase in biomass of plants grown inside the enhanced greenhouse.

One of the highlights of the workshop was the talk of Prof. Dr. Nicolas Grandjean focusing on new developments in inorganic LED components. We arrived at a point where the GaN based white LED supersedes other light sources in both efficacy and colour quality. Dr. Grandjean explained how LED manufacturers reach such high performance and how performance can be increased while at the same time reducing production costs. While internal quantum efficiency in today´s top-end blue GaN LEDs is very high (>90%), light extraction and thermal management can further improve the total wall-plug efficiency of an LED emitter. According to Grandjean a reduction in costs can be achieved by moving towards Silicon as a next generation substrate and by a careful choice of wavelength converters in the green gap where both GaN and AlInGaP technologies are relatively inefficient.

Dr. Mohammed Ibn-Elhaj of Rolic, Switzerland gave an overview of light controlled molecular orientation technologies. Rolic's technology enables the latest LCD panels and other (non-display) applications to achieve brighter, thinner and wider viewing angles and further reduces energy consumption.

The day came to an end with a presentation on outcoupling schemes by large area homogeneous structures. Light guides are used to provide backlight illumination for display and gain more and more attention in large area general lighting applications. **Dr. Patrick Hoffmann** of EPFL, Lausanne explained how to fabricate light distributors with an area up to $3m^2$.

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IREC, the Catalonia Institute for Energy Research, was created to contribute to the objective of creating a more sustainable future for energy usage and consumption. The Lighting Group's research lines includes: 1 Innovative materials and concepts - new advanced nanomaterials: nanostructures, OLEDs, etc.: 2 Intelligent lighting - applications ranging from devices: LED, sensors, processors, etc. to holistic solutions: net-zero buildings and communities and public lighting systems: 3 Photometry, colour and human response - proper measurement of light, optic design, colour, texture: 4 Thermal management. www.irec.cat

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