3D packages from Lednium provide wide-angle sources

An Australian company, Lednium, has developed a packaging technology to produce a wide-angle distribution for solid-state lighting, and has teamed with Optek to market its products.

Lednium, an LED technology company based in Melbourne, Australia, has developed what is described as the world's first three-dimensional LED platform for both white and monocolor LEDs. Products include a multichip geodesic-dome-shaped 10 W LED assembly that is available in white, blue, green, amber and red. The white device yields 250 lm with a viewing angle of 120º (figure 1).

The company recently signed an agreement with US-based Optek Technology to jointly develop and market a series of products using the 3D packaging technology (see "Lednium and Optek target solid-state lighting", pxx). Even more recently, Lednium signed a patent licensing agreement with Osram to license the German company's phosphor technology for manufacturing white LEDs.

The 3D products are assembled by mounting chips into cups, then the cups are placed into a dome-shaped lead frame. Lednium's unique packaging technology is repeatable in mass production, and it can accept all chip architectures, which means that it can benefit from future advances in chip technology.

LEDs Magazine spoke with John Montagnat, the senior development engineer at Lednium, to discuss details of the company's novel packaging approach.

Fig. 1. With a unique dome-shaped package, the 10 W Lednium LED produces 250 lm in white at a current of 1.05 A. Excluding leads, the package size is 33×33 mm, and the height is 8 mm.

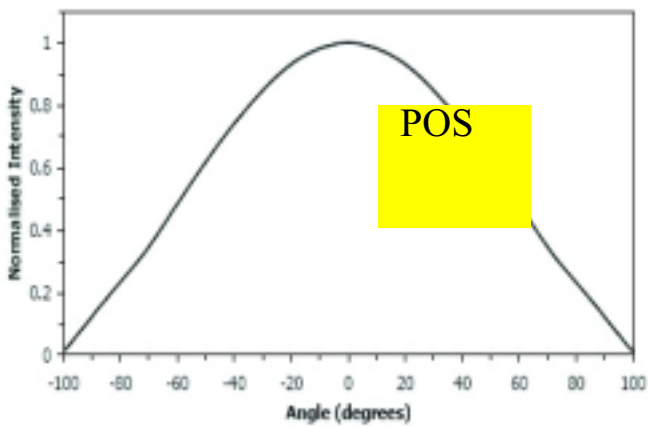

Fig. 2. The spatial intensity distribution of the 10 W Lednium array is extremely uniform and has a viewing angle (defined at half maximum intensity) of 120°.

What was the rationale for developing the 3D packaging technology?

Our ultimate goal is general illumination, which we believe can be best achieved using LED arrays, and, more particularly, with arrays that are configured to have a "wide-angle-divergent" distribution of light [figure 2].

The 3D concept is, fairly logically, the reverse of the packaging industry trend of a few years ago. At that time LED packagers strove day and night to be able to boast of a light-intensity level that was greater than that of their competition – the more millicandela that could be claimed, the better.

However, the total amount of light was limited, and, to increase intensity, viewing angles became increasingly smaller. This meant that the LEDs available to the market became less useful for illumination. The trend was to make point sources, rather than to imitate the almost Lambertian distribution of an incandescent bulb or a fluorescent tube.

Realizing that it is unlikely that LEDs will ever be able to approximate a Lambertian source, we set out to push the boundaries of even light distribution within a hemisphere. A hemisphere is adequate since a significant percentage of traditional luminaires locate the light source on a surface (usually a ceiling), and this type of application does not require 360º light distribution.

Within the 3D package, LED chips are mounted inside cups, which are themselves placed into the preformed lead frame. Can you describe the manufacturing process?

The assembly process is automated using purpose-built machines that combine four different copper lead-frame [LF] arrays.

The first is an array of cups [LF 1] that is combined with a matching array of preformed insulation cut-outs and an array of ring contacts [LF 2]. The result is a composite array of cups, each of which has an "insulated ring" attached to its rim.

LED chips are attached into the cups and connected by wire bonds to the ring contact and to the copper cup if necessary. Phosphor is added

in the case of white LEDs. This array has an epoxy package molded over each cup. After singulation from the array, each cup is now an operable packaged LED.

How is the final package assembled?

A preformed lead frame [LF 3] is introduced that contains through-holes in a raised, part-spherical dome. The holes are located to accept the molded cups [figure 3].

The lead frame is divided into three sections. After the cups are attached in the through-holes they are connected in three groups in a series/parallel arrangement by three ring contacts [LF 4]. This assembly is overmolded with epoxy material and enclosed in a two-piece aluminum housing [figure 4].

The lead frame allows any group of cups, or combination of groups of cups, to be controlled independently.

How is the thermal management of the package handled?

Thermal management is primarily handled by the copper lead frame. The thermal resistance from junction to board is only 5 °C/W. The heat source, i.e. the chip, is mounted in a copper cup attached to a copper lead frame that extends outside the package.

The extensions are in the form of pins, which, when coupled to a metal-core PCB or the like, provide excellent thermal conduction.

In addition, these pins are clamped between the two halves of an outer package made from aluminum. The bottom surface of the package is thus used as a secondary thermal path.

Where is production carried out?

Production will initially be carried out in Malaysia, with all design and R&D projects directed from the Lednium headquarters in Melbourne, Australia. Lednium will manufacture all products to be distributed by Optek.

We have no facilities to manufacture LED chips, but there are many potential suppliers of chips for us to choose from. At the moment we have an inventory of chips from the US, Taiwan and Japan.

The licensing agreement with Osram [see "Links"] allows us to use Osram IP to generate white light from any Lednium LED array. ●

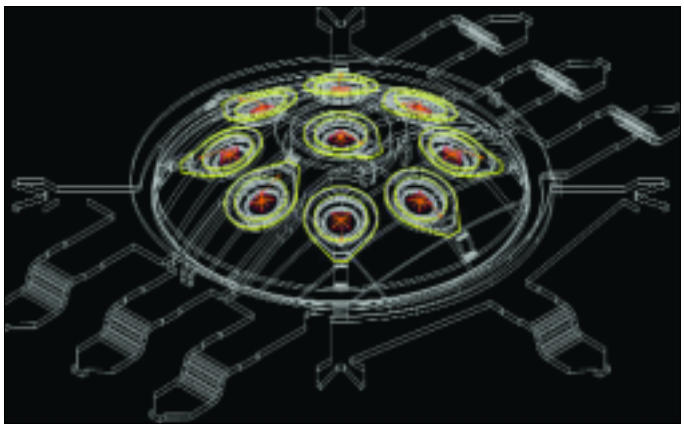

Fig. 3. After placing LED chips inside cups to create individual LED packages, these cups are positioned in a dome-shaped lead frame.

Fig. 4. Once the cups have been positioned in the through-holes of the dome-shaped lead frame and connected to three ring contacts, the assembly is overmolded with epoxy material and enclosed in a two-piece aluminum housing.

Links

Lednium: www.lednium.com
Optek: www.optekinc.com/vled.html

On our website:
Osram and Lednium sign white LED license agreement
www.ledsmagazine.com/articles/news/2/11/21
Optek and Lednium form alliance to target solid-state lighting
www.ledsmagazine.com/articles/news/2/10/14

Lednium and Optek target solid-state lighting

Optek Technology, a visible LED manufacturer based in Carrollton, Texas, which is part of the TT Electronics group, has signed a joint R&D, manufacturing and marketing agreement with Lednium. The alliance combines the strengths of both companies to create what they expect will be a "significant presence" in the emerging solid-state lighting industry.

Optek says that it will develop a series of solid-state lighting products using 3D packaging technology developed by Lednium. The Optek Lednium Series includes the OVTL09LGAx series (figure 1) – a 10 W, nine-LED package available in white, blue, green, amber, and red, along with color combinations such as RGB.

The white device has a luminous flux of 250 lm and an on-axis intensity of 70 cd, with a 120° viewing angle that is common to this design. These characteristics are measured at a junction temperature of 25 °C and an input current of 1.05 A.

Applications for the Optek Lednium Series include architectural and automotive lighting, aviation, display, entertainment, gaming and vending machines, marine, military, signs and signals, variable message signs and general illumination.

Optek established a Visible LED Business Unit in early 2005, and its product line includes industry-standard high-brightness and high-power LEDs. Optek Technology was acquired by TT Electronics plc, a global electronics company, in December 2003.

Optek and Lednium plan to jointly develop products at other wavelengths for markets that include medical and surveillance.

"This partnership is an ideal building-block for many value-added and customer-specific lighting assemblies for our automotive and industrial assemblies programs," said Richard Saffa, vice-president of Optek's Visible LED Business Unit. "Lednium brings a wealth of experience to the partnership, and its commitment to high standards has helped it achieve numerous awards."