Large-area Solid State Lighting

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Dr. Christian Bosshard

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Dr. Christian Bosshard is managing the Thin Film Optics Division of CSEM in Muttenz. He received his degree in Physics (1986) and his doctorate (1991, Silver medal award) from ETH. Christian Bosshard is a Fellow of the Optical Society of America (OSA), board member of the Swissphotonics NTN and coordinator for CSEM in the Heterogeneous Technology Alliance (HTA).

Welcome

Dr. Thierry Dreyfus

Head of Technology, Regent Lighting AG, Basel
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Studies in Mechanical Engineering and History, Boston USA
Aviation Noise Consultant Burlington, MA, USA
Product development of light track systems and adaptors, Eutrac, Berlin
Product development of interior and exterior luminaires, SELUX, Berlin
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SSL for professional / architectural Lighting and Standards
Area lighting is primarily used in offices and large surfaces to obtain an ergonomic base-illumination. Modules, especially standardized ones, are used in luminaires to develop quickly and ensure future proofness.
Smart lighting modules are used to account for deteriorations of the light sources and added features like i.e. daylight simulations.
Zhaga is worldwide the biggest organization which leads this effort. It has liaisons to all other big standardizing groups. Currently this area lighting is almost being neglected and based on simple technology: a brief overview of what is standardized and what will come.

Prof. Dr. Wolfgang Mönch

Professor of Technical Optics with the Technische Hochschule Georg Simon Ohm, Nuremburg, D
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Wolfgang Mönch (Dr. rer. nat. habil.) worked with OSRAM Opto Semiconductors GmbH in Regensburg, Germany. As a senior engineer in the pre-development department, he lead projects with an application focus in solid state lighting, projection, and unconventional optics concepts. Since October 2014 he is a Professor for Technical Optics at Technische Hochschule Nürnberg, Germany.

From Chips to large-area Lighting
My talk focuses on technical concepts for illumination of a remote large area, as encountered in a typical office environment, using inorganic LEDs. These concepts are suited both for packaged LEDs and chip-on-board. I will compare direct backlighting and edge coupling concepts and discuss possible directions and required technological developments to combine their respective advantages in the future.

Dr. Konrad Sell

Business Center OLED Lighting, Philips GmbH, Aachen, Germany
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Dr. Konrad Sell received his PhD from Karlsruhe University, Germany in the field of thin film research. He has joined Philips Lighting in 2005 and was involved in the development of optical coatings for light sources. Since 2010 he is working in the development department of Business Center OLED Lighting with responsibilities for optical and electrical interfacing of OLEDs.

OLED functional lighting – Technology and Markets
Based on progress in technology, cost and performance, leading OLED (organic light-emitting diode) manufacturers are making inroads into functional lighting applications. I will highlight requirements that flow down from functional lighting applications and the implications for OLED design and technology choices, including such aspects as anode sheet resistance and transparency, and encapsulation performance. Some of the solutions implemented in our product range and directions for further improvements will be discussed.

Prof. Dr. Jean-Louis Scartezzini

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Full Professor of Building Physics (ENAC School)
Director of Solar Energy and Building Physics Laboratory (LESO-PB)
PhD in Physics from EPFL (1986); MSc in Geophysics from University of Lausanne (1981); MSc in Physical Engineering from EPFL (1980).
Visiting Professor at National University of Singapore (2009); Visiting Scientist at Lawrence Berkeley National Laboratory & UCLA (1988); Visiting Scholar at Colorado State University (1984).

Smart lighting: SSL and daylighting, a route towards circadian-compatible lighting
Modern lifestyle has moved a large fraction of our daily activities within buildings, where electric lighting can complement daylighting and provide the required light quality and quantity at any time of day and night; it allows performing visually demanding tasks and working 24/7. On the other hand, beyond visual functions of the eye, non-visual light perception enables synchronization of our internal biological rhythms with the external clock time, which modulates physiological functions such as mood, alertness, well-being, cognition and sleep quality.

Daniel Schlaepfer

Artist and Designer, Lausanne VD
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Daniel Schlaepfer is based in Lausanne, Switzerland, where he works as a light designer and artist. His work focuses on the relationship between nature and man-made artifacts. His artistic creations have been shown in many group exhibitions, and he has built several architectural and landscape installations worldwide. He recently represented Switzerland at GLOW, the International Forum of Light in Art and Architecture, in Eindhoven, in the Netherlands.

The tools of a light designer
Artists, like any other professionals, need tools to work. In my conference entitled *Light Tools*, I will show you an overview of the tools I use as a *lightshaper* to create my installations. Some of the tools are artificial (LEDs, fiber optics, dichroic filters), whereas others are all natural (trees, stones, water, sunlight). In any case, we will see how light can be used to embellish the urban as well as the natural environment.

Dr. Rolando Ferrini

Section Head Integrated Light Management at CSEM SA, Muttenz / Project Coordinator LASSIE-FP7
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Since 2012, Dr. Rolando Ferrini is heading the Integrated Light Management Group at CSEM Muttenz. In 1999, he obtained his PhD in Physics in Pavia (Italy). From 2000 to 2004 at IPEQ-EPFL, he studied the optical properties of photonic crystal devices. From 2004 to 2011 at LOMM-EPFL, he was in charge of the activities on optics, photonics and lighting in collaboration with ILFORD Imaging GmbH.

Large Area Solid State Intelligent Efficient luminaires
In spite of their increasing commercialization, LED luminaires struggle to fulfil the market requirements for large-area solid-state lighting (SSL) sources. In order to achieve luminaires with high intensity, good uniformity and high colour rendering, significant progresses still need to be done. In the European Project LASSIE-FP7, large-area and low-cost intelligent SSL modules are being developed with high efficiency and high lighting quality.

Prof. Dr. Beat Ruhstaller

Professor at Zurich University of Applied Sciences (ZHAW), Institute of Computational Physics (ICP), Chairman at Fluxim AG, Winterthur ZH
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Beat Ruhstaller is founder and CEO of Fluxim AG and professor at the Institute of Computational Physics at the Zurich University of Applied Sciences. He received his Diploma in Physics from ETH Zurich, a Masters and PhD degree in Physics from the University of California at Santa Cruz, USA, and an Executive MBA from Zurich University of Applied Sciences. During his PhD he developed numerical models for charge transport in organic light-emitting devices in collaboration with the IBM Almaden Research Center, USA. Subsequently he was a postdoctoral researcher at the OLED display technology team at the IBM Zurich Research Laboratory, Switzerland. He has performed research on optical, electronic and thermal processes in light-emitting and light-harvesting thin film semiconductor devices for the last 15 years. He has been a principal investigator in several European research projects and has co-organized several international scientific conferences in the field of organic electronics.

Design and Optimization of OLED Light-outcoupling Enhancement Structures
After an introduction to the light-outcoupling challenges a multi-scale optical model for organic light-emitting devices is presented. This model describes the radiation of oscillating dipoles embedded in real OLED structures including planarization layers, color filters and scattering for enhanced light out-coupling. We show how the scattering properties of textured interfaces or layers containing scattering particles impact the overall performances of white OLEDs for solid state lighting applications. Moreover, electro-thermal properties of large-area OLED panels are briefly discussed.

Dr. Peter Chabrecek

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Dr. Peter Chabrecek studied organic chemistry in Bratislava, Czechoslovakia. From 1992 to 2001 he worked for Novartis AG. He coordinated projects for development of innovative surfaces on biomaterials, predominately on contact lenses.
Since 2001 he is working for Sefar AG as a leader of R&D group. His current work includes modification and coating of special meshes for various applications, above all for solar cells and OLED application

Substrates for large area OLED, OLEC
The self-supporting electrodes with very high conductivity and high transmittance in visible region were produced by integration of conductive wires into precision fabrics, made of transparent polymeric monofilaments. In addition, the fabrics were coated (filled) with a transparent flexible polymer and/or barrier films. The fact that the fabric electrodes have much lower sheet resistance than ITO allows one to predict that large area OLED or OLEC devices can be produces using these electrodes. Results obtained from the first experiments will be presented.

Dr. Adrian von Mühlenen

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Adrian von Mühlenen holds a diploma in micro engineering and a PhD in material science, both from EPFL. He studied organic transistor at CSEM. With BASF he is evaluating new technologies with a strong focus on business model targeting the added value generation for BASF as stated in their *We create Chemistry* strategy in the field of optics.

Advanced optical (fluorescent) materials for SSL
BASF's *we create chemistry* strategy strives for sustainable innovation solutions to make the customer more successful. Therefore BASF derived from the megatrends as intersection with the customer industry growth fields. Target is to realize a turnover of >30 bn € by 2025 with new products. We will report on Light Management activities in the framework of these growth fields.

Prof. Dr. Nicolas Grandjean

EPFL Laboratory of Advanced Semiconductors for Photonics and Electronics (LASPE) at the Insitut de Photonique et d'Electronique Quantiques (IPEQ), EPFL Lausanne VD
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Nicolas Grandjean received a PhD in Physics in 1994. He started at the CNRS as staff member. In 2004 he moved to EPFL and became Full Professor in 2009. Since 2012 he is the head of the ICMP. He was awarded the Sandoz Family Foundation grant and *Nakamura Lecturer* award. His research interests are the physics and technology of GaN-semiconductors.

New developments in LED components for SSL
III-nitride semiconductors are nowadays the corner stone of white LEDs used for solid-sate lighting. In this presentation we will review the last developments of this technology aimed at improving the luminous efficacy as well as the quality of light. We will also discuss the main avenues which are pursued to reduce the fabrication cost like the growth on silicon wafers.

Dr. Mohammed Ibn-Elhaj

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Obtained Doctorate in physics and material science, Louis Pasteur University, Strasbourg, in 1992, followed one year research associate at Manchester University. After 5 years at the Max-Plank Institute of Colloids and Interfaces, Berlin, he joined Rolic in 1999. In 2001, he took over leadership of the Nanotechnology Group. Other stations included leadership of the Application, Security, Display and Materials development groups. Head of New Technologies since 2011.

Functional Materials & Films for Light Management & OLEDs
Rolic® Light Controlled Molecular Orientation (LCMO) technology is the breakthrough alignment technology for todays advanced mass production technologies for large LCD-TV panel and Optical Films. Recent advances in LCMO materials and technologies allow an easy achievement of high-resolution microstructures with complex orientation patterns. This enables various Display and non-Display applications, such as light management to achieve brighter, thinner and wider viewing angles devices with reduced energy consumption.

Prof. Dr. Patrik Hoffmann

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Adjunct Professor at LPMAT, Swiss Federal Institute of Technology Lausanne, EPFL
Laboratory Head of Advanced Materials Processing, Empa, Swiss Federal Laboratories for Materials Science and Technology, Thun.
Chemistry studies at University of Karlsruhe, PhD thesis at EPFL in 1992. Industrial experience at IBM San Jose (USA) and manager of dental section in company (Germany). Since 1997 research and teaching Laser Micro-Processing at EPFL. Since April 2009 heading LAMP at Empa, continuing teaching at EPFL. Author of 111 peer reviewed journal papers and inventor of 6 patents.

Outcoupling schemes by large area microstructured surfaces
For homogeneous illumination, light scattering from surfaces by wedge, printed or embossed gradually changing scattering points of transparent light guiding devices are state of the art. More sophisticated approaches with local variations of light emission and engineered out coupling angles are also possible. The technological process of fabrication of such large area light distributors up to 3 m^2 will be presented.

Dr. Harun Solak

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Harun Solak has over twenty years of experience in the fields of micro and nano fabrication. He received his PhD from the University of Wisconsin. He worked at the Paul Scherrer Institute as a senior scientist and founded Eulitha AG in 2006. Dr. Solak has more than one hundred technical articles published in the fields of nanolithography and x-ray microscopy.

Nano-patterning for better and more efficient photonic devices
Micro and nano-patterned substrates are finding increased use in fabrication of LEDs. For example, most manufacturers of high brightness LEDs rely on patterned sapphire substrates for improving defect free crystal growth and out coupling efficiency. Eulitha's PHABLE photolithography technology offers a cost-effective solution for production of PSS wafers and photonic out-coupling structures.

Dr. Christoph S. Harder

Dr. Christoph S. Harder, President Swissphotonics NTN, Wollerau SZ
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Dr. Christoph S. Harder received the Electrical Engineering Diploma from the ETH in 1979 and the Master and PhD in Electrical Engineering in 1980 and 1983 from Caltech, Pasadena, USA. He is co-founder of the IBM Zurich Laser Diode Enterprise which pioneered the first 980nm high power pump laser for telecom optical amplifiers.
He has been managing during the last few years the high power laser diode R&D effort in Zurich expanding, working closely with a multitude of customers, the product range into 14xx pumps as well as 808 and 9xx multimode pumps for industrial applications. He has published more than 100 papers and 20 patents and has held a variety of staff and management positions at ETH, Caltech, IBM, Uniphase, JDS Uniphase, Nortel and Bookham.

Panel moderator

Dr. Christian Hochfilzer

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Dr. Christian Hochfilzer is currently Technical Director, Head of SCM and Member of the Management Board at REGENT Lighting, a major European lighting company located in Switzerland. In this function he is responsible for the product development and realization process on luminaire, controls and system level. Mr. Hochfilzer's technical background encompasses physics and engineering in the field of solid state lighting and optoelectronics with more than fifteen years of industrial experience. Prior to his current position he was Head of Research and Development at TRIDONIC Optoelectronics, a global pioneer in Chip on Board Solid State Light Sources and CEO of LUMITECH, at that time an opto-electronic engineering start-up company. He has numerous publications in peer-reviewed journals and conference proceedings and holds several patents.
Christian Hochfilzer received his PhD in solid-state physics from the Technical University in Graz.

Panelist

Albert Studerus

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Albert Studerus is the CEO for SLG, Swiss Lighting Association, since 2012. He recently developed the only training course offering a lighting planer diploma accepted by the swiss government.
Previously he was senior vice president at OSRAM responsible for SSL sales worldwide. He holds an electrical engineering degree from the Zurich University of Applied Sciences.

Panelist

Oscar Salas

Coordinator General, GAIKER Centro Tecnologico, Zamudio, Spain
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Scientific &Technological Coordinator of GAIKER. He is in charge of the Innovation Process which involves three different fields: Environment, Materials and Biotechnology, in parallel he is the coordinator for actions in Horizon 2020.

Expert on innovation and R&D organizations. Bachelor of Chemistry Science and MBA. His research background has been focused on waste management and environmental sustainability impacts and tools.

Panelist

 **Huub Ubbens**	**Huub Ubbens graduated at the Rietveld Accademy of Art in Amsterdam.** **Designer, Montpellier, France** ubbens@tiscali.it |www.huububbens.com Huub Ubbens graduated at the Rietveld Accademy of Art in Amsterdam. From 1997 to 2004 he worked as the artdirector of Artemide. He was also the artdirector of Danese-Milano . In 2005 he opened his design studio in Milan, concentrating on product design and light-art installations working with companies such as Panasonic, Artemide, Manade, 3M, Osram, Danese-Milano, Fiat, and Alessi. In 2010 he moved to Montpellier-France. **Panelist**

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