

The image shows a large, modern building with a glass facade. The OSRAM logo is prominently displayed on the glass in large, orange, three-dimensional letters. The building's interior lights are visible through the glass, and the sky is a clear blue.

OLED development @ OSRAM

Past, Present and Future Topics

Alireza Safaee and Thomas Wehlus | Feb. 01 2017 | Long Beach, CA
DOE SSL R&D WORKSHOP

OSRAM

Outline

1. The Past - GI

2. The Present - Automotive

3. The Future

OSRAM's OLED Activities mainly focused on General Illumination & Automotive

Automotive is expected to be the first volume application

Special



Furniture, White Goods, Decorative,...

Focus:

- Depending on application

General Illumination



Focus:

- Cost
- Efficiency
- Lifetime

Automotive



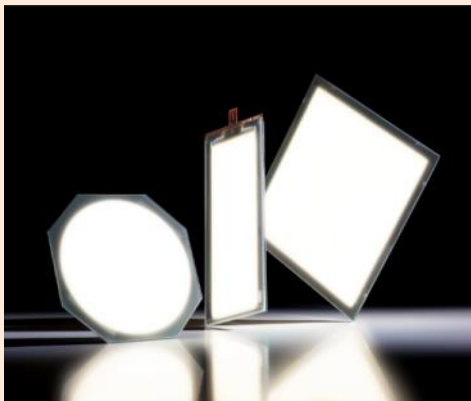
Focus:

- Features
- Reliability
- Cost

The Past.

In the past OLED Development was focused on General Illumination

Mirror/Diffuse



Transparent



Flexible

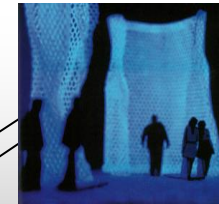


From 2007: OLED – Street to the flat light of the future

3rd Gen OLED

high efficiency
full flexibility

General lighting
Transparent room separators



Flexible OLED
Lighting wallpaper
and light curtains

Diffuse ceiling lighting



2nd Gen OLED

high reliability
transparency

Advertisement



Automotive interior lighting

1st Gen OLED

thin, flat, diffuse
area light source



Decorative
illumination



Emergency and
other signs



Female

From talk given by Dr. G. Schmid in 2007
during ProcessNet Conference in Frankfurt

Examples for General Illumination with OLEDs

Reference luminaires with OSRAM OLEDs



“Ventura” Solid, NL



“O-Range” Tunto, FIN



“Cluster+2.0” Ben Wirth, GER



„SOL“ WAC lighting, US



„AT-O-LED“ Ludwig Leuchten, GER



Zumtobel, AUT

Examples for General Illumination with OLEDs

Installations with OSRAM OLEDs



Dula, Germany



TÜV Süd, Germany



NMD, Germany



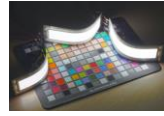













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 2. **The Present - Automotive**
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OLED @ OSRAM

Track Record

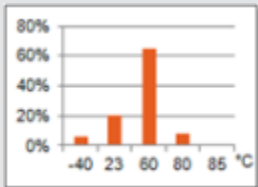
	R&D	Production	Products & Applications
2005 - 08	<ul style="list-style-type: none"> Launch of OLED lighting activity in Regensburg 	<ul style="list-style-type: none"> Pre-Pilot production launch 	<ul style="list-style-type: none"> World's first commercial OLED luminaire "Early Future" 
2009 - 10	<ul style="list-style-type: none"> Efficiency record for lab sample with 62 lm/W (real white OLED) 		<ul style="list-style-type: none"> 1st Gen OLED products from series production World's first „long term“ installation of 100 OLEDs at EXPO in Shanghai
2011	<ul style="list-style-type: none"> World record for 2.5D white OLEDs with 32 lm/W efficacy Lab record 87 lm/W @ 4000K 	<ul style="list-style-type: none"> Opening of OLED pilot line 	<ul style="list-style-type: none"> Award winning luminaire "Airabesc"  
2012	<ul style="list-style-type: none"> 1st Auto milestone: 1600 h LT70 @ 50°C Large area transparent OLED (116 cm²) production proven design 		<ul style="list-style-type: none"> 2nd Gen OLED products from series production (40 lm/W, 2000 nits, 10 kh LT70) System expertise proven by dedicated connector and electronics solutions
2013	<ul style="list-style-type: none"> 2nd Auto milestone: 3 kh LT70 @ 50°C 		<ul style="list-style-type: none"> Award winning OLED module  
2014	<ul style="list-style-type: none"> Gl eng. samples from pilot line: 65 lm/W @ 3000 cd/m², 15 kh LT70 3rd Auto milestone: 3kh LT70 @ 85°C 	<ul style="list-style-type: none"> ISO9001 and ISO14001 certification 	<ul style="list-style-type: none"> Launch OLED Reading Light Demonstrator in cooperation with automotive lighting  
2015	<ul style="list-style-type: none"> 1000 nits: 8000 hrs reached 	<ul style="list-style-type: none"> TS16949 Audit (Letter of conformity received in November) 	<ul style="list-style-type: none"> BMW M4 "Iconic Lights" Showcar at CES 
2016/2017		<ul style="list-style-type: none"> Serial Production for automotive application 	

Automotive Requirements

Environmental Exposure as major Challenge

High temperature operation

- Lifetime at elevated temperatures



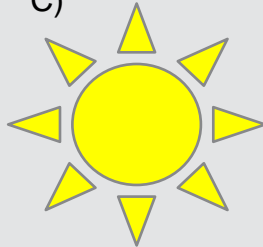
- Temperature profile for RCL

- LT70 6kh / 8 kh at 1200nits / 1000nits, according temperature profile



High temperature storage

- Storage at elevated temperatures ($\geq 85^{\circ}\text{C}$)

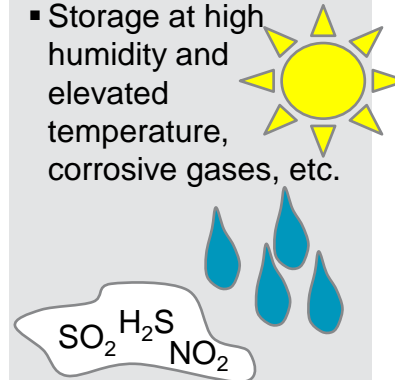


- $>3.000\text{h}$ at 95°C (accelerated testing conditions)
- $>1000\text{ h}$ at 105°C



Storage under harsh environmental conditions

- Storage at high humidity and elevated temperature, corrosive gases, etc.

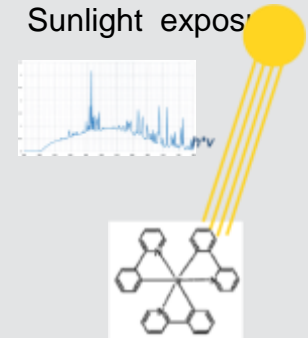


- >10 years under defined environmental condition; negotiated failure criteria



Sunlight exposure

- Storage under Sunlight exposure



- UV blocking (RCL lens supporting)

Automotive Demonstrators: Proven conformity

ECE conform Rear Combination Lamp (RCL)

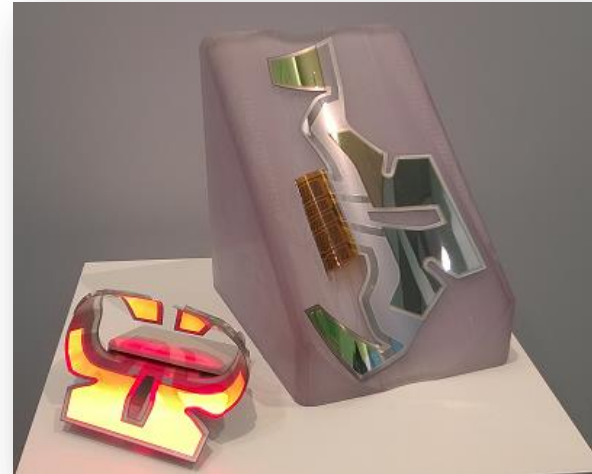


Fully functional ECE conform OLED RCLs have been shown, but first RCLs will be hybrids:
LED + OLED technology

R2D2 Research Project:

Rear light demonstrator with flexible OLEDs

1st public presentation at 11th International Symposium
on Automotive Lighting (ISAL 2015)



**Flexible automotive
technology demonstrator**



Vorsprung durch Technik



GEFÖRDERT VOM

DIEHL

VON ARDENNE 



Bundesministerium
für Bildung
und Forschung

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The future of Automotive OLEDs

What is necessary to make this happen?

Better organic materials and a lot of stack development



Accents,
DRL



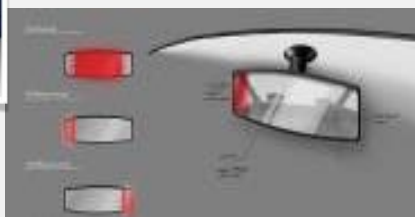
Stop Light,
Indicators



Various Interiors



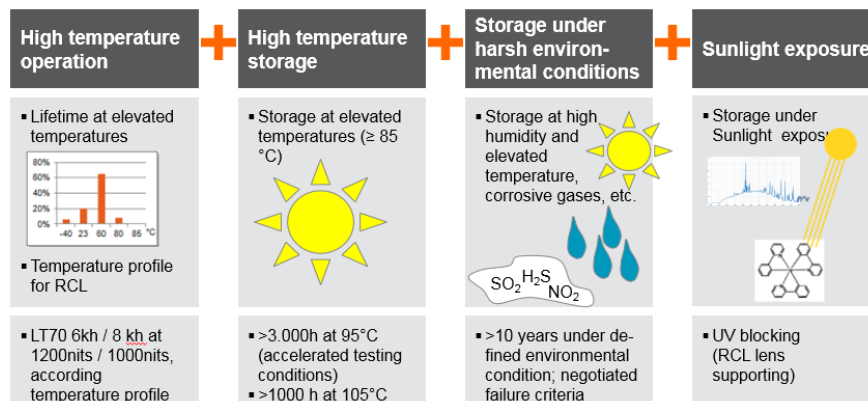
Rear Light



Topics beyond stack development



Flexible OLED needs
to become Automotive ready.



Topics beyond stack development: Cost and Design

Overall OLED price
needs to decrease.
Chance for R2R?

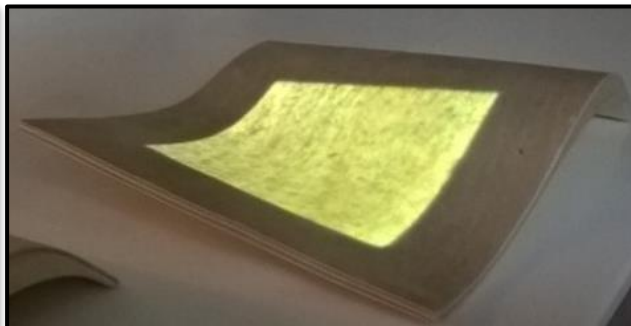


Source: COMMED

Personalization/ Individualization of OLEDs

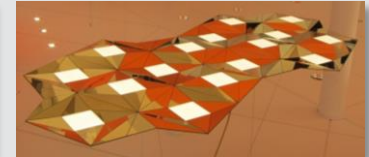
- Gapless segments.
- Borderless OLEDs/
Seamless tiling.

Surface refinement.

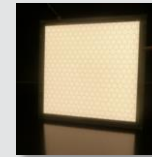


Take-Away Messages

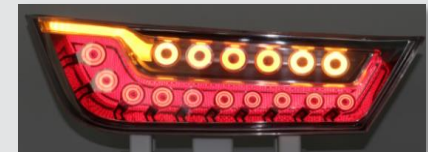
OLEDs offer design options and quality of light unmatched by any other light source but they are still quite **expensive**.



Automotive OLEDs are less price sensitive but the **technical challenge** is harder. OLED development for Automotive shows remarkable progress.



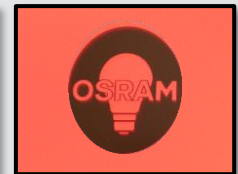
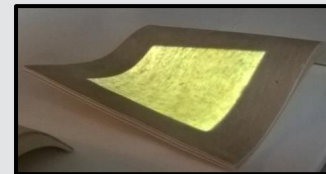
Automotive is the first volume application and is strongly **design driven**.



Segmentation, transparency and flexibility are key features for future applications. Flexible needs to become automotive ready.



Stack development is one hard challenge to enable more applications. But topics like personalization or surface refinement are important, too.



Many Thanks.

OSRAM