

# Transparent displays may create more intuitive infotainment

OLED technology could take screens to the windscreen and rear-view mirror. By Elle Farrell-Kingsley

**T**alk of transparent infotainment displays has been in the mix over the last decade. Bosch showcased a transparent LCD panel in 2020, while Volvo has backed optical and imaging technology start-up Spectralics, which has developed a multi-layer thin combiner (MLTC)—a film that can be applied to transparent surfaces like windshields. This could produce a more immersive version of the augmented-reality head-up displays already seen in the 2021 Mercedes-Benz S-Class.

The concept of a smart windshield acting as an infotainment system for the driver is in development. However, this requires specific materials. OTI Lumionics is in the business of organic light-emitting diode (OLED) materials, specifically cathode patterning materials (CPM), bringing transparent infotainment systems in cars one step closer to realisation.

OLEDs create thin, efficient, and flexible displays and lighting panels. They are used in many applications, such as TVs, smartphones, laptops, automotive displays and lighting solutions.

OTI's unique materials help make OLED displays more transparent for automotive applications. "When you make an area more transparent, you can put a camera sensor or

potentially an infrared sensor or receiver behind that screen, thus allowing many functions," says Jacky Qiu, Co-founder and Vice President of Strategic Operations at OTI.

## Design process

However, making transparent screens isn't straightforward. "All modern material companies use an artificial intelligence (AI) machine learning set-up that allows a material discovery platform to identify potential molecules," he explains. "One of our specialities is internal pilot production testing of these panels in a mass production environment." The company's 100m long production lines are vacuum conditioned to one billionth of an atmosphere, and the display panels take ten days to create.

These processes help the materials become fully transparent, but one major challenge lies ahead: "In terms of the front windshield, making it very transparent is doable, but the issue has always been that the automotive lifespan must match automotive grade durability under a diversity of extreme conditions." To last for the full lifecycle of a vehicle, it "must be able to drive from the scorching heat in Arizona up to the far north of



Transparent screens are created with OTI's powder

the North Pole within five days and come back without developing a fault in any way.”

## Changes to screens as we know them

Compared to regular LED screens, OLEDs deliver sharper images, text and touch interface. OLEDs also have the distinction of being able to produce both light and colour from a single diode. Because of this, they don't require a separate backlight. Each OLED pixel is a self-contained source of colour and light as opposed to LEDs, which have persistent pixels that require an external source of light to be seen.

Sharper images will be important if the size is to increase. “In the infotainment space, you have bigger screens inside the centre console. Tesla inspired much of this narrative with its 17-inch screen,” he says. “Screens are just getting

bigger and bigger.” Providing sharper, clearer images, will allow display panels to provide a hyper-realistic view of what's going on outside of the vehicle.

In addition to making screens larger and more transparent, Qiu also believes the number of car screens will increase as infotainment is displayed in places where it was previously absent, such as the car windshield or side window. “The ability to display information and maintain reasonably good transparency will be significant as we move into a future characterised by autonomous driving because the driver's attention can be redirected elsewhere other than on the road.”

## Regulations

Research from the US Department of Transportation and Industry has been examining display technologies to help develop an information backbone that will support

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applications to enhance safety and mobility. As such, a unique set of challenges is presented for designers of driver-vehicle interfaces (DVIs).

These advanced technologies produce a large amount of information. Sometimes, the information may be complex, such as warning a driver of a blind spot before a lane change or providing notification of an upcoming hazard. In some cases, this complex information may need to be provided, comprehended, and rapidly acted upon by the driver to avoid a collision. Thus, ensuring that the DVI enables drivers to access needed information quickly and efficiently is of great importance to overall performance.

Qui expands upon the US National Highway Safety Transportation Board's (NHSTA's) requirements for transparency: "NHSTA wouldn't allow a car windshield that's less than 75% transparent to be in front of you because it might endanger your field of view," he says. "That could be challenging for any active display technology."

In terms of design, the DVI Design Guidance published by the NHSTA states, "Distraction can occur due to drivers taking their eyes off the forward roadway to perform an in-vehicle task and when drivers return their eyes to the

forward roadway while still performing the in-vehicle task."

Qui explains that an alternative could be a heads-up display using projector-based technology: "It will be less of a challenge to use because it's bouncing the light off a projector into your eyes." Furthermore, he states that adding infotainment systems and screens to a side window, which has fewer regulations because it's not in front of the driver, could be an "area of interest."

## Letting the car know what you want

After the materials are transparent enough to pass regulation, other innovations can be developed and added to the car, such as the capacity to integrate a camera, eye tracking, time-of-flight, and a biometric face identification sensor. The benefits of adding an eye tracking system are something many automakers are working on to help improve driver safety and develop the next step of assisted driving.

"By placing a sensor behind a transparent display, either an eye-tracking sensor or camera sensor, the car will be much more responsive to the user in terms of their needs," says Qui. He points out that, currently, cars don't know what drivers want. "If the car can determine what the driver needs by tracking where they are focusing, it can customise and display the relevant information suitable to their needs."

Transforming the windshield into a large screen, combined with eye-tracking, could enable users to intuitively access services and information without taking their eyes off the road. Using transparent materials to create next-gen infotainment systems opens many doors towards smarter and safer vehicles.

# Next-gen cars will create new forms of entertainment

The in-vehicle experience is set to change as cars turn autonomous and electric. By Elle Farrell-Kingsley

According to MarketsandMarkets, the in-vehicle infotainment (IVI) market is projected to grow from US\$20.8bn in 2021 to US\$28.4bn by 2027, at a CAGR of 10.8%. Research suggests that the IVI market is driven by the increase in vehicle production, technological advancements, telematics regulations, and increasing demand for luxury vehicles.

In the wake of these trends, the entertainment offering is constantly evolving. “Infotainment in cars is approaching a critical inflexion point where many of the traditional forms of in-car entertainment are on the precipice of becoming extinct,” says Iliya Rybchin, Partner at Elixirr, a consulting firm which has advised automotive and entertainment companies. Rybchin specialises in customer experiences, particularly how changing consumer expectations and business model disruption impact various industries.

“If you consider the history of in-car entertainment, it began with the AM radio, moved to FM, then 8-track, tapes, CDs, MP3, and more recently satellite and internet services such as Spotify, Pandora and YouTube,” he says. Although the underlying technologies have changed, the core product was typically the same—audio content, including music, talk, news and podcasts. He believes that while some audio content will continue, two major innovations are creating fundamentally new entertainment needs: driverless cars and electric vehicles (EVs) requiring lengthy charging.

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## Driverless cars

In the case of driverless cars, he refers to how drivers must pay attention while driving, and as such, entertainment had to optimise for formats that would not distract the driver. “While rear-seat passengers have been able to enjoy video content and games in recent years, the driver has been restricted to audio content.” Autonomous vehicles are set to completely change the in-vehicle experience.

As cars become more autonomous, Rybchin points to considerations from automakers: Will drivers need to maintain 100% focus on driving? Will it ever get to 0% focus, or will there need to be some middle ground? Will video entertainment become feasible? Can the windshield and windows become displays for movies, news, and TV shows?

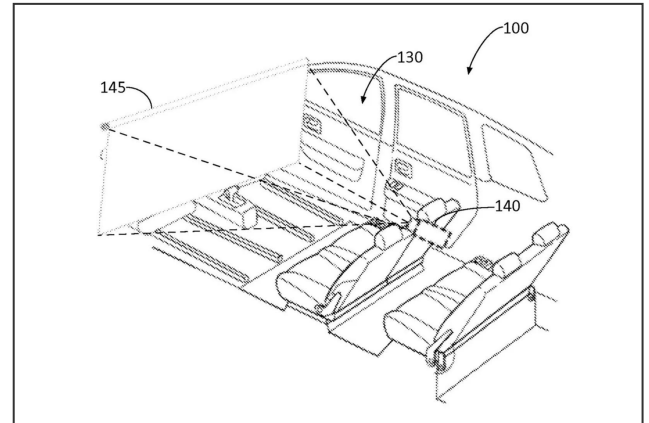
One of his suggestions is to include short-burst news alerts that appear in the heads-up display (HUD). A secondary step could be books broken into two- to three-sentence bursts with a two- to three-second pause that allows a driver to read as they maintain partial focus. When consumers and government regulators become comfortable with fully autonomous cars, the end state might be a theatre-like experience where the windows and windshield dim and an immersive, two-hour movie is shown to the passengers on longer journeys. Ford submitted a [patent](#) to turn the driverless car into a mobile movie theatre, while BMW has showcased previews of a ‘Theatre Screen’.

There may also be contextual infotainment ahead. Rybchin points to machine learning algorithms capable of learning the passengers’ tastes: “Our cars know a lot about our driving patterns and intent,” he tells *Automotive World*. Could a video tutorial on how to make a favourite recipe on the way to the grocery store be the future of IVI? Will sports highlights be the best content to show as passengers make their way to the stadium for a Sunday football game? The logical next step for in-vehicle entertainment may be for the car to recommend content based on destination or goals rather than the user selecting content from the display.

## Making charging entertaining

As EVs grow in popularity, the automotive industry also needs to account for what car owners will do while recharging. “An internal combustion engine (ICE) car can fill up at a gas station in ten minutes, but, even with a supercharger, an EV can take 30 minutes or longer to charge fully.” Is sitting in the car listening to a podcast “enough entertainment”?

He believes automakers should follow Tesla, which has led the market in this space by including Netflix, Hulu, YouTube, and a wide assortment of video games in its entertainment



Ford’s patent presented the idea of a projector, but as technology progresses, this content could potentially be projected onto the HUD

system. However, this could be just the tip of the iceberg. “This is an issue for younger passengers. Sitting in their cars and scrolling through TikTok or other social media apps on their phones may not be enough. Most modern cars now have large display screens—luxury brands are leading the market by installing massive screens. Tesla will not be the only OEM to offer video or gaming entertainment.” Toyota currently has a computer game system for its Auris, while [Volvo has recently partnered up with Epic Games](#).

Irrespective of which of the above trends come to fruition first or which experiences consumers will expect, Rybchin considers the fundamental issue to be content creation. However, car manufacturers can only supply the platform for which the content can be consumed. They do not create the content. “For this to work, media companies must create specialised content for the auto-user experience,” he says. This will also mean that OEMs will need to partner with media companies too, similar to many of the recent technology and automaker collaborations.

Subsequently, “The car will create new forms of content not yet imagined,” concludes Rybchin. “Meanwhile, the media industry will look to cars as a way to unlock new business models and new revenue streams for their content.”