



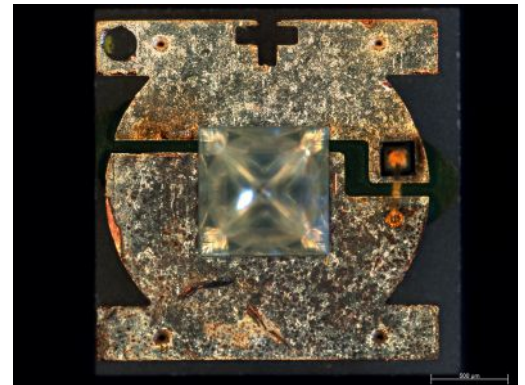
Michel Allain, CEO, System Plus Consulting

Cree SC³ technology uses SiC to increase lumens per dollar

"This new XB-D offers a simpler construction than the XP-E analyzed in 2010, without sacrificing performance. Robustness is increased by eliminating the multiple wire bonds and cost is reduced by using a simple flip-chip structure and texturization of the SiC substrate, rather than a vertical structure with wafer bonding and substrate lift off," says Eric Virey, Yole Développement.

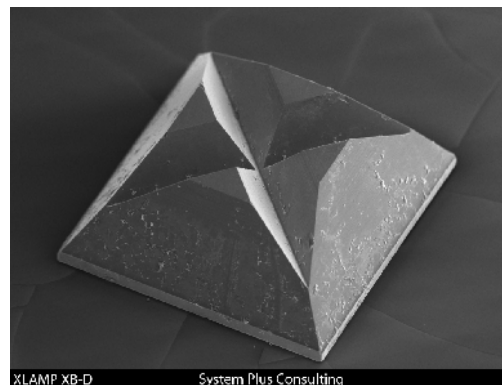
The XLAMP XB-D is a high-brilliance LED launched in early 2012. The XB-D delivers up to 136 lumens per watt in cool white (6000K) or up to 105 lumens per watt in warm white (3000K), both at 350 mA and 85°C.

The Cree SC3 Technology Platform combines a silicon carbide LED chip, improved light extraction and improved phosphor.



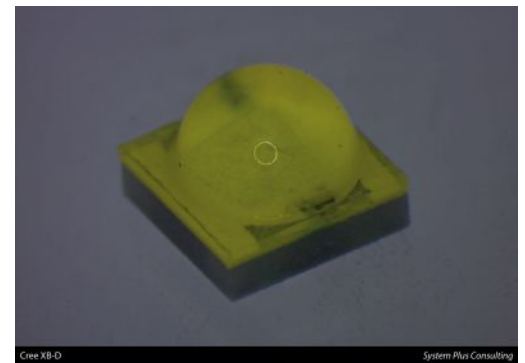
LED top view after phosphor removal. (Courtesy of System Plus Consulting)

Aluminium nitride is replacing alumina in LED substrates: a similar change has been observed in Lumileds and Osram devices.



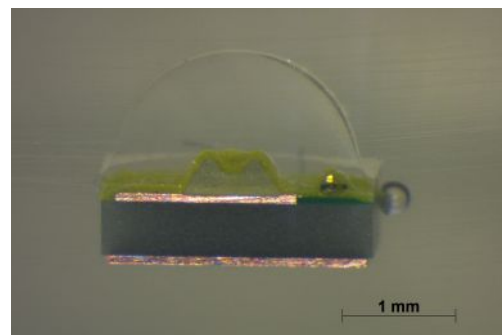
LED Die SEM view. (Courtesy of System Plus Consulting)

The silicon carbide is patterned into shapes in order to increase the probability that emitted photons exit the LED die with a minimum of internal reflection, thus increasing light extraction.



Packaged LED external view. (Courtesy of System Plus Consulting)

A hemispheric silicone lens covers the substrate, resulting in a tiny package (2.45mm x 2.45mm x 1.80mm).



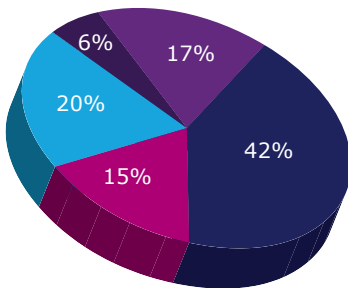
LED cross-section. (Courtesy of System Plus Consulting)

The LED chip structure, the phosphor technology and the package design allow the XB-D LED to be more efficient than Cree's previous-generation LED.

The 4" SiC raw wafer remains the main cost factor. The LED cost is highly dependent on the yield at each manufacturing step, as well as the binning yield. With an optimized yield, the selling price should be able to reach 200lm/\$ for the cool white LED.

The LED is flip-chipped on top of the ceramic substrate. A silicon protective diode is wire bonded, and then the whole substrate is covered with YAG phosphor.

The ceramic substrate is made of aluminium nitride (AlN). The top and bottom metal layers are copper, plated with silver.



- phosphor
- front end
- epitaxy
- raw wafer (SiC)
- packaging

LED cost breakdown, 2012. (Courtesy of System Plus Consulting)

Michel Allain, General Manager, System Plus Consulting

Michel Allain has been working for System Plus Consulting during more than 12 years, introducing cost simulation of electronics. Previously he held some management positions in the semiconductor industry and took part in several startup companies.