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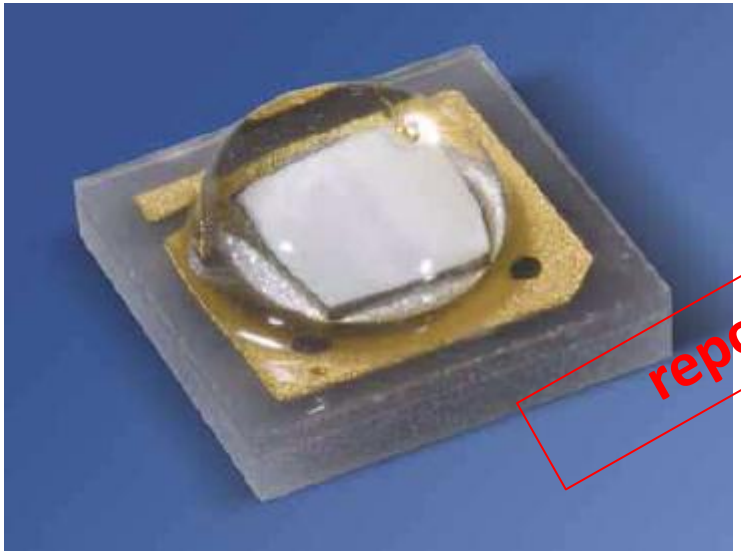
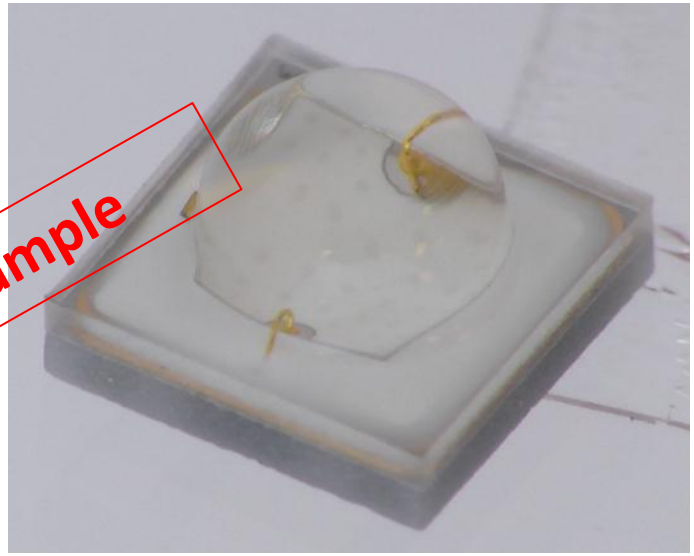
Reverse Costing analysis





report sample

OSRAM
Oslon SSL and Square Royal Blue LED
1mm² LD-CQDP and 2mm² LD-CQAR

February 2013 - Version 1

Written by: Sylvain HALLEREAU

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Table of Contents

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Executive Summary

- **This full reverse costing study has been conducted to provide insight on technology data, manufacturing cost and selling price of 2 OSRAM Oslon Blue LEDs:**
  - ✓ **SSL ref. LD-CQDP**
  - ✓ **Square ref. LD-CQAR**

- **The LD CQDP series have a typical Luminous Flux of 515 mW at 350 mA and up to 1219 mW at 1 A. The semiconductor LED area measures 1mm sq.**

- **The LD-CQAR series have a typical Luminous Flux of 1100mW at 700 mA. The semiconductor LED area measures 2mm sq.**

- **The components are provided in a specific 2-pins package, compatible with SMT process.**

- **They can be used in a wide range of lighting applications, including:**
  - ✓ Architectural lighting
  - ✓ Stage and entertainment lighting
  - ✓ Retail and shop lighting
  - ✓ Color changing fixtures
  - ✓ Remote-phosphor fixtures

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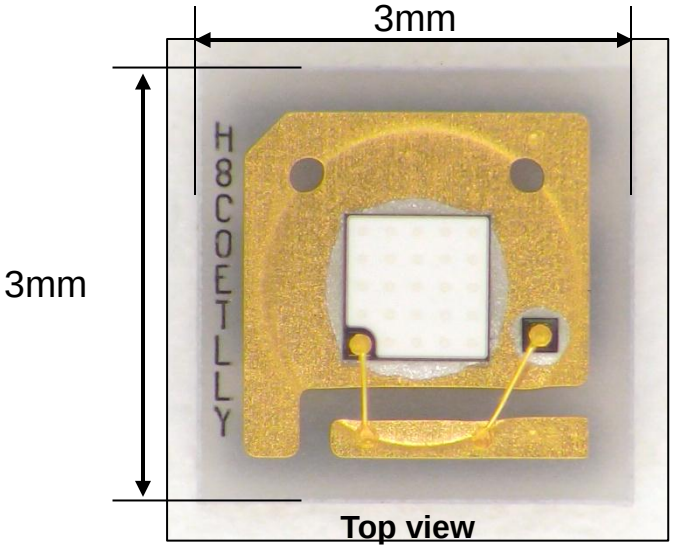
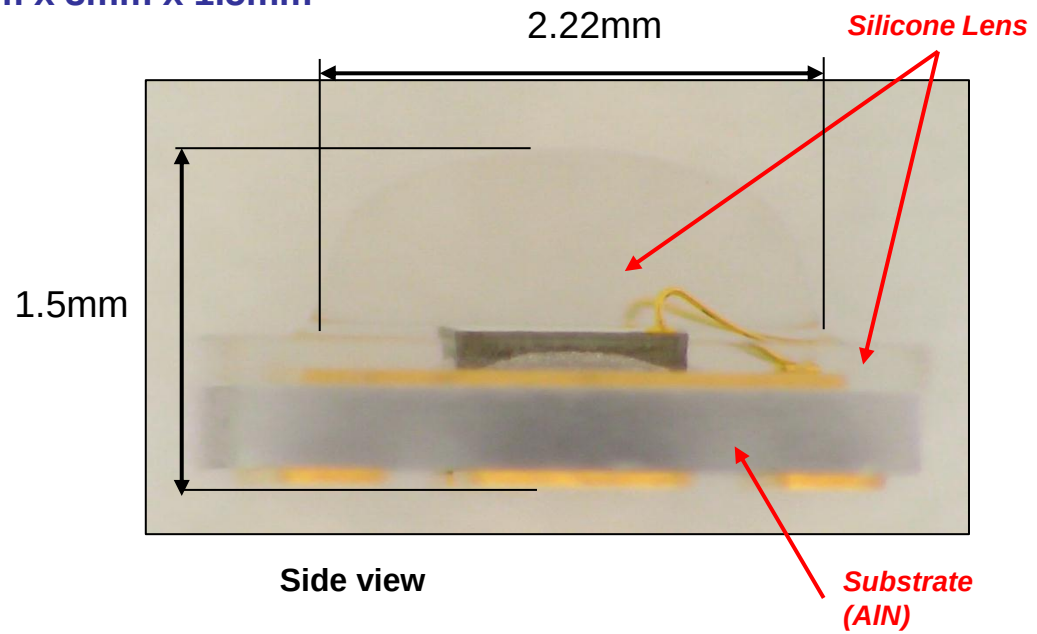
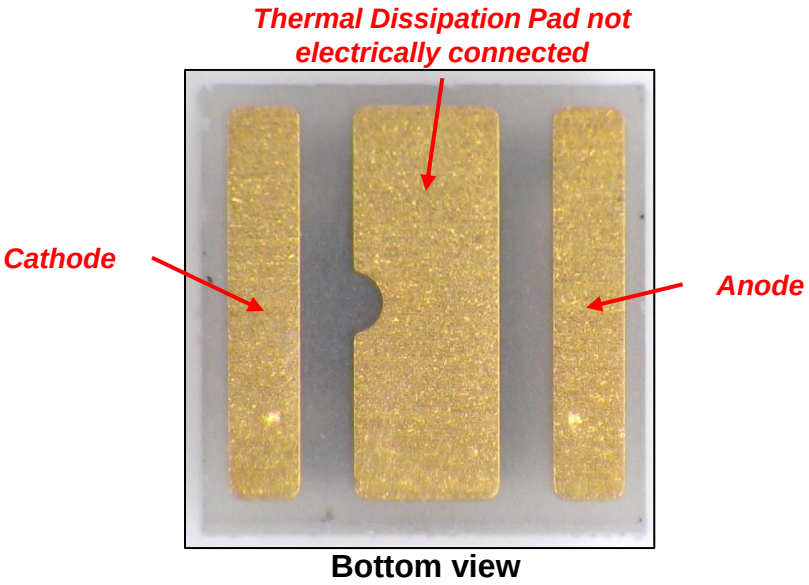
1mm² LED - Package Characteristics

- **The package is a specific 2-pins package, 3mm x 3mm x 1.5mm**







- **The package is a lead-less ceramic carrier, with an over molded one piece silicone lens. The LED die and protection diode sit on top of a copper plate. Two bond wires are present: one connecting to the LED die and one to the protection diode.**

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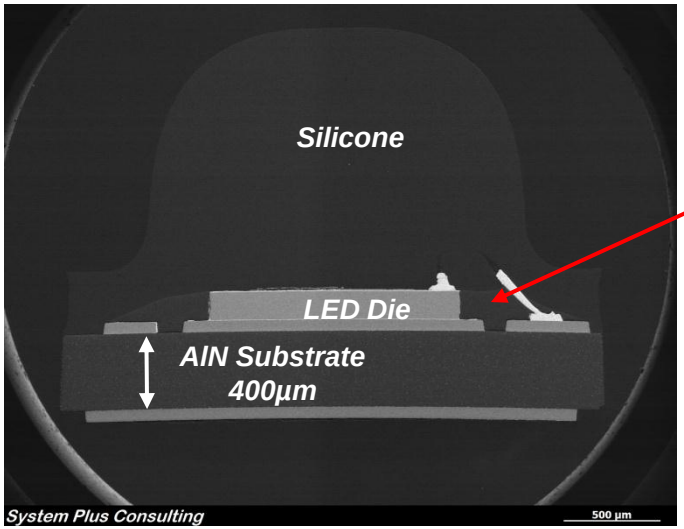
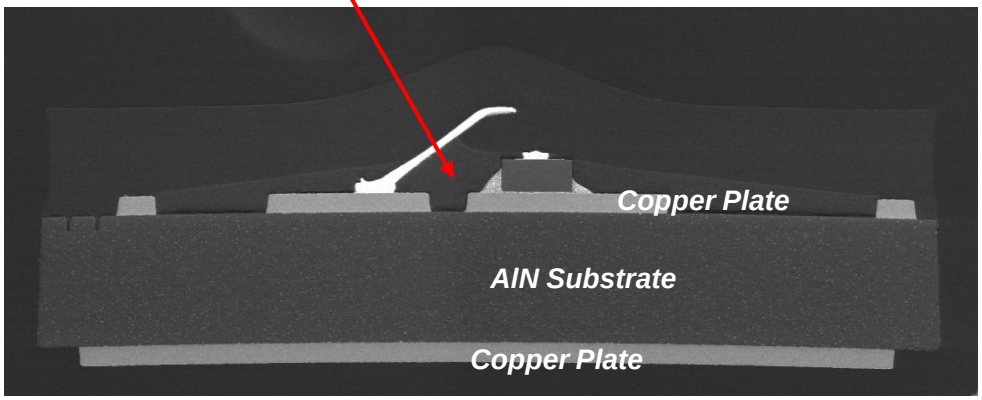
2mm² LED - Package Cross-Section

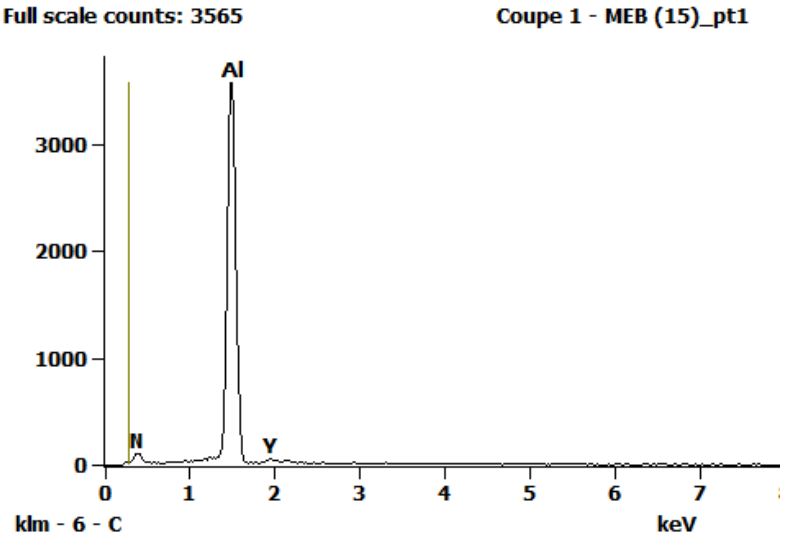


Cross-section view

The white silicone has partially covered the protection diode.



Cross-section view



EDX spectrum of the ceramic package

- **The ceramic package is an AlN ceramic substrate with a small percentage of yttrium, conventional additive in the manufacture of AlN ceramics.**

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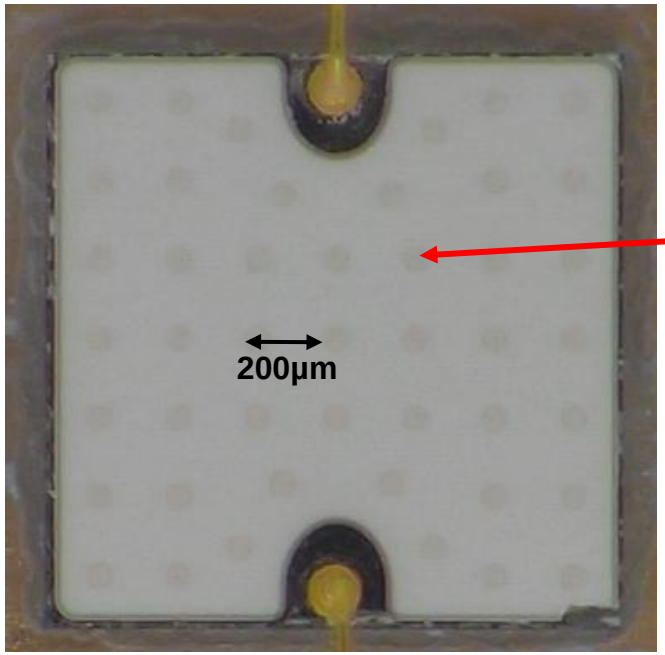
2mm² - LED Die : thin GaN and UX:3 technology

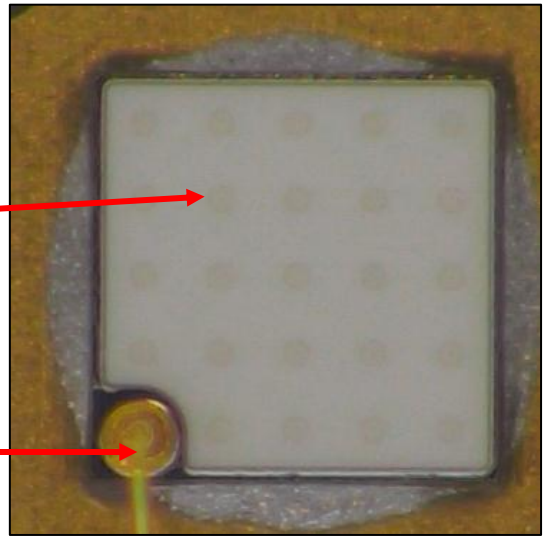


2mm² LED

The GaN layer is white on the pictures.

Cathode contact

Anode



1mm² LED

- UX:3 technology : the cathode is under the GaN layer.
- The new design of the cathode and anode enhances the electron flux on all the surface of the LED without masking the light.
- We measure a pitch of 200µm between each cathode contact

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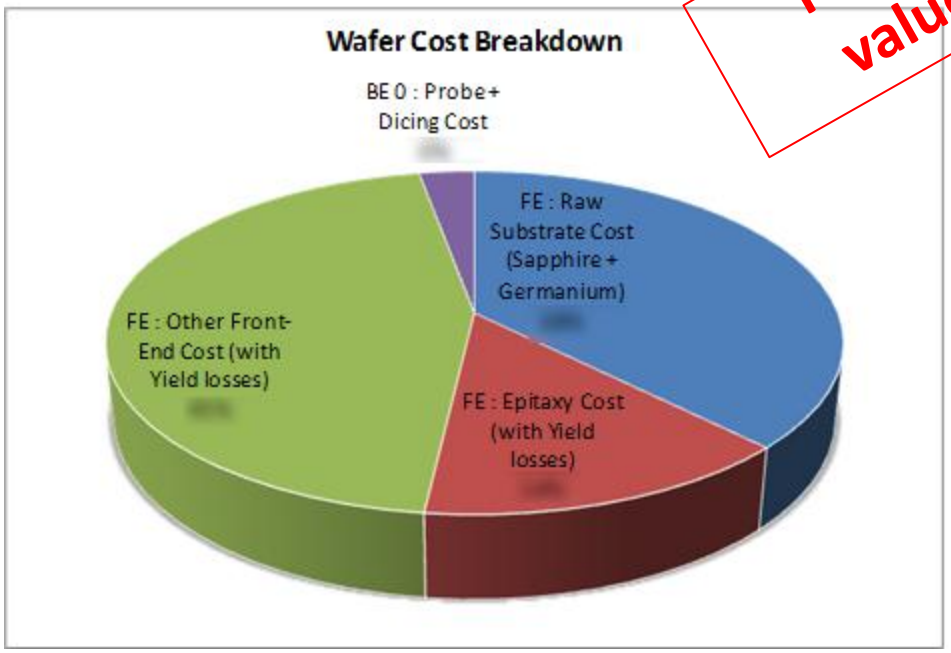
1mm² - LED Wafer & Die Cost (FE+BE 0)

	Low Yield		Medium Yield		High Yield	
	Cost	Breakdown	Cost	Breakdown	Cost	Breakdown
FE : Raw Substrate Cost (Sapphire + Germanium)						
FE : Epitaxy Cost (with Yield losses)						
FE : Other Front-End Cost (with Yield losses)						
BE 0 : Probe + Dicing Cost						
TOTAL Wafer Cost						
Nb of potential dies per wafer						
Nb of good dies per wafer						
FE : Raw Substrate Cost (Sapphire + Germanium)						
FE : Epitaxy Cost (with Yield losses)						
FE : Other Front-End Cost (with Yield losses)						
BE 0 : Probe + Dicing Cost						
Die Cost						

report sample – values blurred



- The final wafer cost ranges from [redacted] to [redacted] according to yield variations.
- The final LED die cost ranges from [redacted] to [redacted] according to yield variations.
- The Front-End (FE) cost represents [redacted] (Substrate + Epitaxy + Other FE).
- The Back-End 0 cost (Probe Test & Dicing) represents [redacted].

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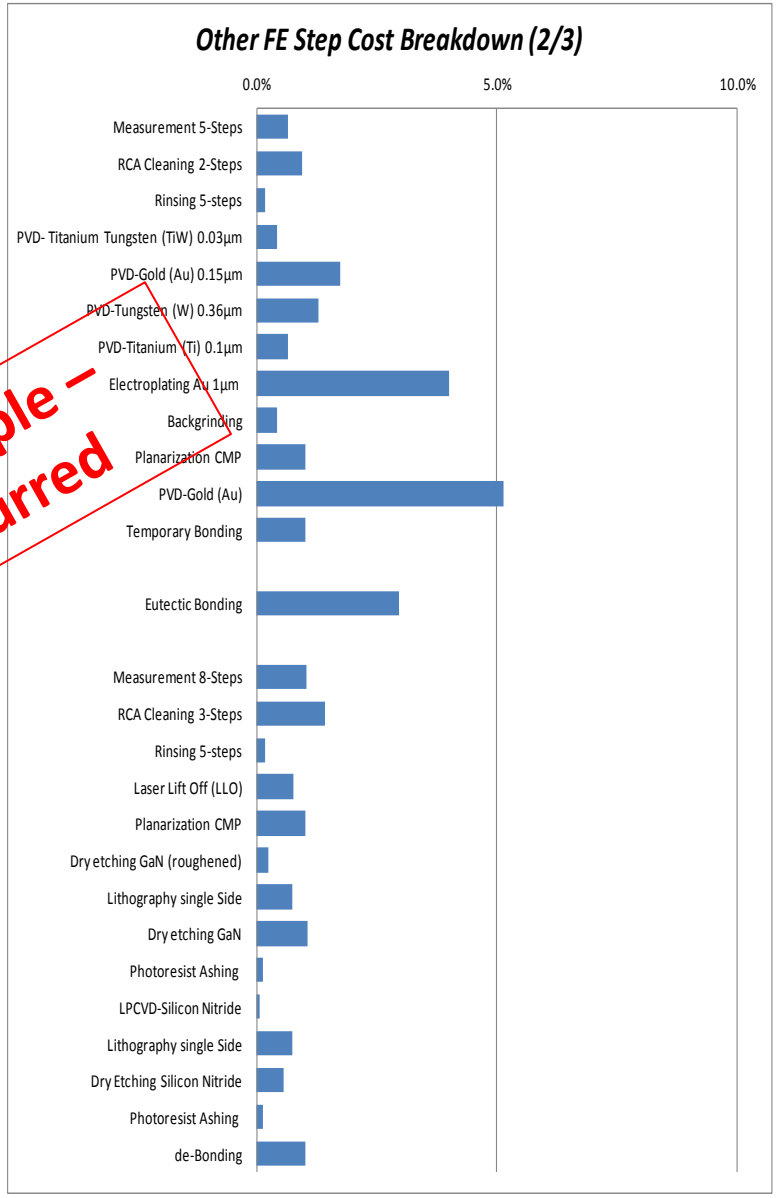
2mm² - Front-End : Other Front-end Cost per Steps (2/2)

Germanium Metal Layers		
Measurement 5-Steps	[illegible]	[illegible]
RCA Cleaning 2-Steps	[illegible]	[illegible]
Rinsing 5-steps	[illegible]	[illegible]
PVD- Titanium Tungsten (TiW) 0.03µm	[illegible]	[illegible]
PVD-Gold (Au) 0.15µm	[illegible]	[illegible]
PVD-Tungsten (W) 0.36µm	[illegible]	[illegible]
PVD-Titanium (Ti) 0.1µm	[illegible]	[illegible]
Electroplating Au 1µm	[illegible]	[illegible]
Backgrinding	[illegible]	[illegible]
Planarization CMP	[illegible]	[illegible]
PVD-Gold (Au)	[illegible]	[illegible]
Temporary Bonding	[illegible]	[illegible]
Eutectic Bonding	[illegible]	[illegible]
Front End on Germanium		
Measurement 8-Steps	[illegible]	[illegible]
RCA Cleaning 3-Steps	[illegible]	[illegible]
Rinsing 5-steps	[illegible]	[illegible]
Laser Lift Off (LLO)	[illegible]	[illegible]
Planarization CMP	[illegible]	[illegible]
Dry etching GaN (roughened)	[illegible]	[illegible]
Lithography single Side	[illegible]	[illegible]
Dry etching GaN	[illegible]	[illegible]
Photoresist Ashing	[illegible]	[illegible]
LPCVD-Silicon Nitride	[illegible]	[illegible]
Lithography single Side	[illegible]	[illegible]
Dry Etching Silicon Nitride	[illegible]	[illegible]
Photoresist Ashing	[illegible]	[illegible]
de-Bonding	[illegible]	[illegible]
TOTAL	[illegible]	[illegible]

report sample – values blurred



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Contacts

- **This reverse costing analysis represents the best cost/price evaluation given the publically available data, completed with industry expert estimates.**

- **These results are open for discussion. We can re-evaluate this circuit with your information. Please contact us:**

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