

# OLED Lighting

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## Overview

*OSRAM, August 2010*



# Outline



## OLEDs for Lighting

- Features & Characteristics
- Applications
- OLED Technology – a brief Introduction
- Technology Status
- Go to Market

# Lighting Industry Trends



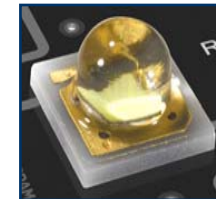
Lighting industry moves to energy efficient solutions and SSL technology



From incandescent to energy efficient lighting



From classical technology to LED & OLED



From components to solutions



# Solid State Lighting Technologies: LED & OLED

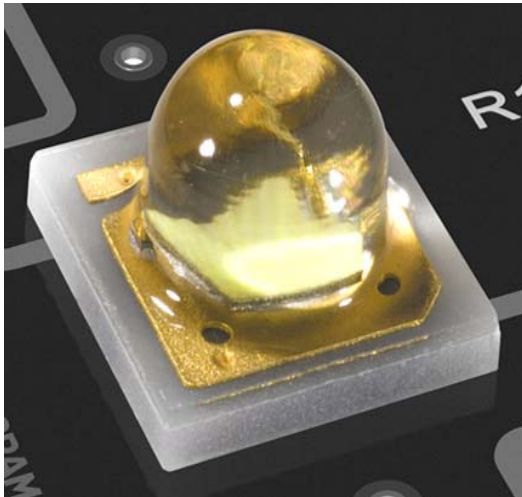


LEDs & OLEDs have the potential to outperform all other light sources

⇒ Energy saving potential, mercury-free, long lifetime, new freedom in design

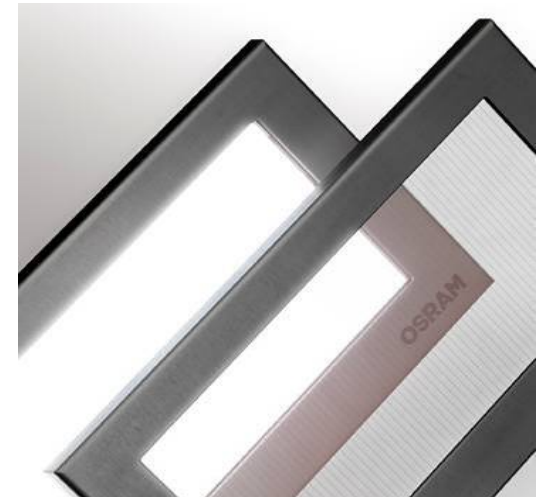
LED

high brightness  
**POINT** light source



OLED

2-dimensional  
**AREA** light source



Complimentary  
features

**OLED is not a lamp, not just a light source – it is a new light emitting medium!**

# What is OLED Lighting ?



## OLEDs – energy saving and aesthetics appeal



# OLED – The Aesthetics of Light



**OLED positioning will be centered on the emotional perception:**

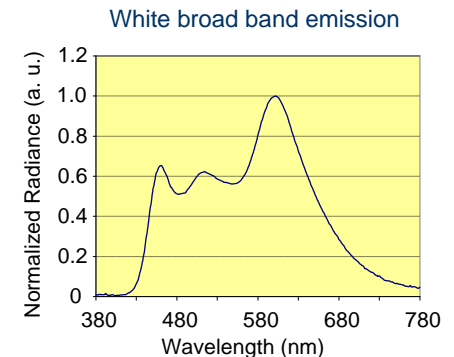
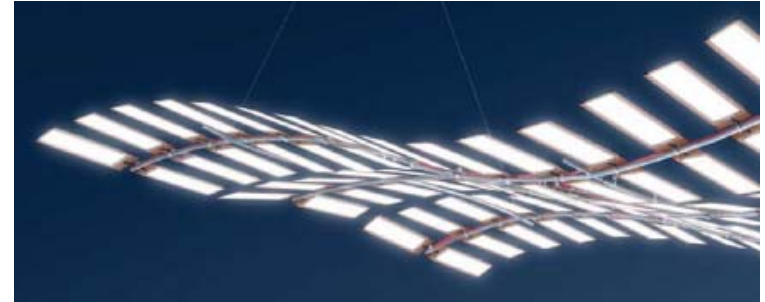
- OLED – is just light
- OLED – is ultimately reduced and pure aesthetics
- OLED – delivers harmony of form and light



# Outstanding Features



- **Diffuse non glaring area light source**
- **High quality white light**
  - Currently up to CRI 80
  - CRI 95 in future
- **Low voltage DC**
- **Instant on/off**
- **Mercury-free, RoHS conform**
- **No thermal management required**
- **High luminous efficacy**
  - 23lm/W on product level
  - 62 lm/W in lab
  - >100 lm/W reachable in future
- **Various CCTs and colors possible**
- **Design & Aesthetics**
  - Thin, flat, lightweight
  - Diffuse, mirror or transparent
  - Flexibility (products expected 2015+)



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# The Application Categories Lead to Challenging Requirements...



...to be fulfilled without sacrificing the aesthetic appeal and the lighting essentials: lumen maintenance, sustainability, low cost **and efficiency**

## Mood Lighting

- Decorative light
- Accent light
- Light art



### Requirements:

- Diffuse emission at moderate luminance level (500-1000 cd/m<sup>2</sup>)
- Excellent off-state appearance

## Object Illumination

- Windows
- Shop
- Installations



### Requirements:

- Large area & transparency and/or aesthetic tiling concepts (1000-2000 cd/m<sup>2</sup>)

## General Illumination

- Task light
- Integrated ceiling & wall light

### Requirements:

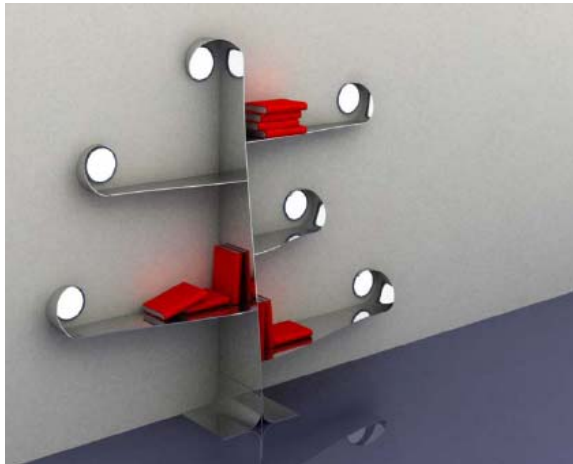
- High luminance level (up to 4000 cd/m<sup>2</sup>) & directional beam shaping



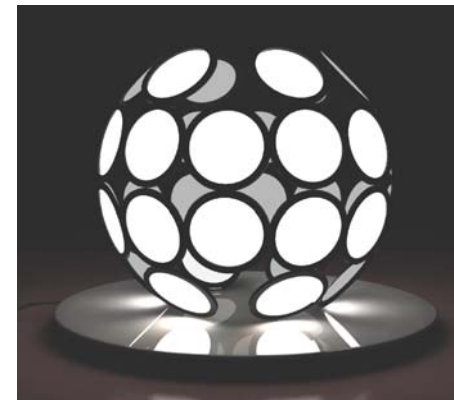
Note: Automotive applications are currently not in focus due to high required temperatures

# OLED ORBEOS

Furniture, Decorative Lighting and Accessories



Decorative &  
Mood lighting



Source:  
PPML design contest 2009, Osram, Lösche Design

# OLED ORBEOS

Display Lighting, Museum, Shop



Source: Osram

# Outline



## OLEDs for Lighting

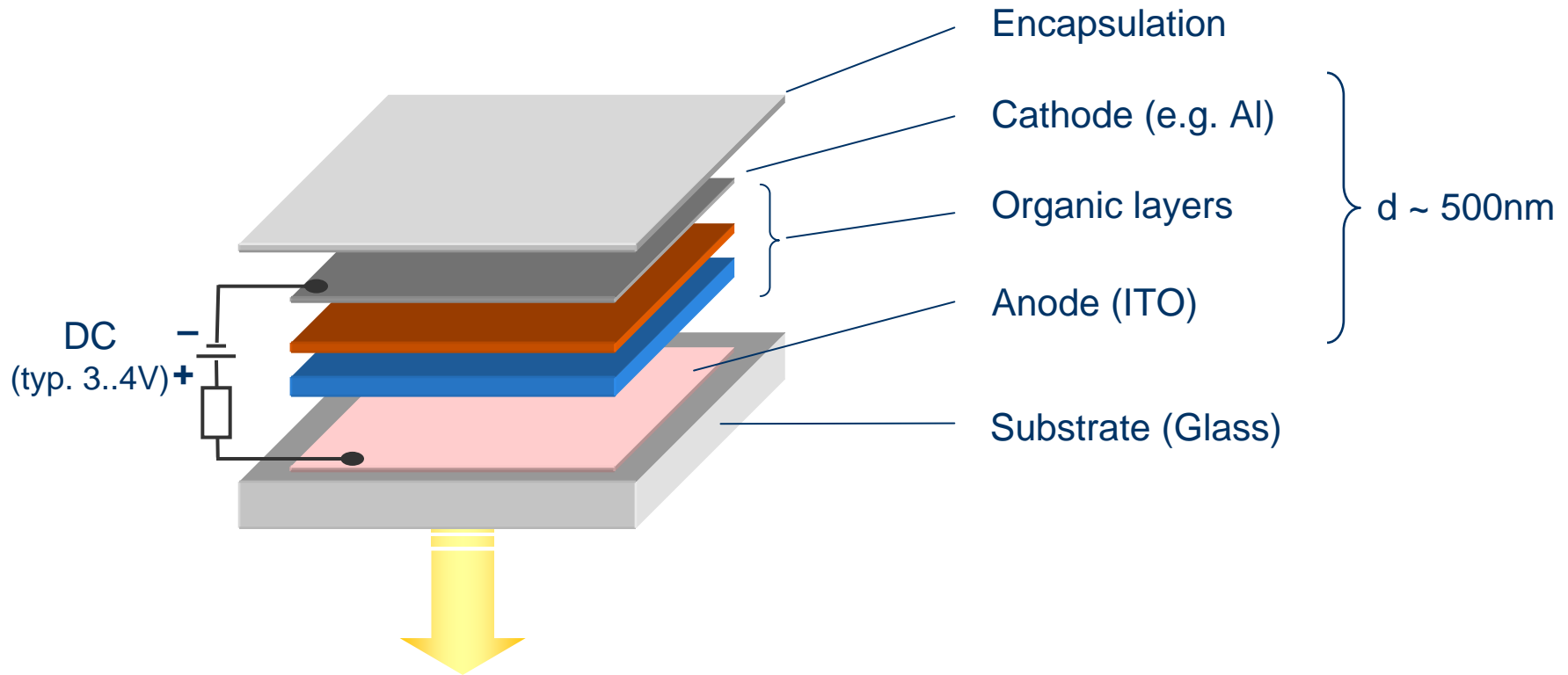
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# Device Architecture

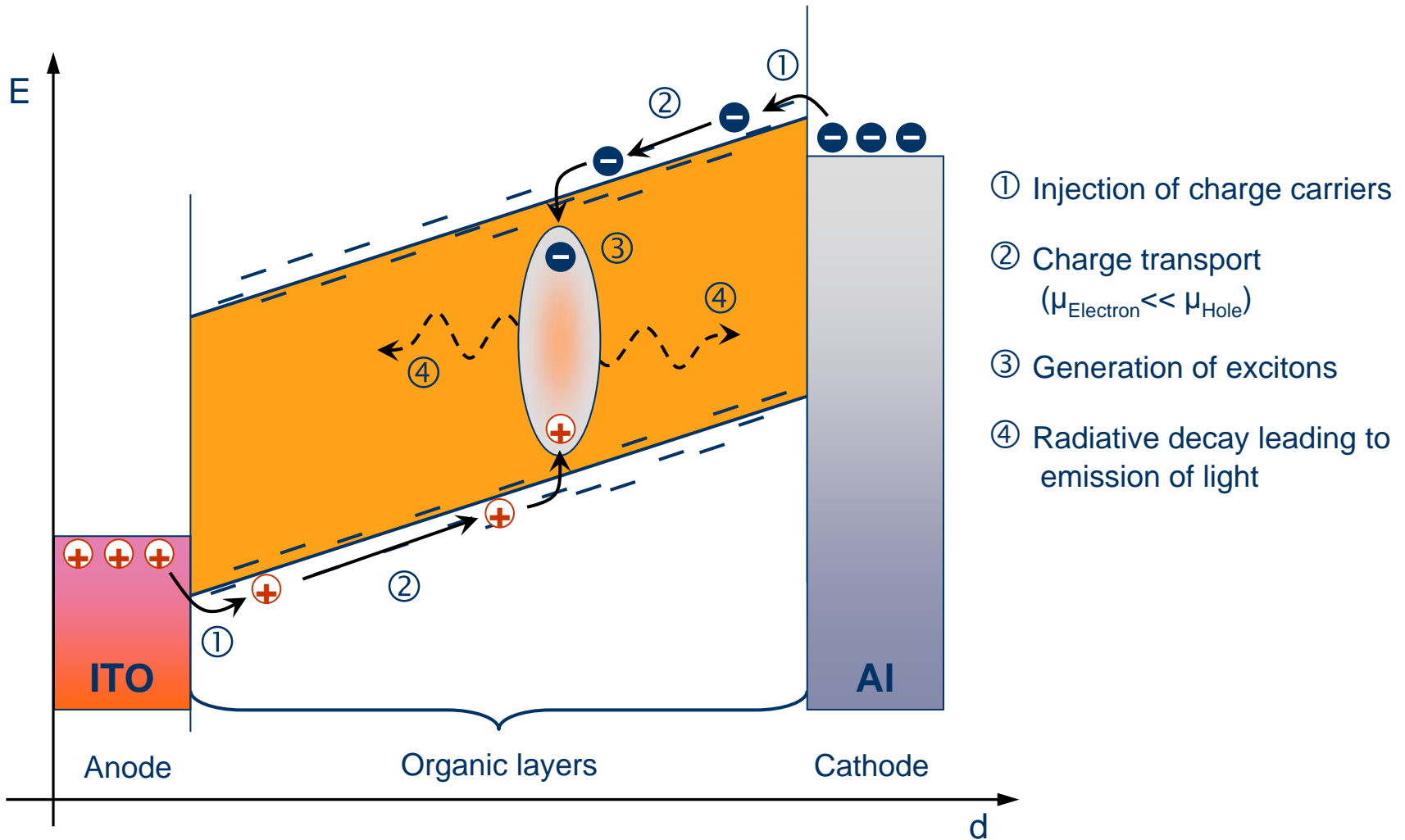


## OLED-Stack:

Layers of organic materials sandwiched between anode and cathode



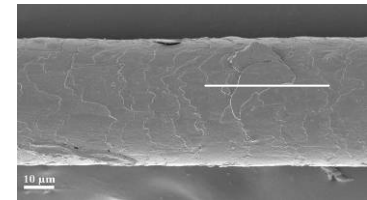
# Operation Principle



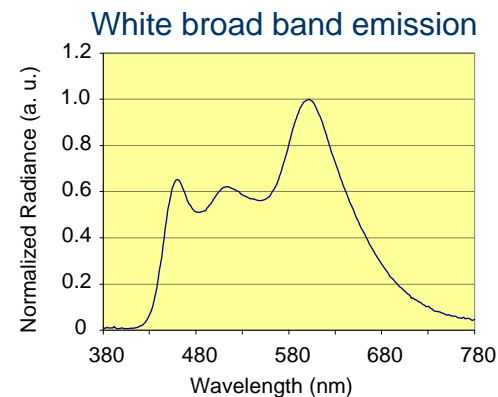
# White Emission by R-G-B Device Structure



Active layer is extremely thin...  
 $d \sim 100 \dots 500 \text{ nm}$



Comparison to a human hair



# Outline



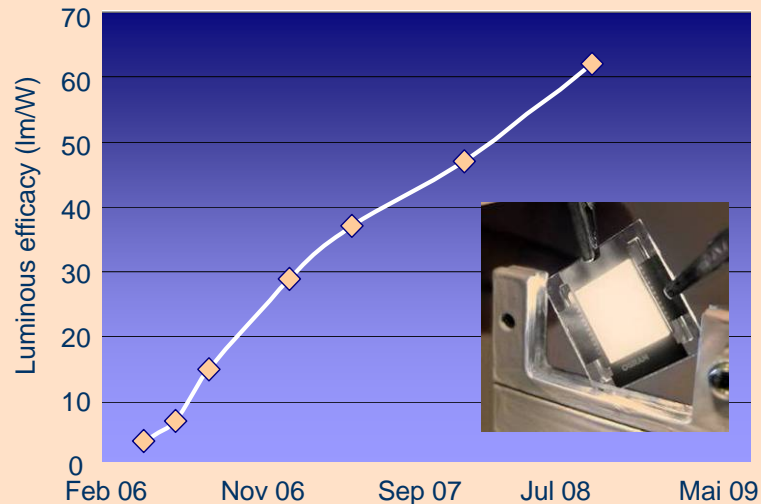
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# OLED Performance Today



## R&D-Level (small area device):



### Note:

After demonstration of high efficient devices (in the range of CFL) OSRAM Opto Semiconductors focused on process management and reliability for future products.

## Product level (e.g. CDW-031, 50cm<sup>2</sup>):



- Brightness 1.000 cd/m<sup>2</sup>
- Driving current ca. 180mA
- Efficacy typ. 23 lm/W (15lm Output)
- CCT 2800 K
- CRI ~ 80
- Lifetime 5.000 h
- Lambertian emission profile

# R&D Result: Thin Film Encapsulation



Thickness comparison:

Cavity glass & getter

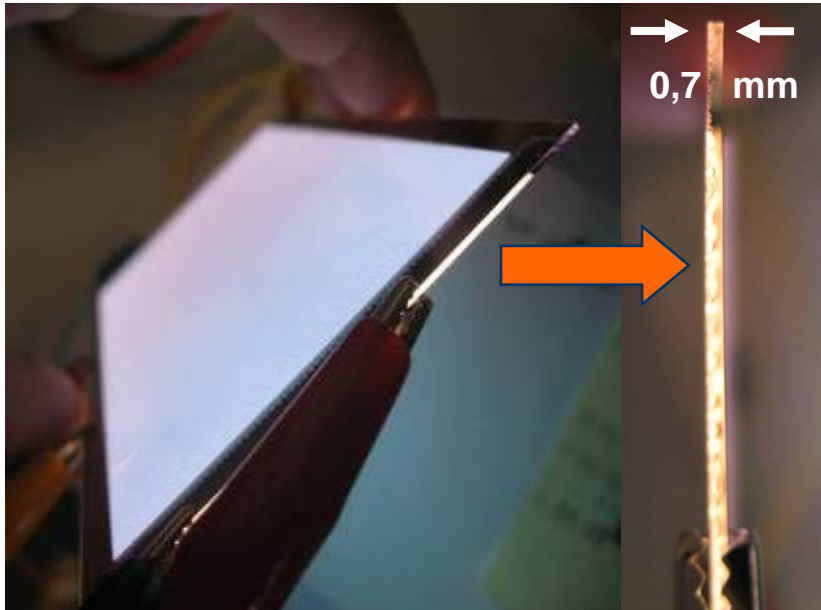
Thin film & laminated glass

Thin film only

d = 1.8 mm

d = 1.4 mm

d = 0.7 mm



## Features:

- Usable on large area
- Ultra thin
- Clear view: no busbars, no getter
- No cavity glass
  
- Significantly reduced cost
- Enabler for transparent and flexible devices
- ... Without sacrificing the aesthetic appeal and the lighting essentials



# R&D Result: Large Area Transparent OLED

Transparent OLEDs open up completely new opportunities regarding design and applications!



First products  
expected in 2012

## Technology facts:

- Panel size 15x15cm<sup>2</sup>
- 210cm<sup>2</sup> active lighting area
- About 50% transmission
- Highly conductive electrodes
- 2 contact pads (lighting conform)



# OLED Technology - Future Perspectives



Future product specs are already under investigation in R&D today

## Requirements

### OLED should have

- Longer Life
  - Higher Brightness
  - Lower Costs
  - Higher Efficiency
- AND
- Keep the aesthetic appeal

## Primary Milestones and Deliverables In TOPAS 2012 project

### Performance

Transparent OLED Module on 1 m<sup>2</sup>  
70% transmission & 30 lm/W NW & 3 kh LT70  
High performance OLED Lighting Panel  
>200 cm<sup>2</sup> & 50 lm/W & 15kh LT 70 & CRI 85 & high yield

### Features

FlexOLED on metal foil,  
Lighting panel with directed emission

### Potential

>100 lm/W on R&D devices  
>100.000 h (LT50) on R&D devices

# Outline



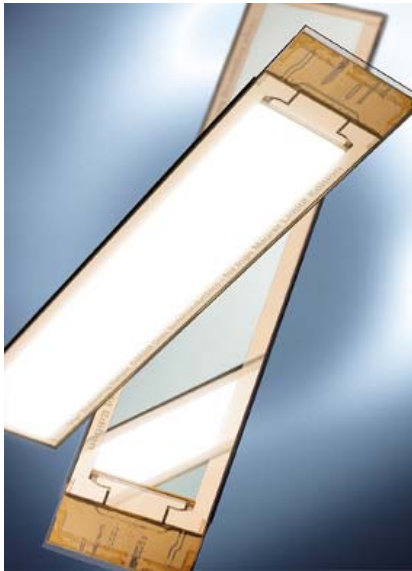
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# OSRAM and Ingo Maurer at L&B 2008



## First Mover: „Early Future” - a table light with OLED-modules



<http://www.osram-os.com/press>  
<http://www.ingo-maurer.de>



OLED light art product made by Ingo Maurer and 10 OSRAM OS OLED panels with 132 x 33 cm<sup>2</sup> emitting area each.

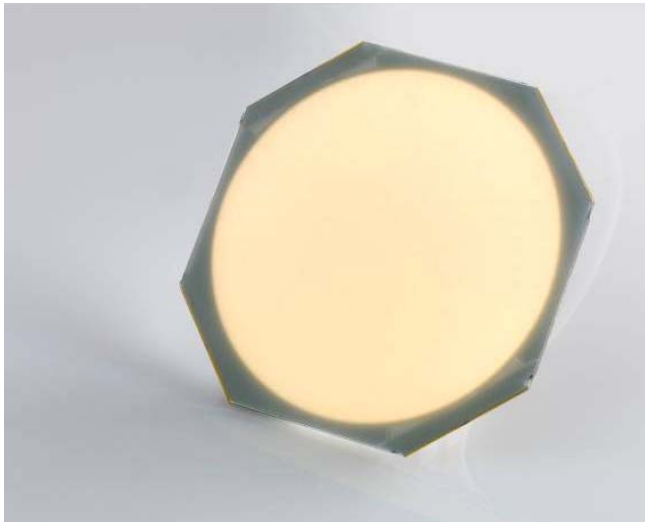
# Launch of ORBEOS™ product in Nov 2009



## ORBEOS™ – A new standard of lighting

- Launch of first certified OLED product by Osram Opto Semiconductors
- Certified panel available for everybody
- Typical performance: 23 lm/W, 50 cm<sup>2</sup>, 1000 cd/m<sup>2</sup>

ORBEOS™ CDW-031



First installation @ EXPO 2010



# OLED ORBEOS

## Design Luminaires based on ORBEOS (selection)



BenWirth Licht



DESIGN PLUS 2010  
powered by light+building

WAC Lighting



2DoDesign



Acuity Brands



Ostwald Design



Ingo Maurer



# OLED Mirror Cabinet

light+building



## OLED room installation with „Licht Kunst Licht“ (Prof. Schulz)



### *ORBEOS – Pure light*

→ Thin mirror panels with 50 ORBEOS each

### *ORBEOS – Space for inspiration*

→ Abstract presentation as teaser mixed with applications studies

### *ORBEOS – A new lighting experience*

→ 800 ORBEOS panels in total illuminating the entire room



(For 360° view and videos visit [http://www.osram.com/osram.com/Tools\\_&\\_Services/light+building/](http://www.osram.com/osram.com/Tools_&_Services/light+building/))

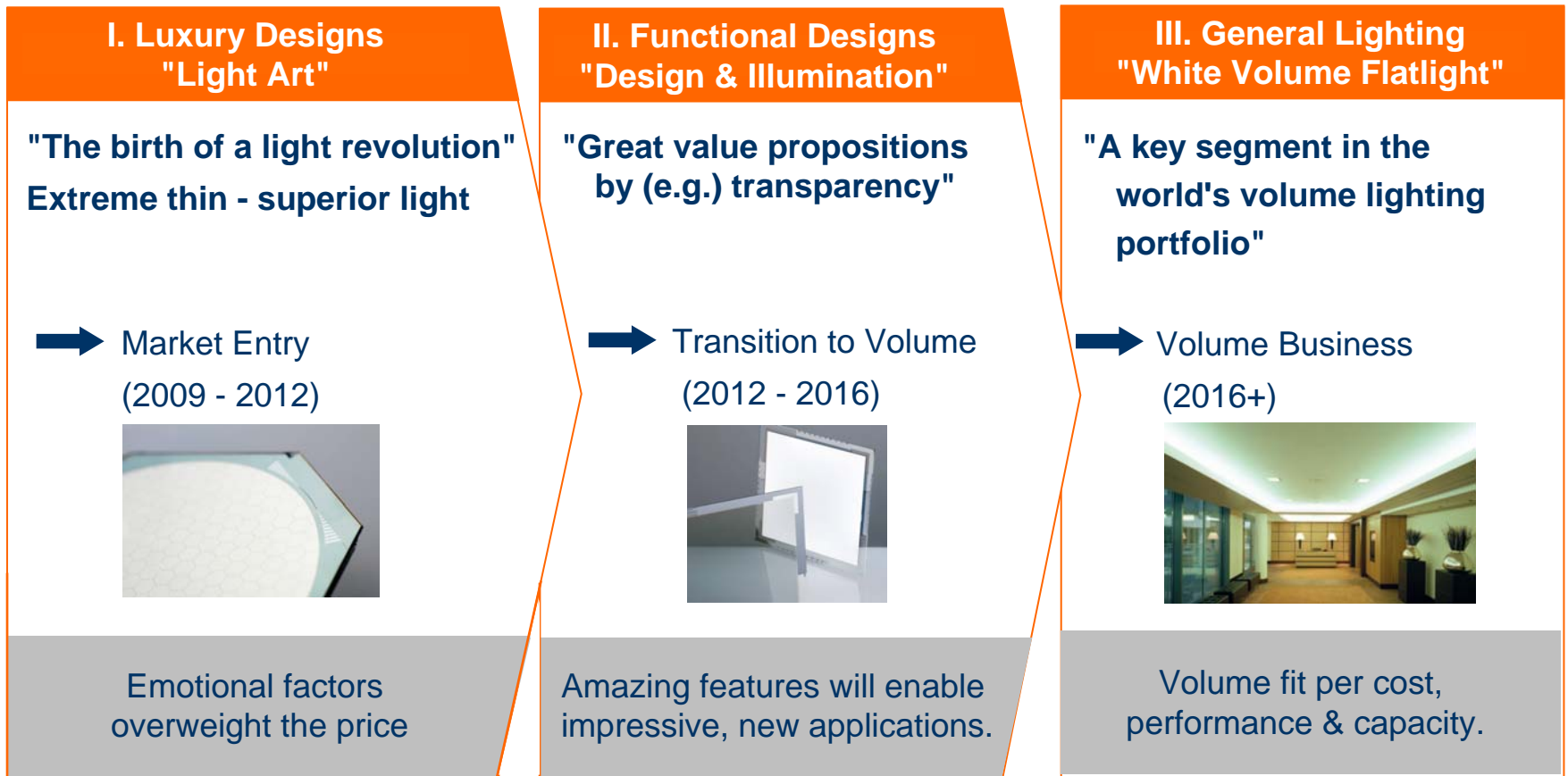


OLED Mirror Cabinet

# OLED Lighting - Market Development



OLED market will develop from high end to high volume applications



# The Aesthetics of Light

## First Osram OLED Luminaire



### “PirOLED”

- Premium design luminaire
- Five 360° turnable OLEDs
- Light to look at
- Light to touch
- Light to play with
- Intelligent combination of OLED & LED
- 500 lux @ desk surface



Design by Martin Moeck





**OLED. Pure light.**

Thank you for your attention!

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