Sensing is life



# **Die Zukunft des Lichts ist smart**

Dr. Martin Strassburg 16/05/2022





Supported by:

Federal Ministry for Economic Affairs and Energy

on the basis of a decision by the German Bundestag

### Agenda

- 1. LED Technology: A brief history of light
- 2. LEDs today's challenges
- 3. Smart light for a bright and safe future

Towards autonomous mobility UV-C LEDs for disinfection Horticultural lighting

4. Q & A

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## What is Light?



### Light is defined for human vision

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# Light - Everything depends on the Sun

# Candlelight...







## And than came the LED...



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# White Light-Emitting Diodes Materials and function



1995

#### Early-stage Research: Ill-nitride semiconductors

- tunable direct bandgap from IR to UV
- well-established p-type doping & processing



#### Research and Development: GaN and InGaN blue LEDs

high efficiency, high power, high reliability



# 1980ies

# The Nobel Prize in Physics 2014







# 2014

Photo: A. Mahmoud Isamu Akasaki Prize share: 1/3 Photo: A. Mahmoud Photo: A. Mahmoud Hiroshi Amano Shuji Nakamura Prize share: 1/3 Prize share: 1/3

The Nobel Prize in Physics 2014 was awarded jointly to Isamu Akasaki, Hiroshi Amano and Shuji Nakamura "for the invention of efficient blue light-emitting diodes which has enabled bright and energy-saving white light sources".

taken from nobelprize.org

#### **Research and Development and Innovation: Converted white LEDs**

phosphor dyes absorb part of the blue light and convert it to green, yellow and red



phosphor-converted

white LEDs



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### From LEDs to digital solutions

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## Vision and mission for ams OSRAM

Vision: Create the uncontested leader in optical solutions



Our mission is to create the uncontested leader in optical solutions through bold investments in disruptive innovation and continuous transformation delivering best-in-class profitability and growth.



## Upcoming Photonics Technology

**Smart and Integrated Photonics** 

### **Components, Subsystems and Systems**



#### Emitter

opto-electronics (IR to deep UV), LEDs, laser, VCSEL, chip & design, miniaturization, integration of electronics...



#### System & Modules

package design and materials, system integration, customer experience...

# ))

#### Detector

Photodiodes, arrays, materials, low power





IC know-how Internal driver ICs, ASICs





#### Algorithms, software

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# Towards autonomous mobility



## **Trends and Innovation**

New signaling opportunities for ...





# Future Efficient Display Technology

**Enabling Electrically Autonomously Driven Vehicles** 

From Signaling to Communication → Increasing Level of Integration is required



## Adaptive Driving Beam (ADB) with Higher Resolution: EVIYOS 2.0

#### Higher resolution enables more precise masking: Smoother beam shaping $\rightarrow$ less driver distraction



One chip serves both:

*Illumination* Permanent glare-free

*Visualization* Projection assist





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## LiDAR for autonomous driving – principle of operation



- Time-of-Flight (ToF) LiDAR
- Together with Camera & Radar
- 3D/4D Signal Processing







- LiDAR module sends out short, powerful pulse of light (like shooting a ball)
- Time until light comes back is stopped, this yields distance





### Automotive Sensing Applications IR Technology for higher Safety and Comfort

The Future of Mobility is safer and more enjoyable. ams OSRAM cutting edge IR technologies are enabling new applications for driver and passenger safety and comfort.

#### **Applications**

#### ADAS (Advanced Driver Assistance Systems)



#### Driver / In-Cabin Monitoring



#### **Gesture Recognition**



#### Light Sensors (ALS, Rain)



#### **Exterior Sensing**



**CALC** OSRAM

# UV-C LEDs for disinfection



### Disinfection by UV-C Is UV-C radiation an artificial light source and why can it be used for disinfection purposes?





• UV-A	320-400 nm	non germicidal	
■UV-B	280-320 nm	germicidal	actinic
• UV-C	200-280 nm	germicidal	actinic
• VUV	100-200 nm	vacuum ultra violet	actinic

• The range of **200-280 nm** is mainly used for **disinfection** purposes.

Since there is no UV-C radiation from sun on earth ground level, **most organisms had no need to develop any protection**.

Therefore UV-C radiation can be used for disinfection purposes to kill bacteria and to inactivate viruses.



### Fighting Corona: UV-C Most effective to kill the virus: 265 nm

# UV-C irradiation is highly effective in inactivating and inhibiting SARS-CoV-2 replication

Andrea Bianco, Andrea Biasin, Andrea Biasin, Andrea Biasin, Andrea Bianco, Andrea Bianco, Andrea Biasin, Andrea Biasi





#### **Conventional UV-C mercury lamps**

- Emit at 254 nm (Hg-line)
- High system efficiency (33%)
- Mature technology
- Cheap, but bulky
- Contain mercury





#### UV-C LED to emit at 265 nm

- still difficult as efficiencies are very low due to AlGaN system
- still very high cost vs. Hg-lamps but dropping dramatically
- ams-OSRAM research since more than 5 years
- high irradiance for ultra-compact devices





## Application example of UV-C LED and UV Sensor II

Spectral details of the experiment based on the UV-C LED, the UV Sensor

The detection of a contamination requires a UV-C LED sources as well as a UV Sensor to measure the fluorescence of the microorganisms.



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### **UV-C LEDs applications**

Disinfection market is split by field of applications and requirement segmentation



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# Horticultural lighting

State and

And the second

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# Horticulture is a rapidly growing application

Artificial Light in Greenhouses Globally

Total area of Greenhouses: ~ 4.750 km<sup>2</sup>



# Urbanization & Growing Need



- Growing population requires efficient plant growth
- Higher focus on local food production leads to new concepts
- Lack of water strengthen vertical farming concepts
- Food safety and reduction of pesticide and herbicide usage

# Advanced Horticulture Lighting

#### Sensing and LED Lighting



- Control of angle and intensity of light
- Detection of disease is more optimized with digital image processing vs. manual inspection



 Species of crop and stage of plant growth determine the spectrum



## Greenhouse and Indoor & Vertical Farming

#### **Requirements and Technology**

#### Greenhouse

Top lighting & interlighting to complement sunlight

Traditional HPS still used in tandem with LEDs (Hybrid solution)

### Total photon flux



### Vertical & Indoor farming

Need lighting fixture to replace sunlight

Full control based on tunable systems with sole source of light

### Spectrum and Total photon flux









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## Reduction of Ecological Footprint

#### **Environmental and Economic Sustainability**



### **Resource Efficiency**

- Increase in crop productivity per unit liter of water
- Less energy consumption for crop production
- Saving of growing area and growing volume per kg crop production
- Reduction in transportation km

### Food Safety

- Improved control of plant diseases
- Increase of wanted content of nutrition and ingredients
- Granting local and regional access to fresh food

### Sensing is life Intelligence to light, passion to innovation

Mobile, Wearable, Computing







Industrial, Medical









Automotive









#### Lighting









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# Thank you...

...and I am happy to answer your questions!