



Out of the Shadows, Light Becoming a Key Design Aspect

The integration of LEDs and electronics with materials offers endless opportunities for individualization and product differentiation

By Robert Grace

When one thinks of product design, factors such as shape, material choice, texture, and color leap to mind. Typically, the use of light and shadow would fall far down the list. But some companies want to change that mindset and turn the creative application of light into a primary design feature for certain types of products.

The growing use of integrated electronics, touchscreens, and various types of sensors—in vehicles as well as in other products such as appliances and wearables—is raising the profile of durable, transparent, transmissive, and heat-resistant resins as they find new applications.

Robert Miller, Detroit-based advanced new business development manager with Pacific Insight Electronics Corp., has spent the past 23 years working as an automotive lighting designer with major automakers and firms such as 3M Co.

In a phone interview, Miller said, “The most important thing that I see is material integration with LEDs (light-emitting diodes).” He says he spends 60 percent of his design time these days looking at unique materials, such as films that haven’t been done before, and exploring how to integrate things such as clear, optical silicone, to enable the manufacture of products not previously possible with traditional molding technologies.

“I’m working with holographic imaging, for instance,” he says, “where you take a hologram and then mold that in to materials to create a holographic cup holder.

“We’re taking these opportunities as a canvas and paint and combining them all together to create these really unique technologies... For example, we’ve created

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Imagination is more important than knowledge.



Veteran lighting specialist Robert Miller

an illuminated star roof by working with Covestro for polycarbonate and with PPG for glass, and we’ve successfully laminated clear circuits with LEDs and capacitive touch into glass and into polycarbonate. So, some roofs in the future can actually have some smarts to them, as well as touch capability.” You could have a

dome light inside the glass, or individual stars, Miller notes.

Lighting the 'Mobile Living Room'

"We've taken that technology to a whole new level, and done a matrix of LEDs and laminated into a front window on a 2019 [Chevrolet] Malibu—and we literally can scroll messages across that." The rising popularity of autonomous and ride-sharing vehicles is prompting this increased interest in finding ways to make vehicle interior spaces more like mobile living rooms.

You'll be able to communicate a message in the black line at the top of the windshield, Miller suggests, and you won't even know it's there until it goes on. This can go inside the glass, does not change the thickness of the glass, is incredibly robust, and it can run off an app on a phone.

Miller—who has a separate career as a book author and a photojournalist for *National Geographic*—joined Vancouver, B.C.-based Pacific Insight full time in May 2016. (A little more than a year later, in August 2017, Methode Electronics Inc. acquired Pacific Insight for C\$177 million.)

"I'm skilled in optics, electronics, design and materials," Miller says, "and my mantra is 'Imagination is more important than knowledge'." In his current role, he's letting his imagination run wild.

He also is developing very flexible "wave guides," which he describes as large-surface-area light guides. Such

features could measure, for example, 5 by 7 inches, or maybe 2 inches wide by 30 inches long. "We can illuminate that surface with LEDs very uniformly by edge lighting." You can edge-light a surface the size of a poster board and still have enough illumination for it to shine through fabric, for example.

He's worked on weaving optical fibers into cloth, yielding various patterns and designs. Miller says he always aims to make his innovations capable of being made feasibly in a production setting.

Materials Key to Visual Advances

Miller sees polycarbonate, as well as other materials such as polyurethanes, as being vital to executing his visions, and he plans to continue seeking non-traditional ways in which to apply them. He cites as examples the creative integration of LEDs or holographic images, or the use of edge or back lighting to produce visually striking new applications.

The efficiency of LEDs has increased substantially, making management of the heat they generate less of a challenge than before, Miller notes.

Covestro, the German advanced-materials supplier that is working closely with Miller, is developing some of its own lighting design features. It has produced an automotive B-pillar (the post between the front and back windows of a car) that has what the firm calls a "dead front," meaning it looks like a plain, dark-colored pillar, until the embedded LEDs behind the Makrolon polycarbonate exterior are activated.



Robert Miller says he designed this illuminated center console to showcase some of the leading design trends in automotive interiors. "Smooth, waterfall-like consoles are slowly becoming the norm, and it was our goal to make these surfaces interesting and interactive. We expect to see more of these design trends as autonomous and ride sharing vehicles emerge into the marketplace."

This design used integrated LEDs to simulate stars with capacitive touch and haptic feedback. The traces to the LEDs are nearly invisible and in the next generation, Miller says they will be totally invisible. "Working with Covestro, we were able to package clear film containing our LED circuit and laminate it into 3 mm-thick polycarbonate sheet to create the top part of the console," he says. The holographic patterns in the cup holders showcase light to create an entirely new look.

"Finally," he notes, "we also added a logo projection area—when occupants enter the vehicle they will see a full-color, animated logo displayed under the top glass where the stars are."



This display shows how Covestro's clear Makrolon polycarbonates enable designers to add many features to a part while using a single injection molding tool, in combination with inexpensive film inserts and electronics. In this case, Covestro uses a series of dead-front designs in a B-pillar as an example to escalate trim levels with additional features.

Far left is a simple black pillar for a base model, moving right an illuminated logo is added. Additional features are shown with pillars three and four, until the last pillar on the right demonstrates all features, including a stylized fuel gauge and camera. Cameras work well with clear PCs for everything from autonomous driving to facial recognition for vehicle access control. Photo by Robert Grace

This, notes Mark Torgerson, Covestro's technical marketing manager for mobility in North America, offers various potential benefits:

- » An OEM can achieve differentiation in a pillar made from a single set of molds;
- » Styling can be enhanced by integrating light, sensors, and more (e.g., displaying a logo);
- » The surfaces can be used to create matte or deep-gloss effects; and
- » Clear portals can allow for cameras or other sensors (e.g., for security or facial recognition).

Headlamps Turning a 'Smart Corner'

Some major automotive lighting suppliers, meanwhile, also have recently been displaying their latest innovations. At both January's CES consumer electronics show and Detroit auto show, for instance, Italy's Magneti Marelli unveiled the third generation of its Smart Corner platform.

A CES 2019 Innovation Awards Honoree in the Vehicle Intelligence & Self-Driving Technology



This Magneti Marelli display car at the NAIAS show in Detroit demonstrates both the use of the front panel of an electric vehicle as a sort of "billboard" or changeable information display, along with the firm's award-winning Smart Corner platform, which integrates autonomous sensors into headlamps and tail lamps. This serves to streamline design and aesthetic options while still providing excellent lighting performance. Photo by Robert Grace

category, Smart Corner integrates autonomous sensors into headlamps and tail lamps to provide automakers “with the required functionality for autonomous driving, while maintaining styling aesthetics and world-class lighting performance.”

It can accommodate any sensor an OEM may choose to deploy, including LiDAR, radar, cameras, or ultrasonics, as well as advanced, LED-based lighting features such as adaptive driving beam (ADB) and digital light processing (DLP). Smart Corner provides a 360-degree view around the vehicle with redundancy. Because the sensors are subtly integrated into existing headlamps and tail lamps, Magneti Marelli says an OEM benefits from “a fully calibrated, plug-and-play solution, resulting in a simplified manufacturing process that is lower cost and lighter weight than alternatives.”

Inspired by the modular approach of the Smart Corner, Magneti Marelli—which plans to invest \$12.6 million at its regional headquarters in Auburn Hills, Mich., north of Detroit—also showcased seamlessly integrated connectivity features in a test vehicle. Technology includes active matrix organic light-emitting diode (AMOLED) displays embedded in the front grille and rear applique to communicate intent, autonomous signaling, an interactive virtual assistant, audible alerts, and positional advertising using what the industry calls “vehicle-to-everything,” or V2X, connectivity.

The 100-year-old, Milan-based company, which had been part of Fiat Chrysler Automobiles, agreed last fall to be acquired by Japan’s Calsonic Kasei (itself backed by U.S. private equity firm KKR), for \$7.1 billion, producing the world’s seventh-largest independent automotive supplier. Magneti Marelli also claims to be the first to market with DLP, the world’s first 1.3 million-pixel production headlamp. It says that DLP creates ideal lighting conditions, and can project images onto the road to communicate with drivers and pedestrians.

Exploring the Promise of LEDs

Hella GmbH & Co. KGaA of Lippstadt, Germany, meanwhile, showcased a number of its developments both on the show floor and in a customer suite at January’s North American International Auto Show (NAIAS) in Detroit. In an interview, Steffen Pietzonka, Hella’s head of global marketing for lighting for OEMs, suggested that new LED technology has “opened a Pandora’s box” of opportunities when it comes to design and styling. LEDs—which can be used in a line, or on a curve, or many different ways—offer design options not possible with the Xenon lights that burst into prominence in automotive lighting about 20 years ago.

It took Xenon lights nearly two decades to achieve 11 percent market penetration in automotive headlights, he said. By contrast, LEDs, which were introduced in this application only about a dozen years ago, already command 15 to 16 percent of the global headlight market. And simple LED lights now can even be less expensive than their Xenon counterparts, he says.



Hella’s Pietzonka: LEDs offer a slew of lighting and design options. Photo by Robert Grace

With LEDs, the pixel count is rising exponentially. Lights that previously had 80 to 90 pixels each now can accommodate thousands of pixels—and each pixel can be controlled individually, Pietzonka notes.

Pietzonka posed a provocative question: When autonomous, self-driving vehicles become commonplace, will they even need headlamps? Or will the need for and purpose of lighting change dramatically?

With electric powertrains replacing the internal combustion engine, the distinctive front grilles on EVs no longer are required to provide a vital air-flow function. Instead, these front ends offer the opportunity to become digital bulletin boards or screens. The Mercedes star logo, for example, could be permanently illuminated in a smooth surface.

This, Pietzonka suggests, is akin “to doing heart surgery with the brand owners,” whose logos and design elements are vital to defining their brand language.

Autonomous vehicles also will be able to leverage their many integrated sensors and front-end “billboard real estate” to enhance safety by, for example, “seeing” a pedestrian crossing the street and flashing a warning or braking accordingly.

Hella and others are working on many innovations that involve advanced lighting. For example, the handle on a car door can include a “dead front” light strip that

Featured at ANTEC 2019!

Explore this topic more deeply in the ANTEC Insight session on Thursday morning, March 21, in Detroit, when the following panelists will discuss the use of light as a design feature: **Mark Torgerson** of Covestro; **Robert Miller** of Pacific Insight Electronics; and **John Simonetti** of GOT Interface. Officials from Ford Motor Co. and General Motors also are on the program, discussing the future of mobility.

See the full lineup at: http://bit.ly/ANTEC_Insight_Agenda.



is invisible to the naked eye when off, but which could light up as red to indicate the door is locked or green if unlocked, Pietzonka notes.

BMW, for one, is developing a micro-optical array of lenses—which they call a “light carpet”—that can welcome a driver who is approaching the car, or project light onto the ground near the vehicle to indicate, for instance, which way the vehicle intends to turn. “We can add colors, animations, etc.,” to all these options, says Pietzonka.

Hella Secures New Partners

In just the past few months, Hella has entered into strategic partnerships with both Faurecia and Plastic Omnium, a pair of leading French automotive suppliers.

In a Jan. 21 press release announcing the latter deal, Hella Chief Executive Officer Dr. Rolf Breidenbach, said: “Lighting is shaping the vehicle design more than ever. The demand for individualization and differentiation will continue to grow in the future. Additionally, lighting can also contribute to communication and safety in automated driving scenarios.”

And in a Nov. 21 release announcing the Faurecia collaboration, Breidenbach noted that Hella is “working intensively on concepts for vehicle interior lighting that enable a variety of new functionalities and can be adapted to the different needs of passengers and driving situations.”

Faurecia also is a partner with Nanjing, China-based electric vehicle startup Byton, which for the second straight year made a big splash at CES. At the 2018 show it introduced its all-electric M-Byte SUV Concept and one year later it’s readying the M-Byte SUV for production, scheduled for late 2019 (see separate CES recap story on Page XX).

Byton at CES 2019 unveiled its all-electric K-Byte sedan, which will cost more and is expected to reach the market in 2021, with a third model due in 2023. Both the K-Byte and the M-Byte models will

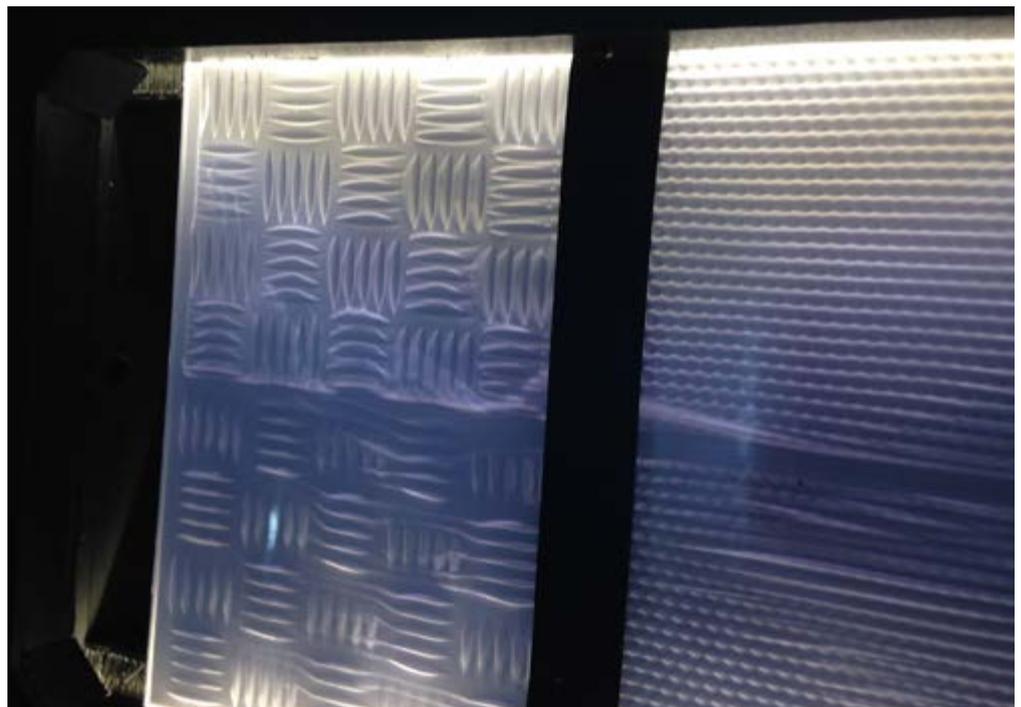
feature artificial intelligence and machine learning, and are being touted as “next-gen smart devices” by the company’s founders.

The M-Byte SUV’s 48 inch-wide, curved digital display in an otherwise spartan dashboard is the real attention grabber, and portends how materials and integrated electronics may help to redesign future vehicle interiors. (See a video interview at CES with Byton product manager Martin Schlierf: bit.ly/Byton_Core77).

Meanwhile, In a joint stand at NAIAS 2019 with HBPO GmbH (born from a 2004 joint venture between Hella-Behr Fahrzeugsysteme and Plastic Omnium Auto Exterior), Hella displayed organic light-emitting diodes (OLEDs) integrated into the combination rear light of the new Audi A8. The module uses a total of eight OLEDs—each of which is divided into four segments, and can be individually controlled to create different animations for Coming Home and Leaving Home scenarios.

‘Hidden Till Lit’ Edge Lighting Shines

At both NAIAS in Detroit and at the CES show the week prior in Las Vegas, Covestro featured a small light box on its stand, along with various seemingly plain plaques of smooth plastic. But initial appearances can be deceiving.



When edge lit, these smooth and plain-looking polycarbonate plaques leverage shadows and light to reveal patterns, geometric shapes, and textures. This “hidden till lit” effect has broad potential applications, well beyond automotive, says Covestro’s Torgerson. Photo by Robert Grace

Slip a plaque into the light box and turn on the edge lighting, and the plain slab visually springs to life, revealing dazzling patterns, geometric shapes, and textures, to even mimic the grain of leather.

Torgerson explains how it's done: "First, a texture is created on the tool surface, which is imparted onto the opaque part via injection molding. A second, clear or translucent shot is then molded over the opaque texture, creating a smooth, easily cleanable top surface."

An alternative approach involves molding the texture onto the back side of a transparent PC part, and then painting the part. "A lighter-color paint or opaque plastic will give a higher contrast effect with the shadows," Torgerson noted, "while a darker, opaque material will yield a subtler effect, similar to the effect of shadows on white versus on a navy blue carpet."

This so-called "hidden till lit" application, he notes, highlights a couple key attributes of polycarbonate-based materials—excellent transparency and surface replication.

Such technology clearly could find application well beyond automotive, with potential uses in everything from appliances and medical devices to consumer electronics, wearables, and even simple decorative panels.

It's clear—from the fervent imagination of designers such as Robert Miller, the electronics expertise of firms like Hella and Magneti Marelli, and the materials know-how of suppliers such as Covestro and PPG—that light is becoming a major element of product design. Light began as functional necessity. Now, combined with the skillful manipulation of color and shadows, light will enable makers of vehicles and other products to endlessly reconfigure and personalize their goods to suit the whims and preferences of their users.

ABOUT THE AUTHOR

Robert Grace is a writer, editor and marketing communications professional who has been active in B2B journalism since 1980. He was founding editor of and worked for 25 years at *Plastics News*, serving as editorial director, associate publisher and conference director. He was managing editor of *Plastics Engineering* from July 2016 through October 2017, and is now btoh editor of SPE's *Journal of Blow Molding* and directing content strategy for SPE. He runs his own firm, RC Grace LLC, in Daytona Beach, FL., and can be contacted at bob@rcgrace.com.



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