## RL6

# High Brightness LED

An Overview

OSRAM Opto Semiconductors GmbH

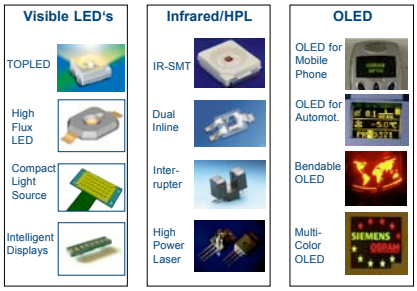


## Contents of the Presentation





## Products of OSRAM Opto Semiconductors



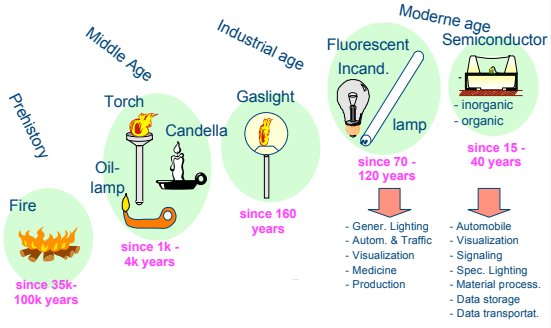



## Contents of the Presentation



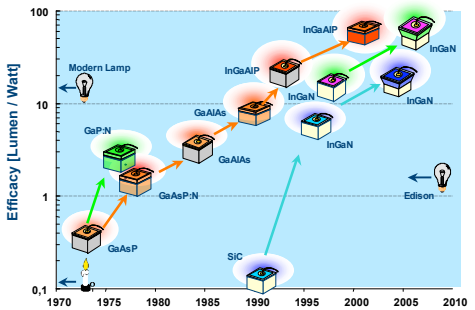


## The Innovation Sequences for Artificial Light Sources Become Shorter

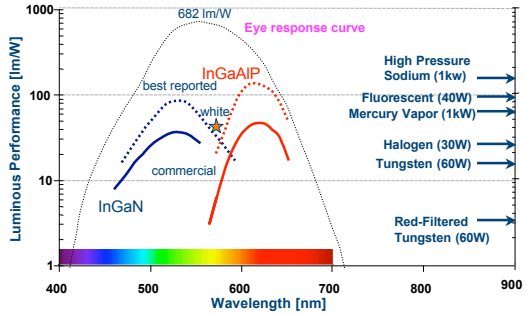





## Dramatic Brightness Evolution of LEDs in the Past- What's going on?



## InGaN and InGaAlP High Brightness LEDs






## Contents of the Presentation

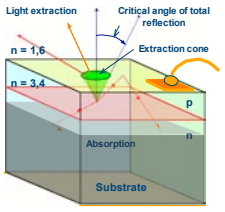


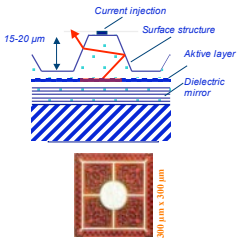


## The Way to High Brightness

only 4% of the light escape the epoxy coated chip in a first pass!

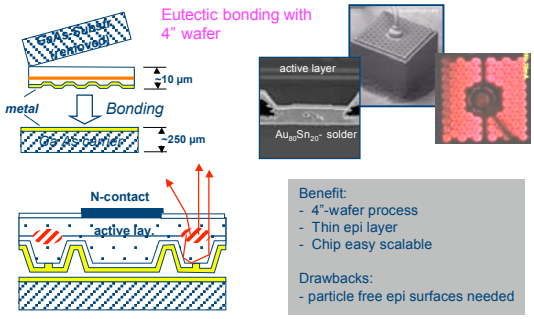
Approach: Doubling of light extraction by "Structured chip surface"






## OSRAM OS Persuits the Way of InGaAlP-Thinfilm-Tech.



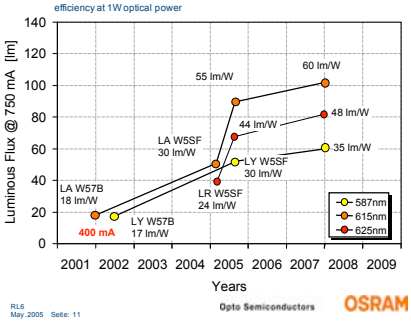

Benefit:
- 4"-wafer process
- Thin epi layer
- Chip easy scalable

Drawbacks:
- particle free epi surfaces needed



## InGaAlP Roadmaps Red/Amber (typical brightness)

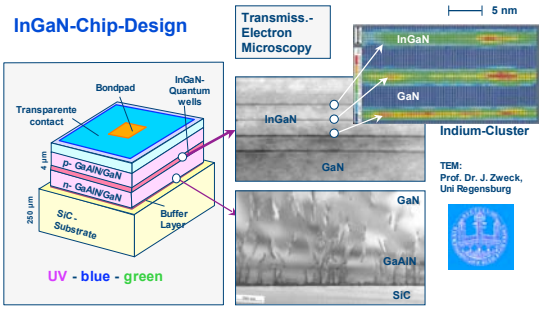
Golden Dragon






## Contents of the Presentation

## InGaN Chip Technology on SiC Substrates




RL6 May 2005 Seite: 13

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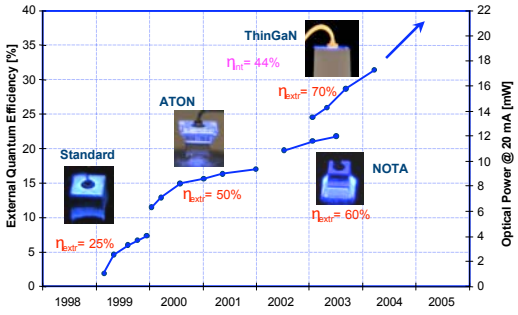
## InGaN Chip Concepts for high Extraction Efficiency Development of New Chip Generations




RL6 May 2005 Seite: 14

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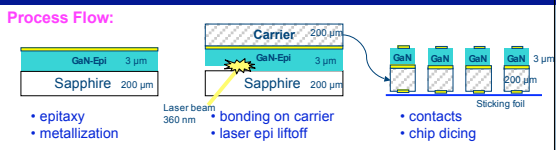
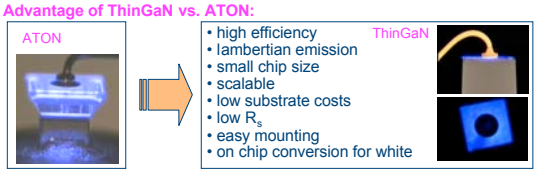
## Process Flow and Advantage of **ThinGaN** - OSRAM's Proprietory InGaN- High Brightness Technology




Advantage of ThinGaN vs. ATON:




RL6 May 2005 Seite: 15

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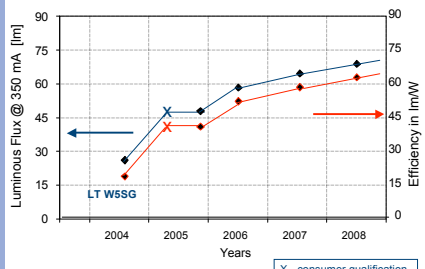
## Roadmaps true green (typical brightness)

Golden Dragon

Production Ramp-up




RL6 May 2005 Seite: 16

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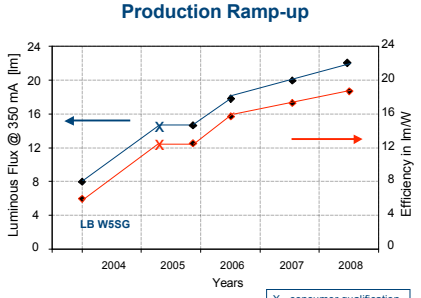
## Roadmaps blue (470 nm) (typical brightness)

Golden Dragon

Production Ramp-up




RL6 May 2005 Seite: 17

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## Contents of the Presentation



RL6 May 2005 Seite: 18

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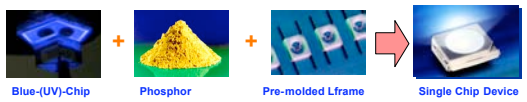
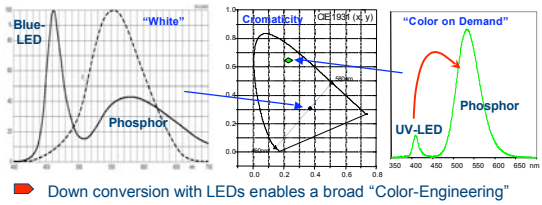
## The Way from Blue (or UV) to Unsaturated Colors and White through Down Concersion

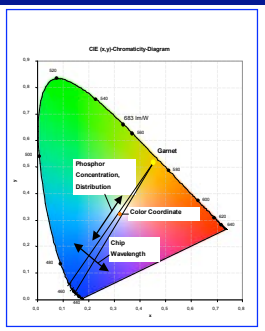


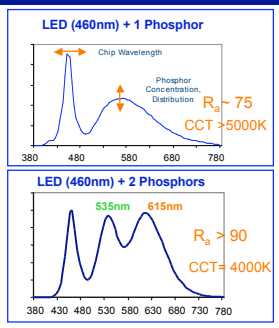




Down conversion with LEDs enables a broad "Color-Engineering"



## CRI Improvement of Blue Chip Based White LED

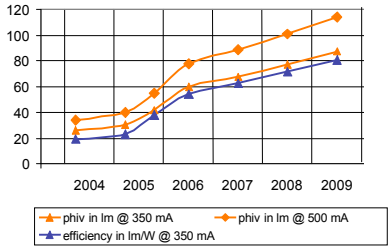




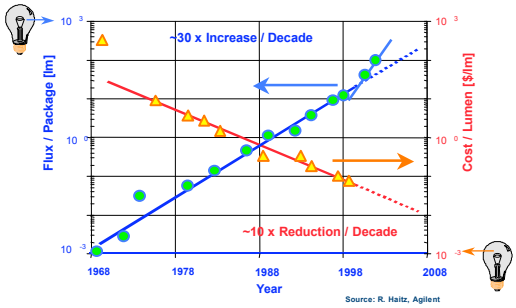

## Roadmaps white (typical brightness)

Golden Dragon






## Haitz's Law for LED Flux and Costs per Lumen



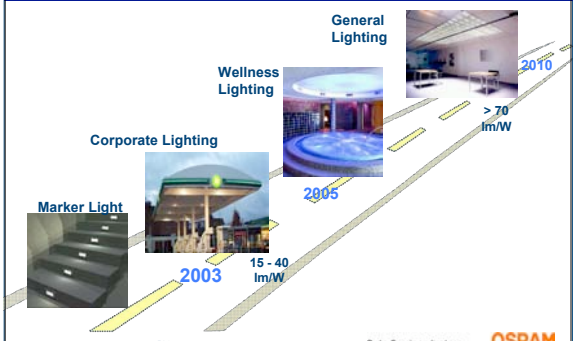



## Contents of the Presentation





## Roadmap for Solid State Lighting



## LEDs “Bridge” Time and Space

A red beam stretches along the Stone Bridge across the River Danube. It provides a visual link between the two banks and at the same time highlights the historical development of Regensburg and one of city’s oldest structures. Osram Opto Semiconductors is supporting Regensburg with an unusual lighting installation in its application to be named the City of Culture 2010…with 21,900 LEDs

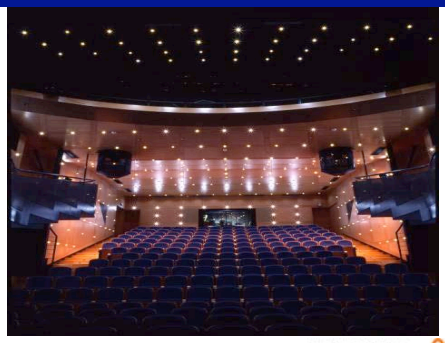


## Signage




## Mood Lighting
## Innovation Award – Light&Building 2004


## Theater Lighting





## Floorlighting



## White LEDs for Surface Lighting and Room Lighting

The four exclusive fixtures, each one a metre square in size, combine to provide an unusually homogenous source of lighting above the conference table.

Each fixture is made up of 128 glass-mounted LINEARlight Modules and combines the luminosity of 4096 white LEDs. The luminaires feature a sandwich-layout and are based on a perforated and insulated metal plate onto which the LED modules are mounted.

From underneath they resemble a grid made up of dots of light on a dark background. Just as required for this lighting concept, the LED modules deliver cold, white light with a colour reproduction index of Ra = 80 and can achieve colour temperatures between 5250 and 6250 K.

## applications DRAGON

Reading light
Desk luminaries

Furniture and display cases
shop lighting
facade illumination

Mobile light






and, and, and .....



## Contents of the Presentation

- OSRAM Overview
- Fast Changing World Of Opto Electronics
- InGaAlP Thin Film Technology
- Thin InGaN Technology
- White Conversion
- Applications ( General Illumination )
- Approach For Further Improvement
- Summary



## Aproaches for Further Improvements of LED Quantum Efficiencies

1. **Improvements of chip materials and structures** (internal Q.E.)
   - reduction of defects and impurities
   - dedicated incorporation of dopants and profiles
   - laser like resonant structures
2. **New chip designs** (extraction efficiencies)
   - chip shaping by simulation
   - chip surfaces by simulation
   - photonic bandgap structures
3. **New package designs** (light utilization and electrical losses)
   - reduction of series resistance
   - improvement of thermal contacts
   - reduction of absorption losses
   - increase of conversion efficiencies
   - encapsulation materials with high refractive index



## Development of Innovative Power-LED Packages

**Increased optical power !!**

$R_{th}$ ~280 K/W
TOPLED®
2 lm 90mW @20mA single chip white

$R_{th}$ ~60 K/W
Advanced Power TOPLED®
10 lm 250mW @200mA single chip white

$R_{th}$ ~10 K/W
Golden Dragon ®
30 lm 1,4W @350mA single Chip white

Integration of concentrator optics

$R_{th}$ ~2,5 K/W
Compact Light Source
100-1000lm 10 - 50W multi chip



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## Summary

1. LEDs have clear advantages in lighting applications where dedicated colors are required.
2. LEDs will increasingly be used for low power white lighting applications accordingly to their brightness evolution.
3. LED lamps will be far more expensive (lumen-wise) than all other conventional light sources for at least one decade.
4. The expensive LED lamp must pay for itself through lifetime, maintenance savings, high degree of freedom for design and color management.


Thank
You