Are “beam array” headlights in automotive’s future?

Yoelit Hiebert - November 10, 2017

Osram’s EVIYOS “smart, controllable, high resolution” LED automotive headlamp prototype, which is able to control its 1,024 LED “pixels” individually, has been creating some industry and press buzz, and is a technological first for the LED lighting industry.

Typically, dimming control for LED lighting is applied to all LEDs simultaneously, but according to Osram, the basic component of the EVIYOS combines an LED chip with electronics to provide on/off/dimming control for each pixel within the LED module, something like this:

The 4×4 mm module delivers about 3,000 lumens when all pixels are activated, compared to the 1,400 lm of the typical LED automotive headlamp module. Direct integration of the control circuitry with the LED chip facilitates optimal use of the limited space within the headlamp, and the module includes an interface for connecting directly to vehicle electronics.
Developed by Osram in partnership with Faunhofer, Infineon, Hella, and Daimler, the EVIYOS is part of an overall “smart” automotive system that continuously analyzes factors such as the road curvature, car velocity, and distance from other vehicles on the road, including oncoming traffic, and makes adjustments to the light emitted from the vehicle’s headlamps accordingly. For example, a wider beam would be provided for high congestion areas to illuminate not only the road ahead, but also sidewalks. But the individual pixel control capability allows the headlamp to do something new: light output can be adjusted to provide better visibility for other drivers sharing the road by darkening the specific pixels that would otherwise be causing glare, while still providing road and signage illumination. After over three years of research and field demos, a prototype was introduced at the International Symposium on Automotive Lighting earlier this year in Darmstadt, Germany. EVIYOS formal launch is expected in 2020.
The EVIYOS headlamp provides real-time dimming of the pixels that would otherwise illuminate the front or rear windows of other drivers, while still illuminating the road and signage. (source: Osram Opto Semiconductors)

Being a reliability and failure analysis fangirl, some questions come to mind. What happens when the pixel control circuitry fails? Do the pixels fail on or fail off? According to Osram, “EVIYOS is a monolithic semiconductor light source with increased design flexibility, but the fail-safe functionality will need to be determined by the system design architecture.”

How many failed pixels constitute a failed headlamp? Osram’s response: “There are limits that need to be addressed to meet Economic Commission for Europe (ECE) and Society of Automotive Engineering (SAE) standards to make a legal lamp. The degradation behavior of all lighting technology needs to be considered, but with 1,024 pixels/ lamp, this is not a significant concern, and will be factored into the system architecture.”

Assuming the module is not repairable, what’s the Mean Time To Failure? Osram answered, “we anticipate similar performance to conventional LED lighting solutions.” This seems like a reasonable position, as the overall life of LED lighting products tends to be limited not by the LED packages, but by other subsystems or components.

Moving control circuitry closer to the LED chips means that its heat will add to the LEDs’ own. As heat is the primary factor leading to lumen degradation, the thermal management scheme would need to channel heat from both the LEDs and the additional circuitry, a potential challenge in such a small physical space, especially given the high lumen output of the LED packages. What then is the projected lumen maintenance life for this product? Osram indicated that, “the product is scaling up, but reliability is anticipated to be in alignment with conventional LED technology.” Osram also noted that in North America, there is no regulatory requirement to periodically check headlamp performance to a standard.
Driverless cars, for better or worse, look to be part of the future of driving, but, consider this: will they even need headlamps? Or will they only need interior lighting so occupants can read or engage in other activities whilst their cars are merrily driving themselves down darkened roads? Now that’s an unsettling thought. Another unsettling thought, at least as it relates to Osram and its partners, is whether the investment they’ve made in developing this technology will pan out.

At its formal launch in 2020, Osram is planning to introduce a separate product family targeting lighting applications for which individual control of light pixels would be advantageous. When asked about potential markets for EVIYOS technology, Osram replied, “with the increasing need for adaptive forward lighting and glare-free headlamps, a dynamically controlled matrix light source provides additional benefit for forward lighting and certain interior lighting applications in a vehicle.” Street lighting and tunnel lighting come to mind as other potential markets, but this technology doesn’t seem like a good fit for indoor general lighting. So is this new technology part of the future of driving? With formal launch over two years away, only time will tell.

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—Yoelit Hiebert has worked in the field of LED lighting for the past 10 years and has experience in both the manufacturing and end-user sides of the industry.