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"The key to new scrap markets in automotive is through end of life. The entire industry must work collaboratively together to determine how to gain access to these markets, avoid down grading of materials for recycling purposes and start considering design for sustainability practices."

– Jamie Zinser, Novelis VP Global Automotive. Page 24



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The drive for sustainability

A common theme in this edition is sustainability. Automotive manufacturers and their suppliers are reviewing the materials used in the manufacture and assembly of vehicles, as well as the way they are designed and put together.

The phrase 'circular economy' has become as much a part of the automotive industry lexicon as 'horsepower' – and it is used more often, along with 'end-of-life.' Recovery or the 'mining' of the metals, plastics and minerals in automotive components has become a science and industry on its own.

As has near-shoring. The US Senate has approved the subsidization of the domestic semiconductor industry in order to alleviate future shortages and dependence on a single source.

Low-cost chips will be a game-changer for recycling. One can only 'mine' if the materials are available in sufficient quantity and suitable quality to reach economies of scale. There should be more value locked into a used car than the revenue from selling it or its parts in second-hand markets, such as Africa.

Editor, Ed Richardson



For this, manufacturers need to track individual components and body parts throughout their life-cycle – embedded chips will make this possible.

OEMs and Tiers will soon have no option. Regulators are in the process of putting the onus on the producer of the product to recover and process it at the end-of-life.

This is where design plays a part – it must be as cost-effective to disassemble a vehicle and its components as it is to put them together in the first place. Track and trace has to be able to follow the vehicle and its components from production line to junkyard. Reverse logistics specialists will need to be added to the organogram.

A recent study by the Capgemini Research Institute found that suppliers in general are more aware of the need to build in sustainability than OEMs. Suppliers interviewed by Capgemini researchers are investing a greater share of revenue (0.93%)

towards sustainability per year than their original equipment manufacturer counterparts (0.79%).

Overall, the implementation levels of sustainability initiatives have improved only marginally, or even reduced in some areas since 2019, according to the "Sustainability in Automotive: From Ambition to Action" report. The authors say automotive organizations have responded to challenges such as ongoing chip shortages and supply chain issues by refocusing their priorities.

As a result, since 2018, the automotive industry has reduced overall greenhouse gas emissions by only 5%, with a further 19% reduction expected to be realized by 2030. At current rates, automotive organizations will not meet the goal of net zero emissions by 2050 under the Paris Agreement, the report warns. This means that the European Green Deal target of a climate neutral Europe by 2050 will also not be met.

On the positive side, some 70% of automotive industry respondents claimed to be focusing on overall emissions reduction across the value chain, including scope 1, 2, and 3 emissions, from sourcing to end-of-life processes. Two-thirds (64%) expect to achieve a reduction in carbon emissions by 2040, and 57% are going beyond ESG compliance to make sustainability a key business driver.

The effects will be felt on the bottom line as well as the environment. Operational efficiency is expected to improve by 22% through 2026 as a direct result of sustainability initiatives that enhance transparency across the value chain. Companies also become more attractive to talent owing to their sustainability initiatives (18% versus 10% for the rest).

"The automotive industry is entering a crucial decade largely defined by its ability to go all-electric. But while sustainability is credited as a top priority, the industry as a whole is falling behind. Automotive organizations must think practically about their sustainability approach if they are to reach the targets set out in the 2050 Paris Agreement. This includes a significant and renewed commitment to the circular economy that focuses on the full lifecycle of the vehicle as well as the inclusion of Scope 3 emissions," said Alexandre Audoin, Global Head of Automotive Industry at Capgemini. "Accountability is imperative for defining goals and KPIs across the entire organization and progressing against these targets." **AI**

AUTOMOTIVE INDUSTRIES and Rutgers, the State University of New Jersey, have put together a digital library of back issues of AI from the early 1900's (high res and low res) of approximately 230,000 images of the print publication. This archive, which documents the birth of the auto industry to the present, is available to AI subscribers. Go to AI's homepage www.ai.com and click on the "AI Library" link or visit www.ai-online.com/100YearLibrary

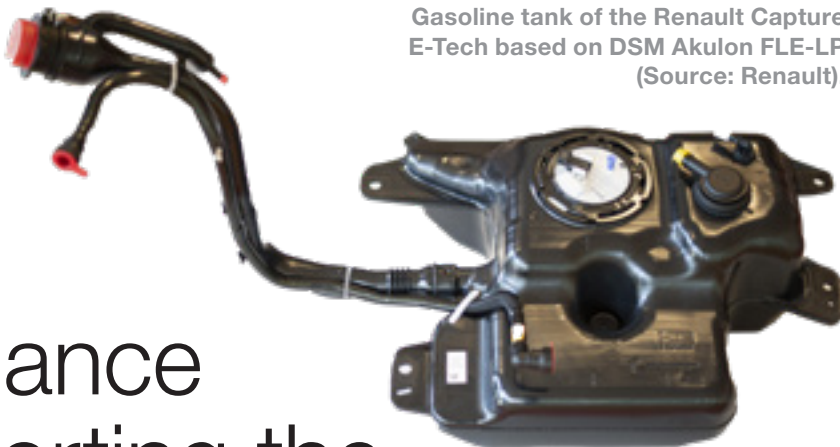


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High-performance plastics supporting the shift to alternate power trains

By: Nick Palmen

Breakthroughs in the formulation of high-performance and sustainable thermoplastics are supporting the move towards a new generation of electric, hybrid and fuel cell power trains. Specialist companies are investing heavily in the development of new formulations of polyamides, high temperature PAs and elastomers in order to help automotive companies meet emission and sustainability regulations and targets.

Automotive Industries (AI) asked **Dr Tamim Sidiki**, **Global Marketing Director Mobility at DSM Engineering Materials**, for his thoughts on prospects for the motor industry.

Sidiki: In the short term the industry is impacted now by all the geopolitical issues around the world. But, the geopolitical impact is just a temporary thing. Whether it takes one or two years, it will definitely disappear. Industry experts see unit sales recovering to the former pre-Covid status by the 2024 / 25 timeframe.

Dr Tamim Sidiki, Global Marketing Director Mobility at DSM Engineering Materials.



Technologically, the move towards connectivity and electrification is further speeding up. After initial feasibility proof in Phase I and the launch of a few high-end expensive cars in Phase II, electric cars are now moving to phase III where the focus will be on driving down costs of the new platforms to enable mass volume manufacturing for the broader population. This is vital as the prices of electric vehicles has risen over the past few quarters to the point where there maybe be some consumer resistance to purchase.

AI: What about hybrids?

Sidiki: Hybrid cars are an important intermediate step towards full electrical cars and are very popular with consumers. DSM has partnered amongst others with Renault to develop the world's lightest and most complex gasoline tank for hybrid cars. Using Akulon® Fuel Lock, DSM's high-performance ultra-low

permeation and low-carbon-footprint PA6 material, the fuel tanks can be produced with a blow molding monolayer construction that significantly reduces weight versus any alternative metal tank and cost versus competing HDPE alternatives without compromising safety or risking additional emissions.

And the beauty is that it is a drop-in solution which provides a second life to the monolayer blow molding machines used for the manufacture of diesel fuel tanks. In most cases, the cost of these machines has already been amortized and rather than staying idle with the drop in Diesel demand, molders can re-use them to produce advanced gasoline tanks for latest generation hybrid cars.

AI: What about sustainability?

Sidiki: Sustainability used to be a nice differentiator companies could use as a marketing tool to boost their image while doing something good for the environment. But now it increasingly becomes a true qualifier. If you do not score high on sustainability, OEMs and also consumers will not select your solution.

Globally, Europe is currently setting the pace. It has overtaken even California in the US with the European Green Deal, as well as the strict regulations which are forcing the industry to move to electric power trains and to adopt more sustainable manufacturing practices. The Green Deal and the upcoming revision of the end-of-life directive are two key drivers.

As DSM we focus on sustainability via multiple levers, from biobased and biomass balanced materials to fully recycled materials. EcoPaXX for instance is a high-performance aliphatic, biobased polyamide that uniquely balances the benefits of typical short and long chain polyamides, such as low moisture uptake and high mechanical performance. EcoPaXX, which has been in the market for more than 30 years, has wide applicability and is especially popular as a PA66 performance booster since it can be processed in the same tools.

Recently we also launched a 100% bio-based PA46, the first high-temperature polyamide in the world. PA46 Stanyl® B-MB is a fully ISCC+-certified mass-balancing solution, and delivers exactly the same characteristics, performance, and quality as conventional Stanyl®. This is a full drop-in solution as no tooling or design changes are required and customers can immediately switch even existing applications with existing molds.

So, companies can switch and score on sustainability without having to requalify the materials or applications.

AI: What about the bus and truck sector?

Sidiki: Looking in into the transport industry as a whole, something like 25% of all emissions are produced by the transport industry. Within the transport sector, about 40% comes from buses and trucks. And it is easier to deliver on sustainability targets for trucks rather than passenger vehicles because volumes are lower, there are fewer players and the additional cost is less of a factor.

The transport industry is taking a multifold approach to sustainability. First, the powertrain is being electrified. This is where fuel cell technology is seen as a very, very strong value driver. I think the market is at this moment roughly about 50/50 in terms of fuel cell technology versus pure battery electric drives.

For fuel cells the choice of right materials is vital. Fuel cell systems need to use materials that are very pure and no hydrolytic or heat aging should occur. A fuel cell is nothing more than two cathodes with an electrolyte in between. If materials in contact with the media leach out ions, it leads to an efficiency drop and the membrane in-between can get clogged leading to a significant fuel cell performance reduction over time.

So, it is super important to use materials with very low ionic leaching. DSM's tailor-made 4080HRE Xytron PPS is the purest material solution on the market today and has the lowest leaching of all the materials that customers have tested within the PPS world, but also in comparison to other suitable polymers.

Our low ion leaching PPS compounds support the entire fuel cell system, whether it is the manifolds, end and side plates or auxiliary components like humidifiers, dehumidifiers, or ion filters. The current transition to EVs is characterized by three phases.

In Phase I EVs were proven as a very feasible technical solution. Phase II saw the launch of various high end and very expensive models. With the recent steep raise in material cost, EVs are however not yet affordable for the broader population.

Phase III with the required transition to mass volume production will therefore require significant effort to reduce the cost of EVs and make them really affordable. One way to reduce the cost is to reduce the volumetric size of the e-axle.

By reducing the size of the e-motors while keeping its power the same, you save on space, weight and cost by taken out expensive metals and magnets. Such a downsizing will reduce the torque but increases the rotation speed of the motor.

To achieve the same power levels, you need to increase the rotation speed of the of the motor. So, the next generation of EVs will have smaller e-motors running at much higher rotation speeds. From the present approx. 10,000 RPM, it goes to 20,000 RPM and above. This impacts on the bearing cages as the higher motor speed generates a lot of heat which can deform the bearing cage. Also, the bearing lubrication needs to be suitable for such high speeds.

So, you need to have materials which have a very high stiffness over temperature. Our customers have tested various high

performing materials and Stanyl PA46 has shown extraordinarily good performance. Its superior stiffness over density at high temperatures allows increase of rotation speeds up to 20.000 rpm without bearing deformations. Stanyl PA46 also delivers high ductility, excellent chemical and temperature resistance for the dedicated high-performance greases used with continuous use temperatures up to 180°C.

AI: Tell us about your Material Advisor that was recently launched.

Sidiki: The Material Advisor is an interface between our customers and us. It provides fast-track material advice in five minutes by asking eight questions.

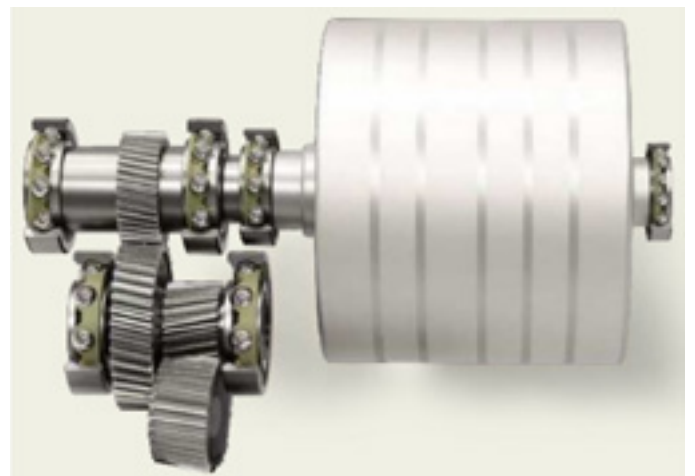
Our objective is to allow our customers to reduce costs and shorten time to market by cutting down development times and avoiding multiple design iterations by getting the material right first time. The material advisor was developed after our research found that about 70% of engineers prefer a self-service option to face-to-face interactions.

Engineers may find inspiration in a lab over the weekend or late in the evening. Our material advisor is available 24/7 and 365 days a year to provide support ranging from a simple material catalogue to accessing dedicated material data like strain-stress curved or carrying out various simulations. This data will give the engineer a feeling of how the material will perform under their application requirements.

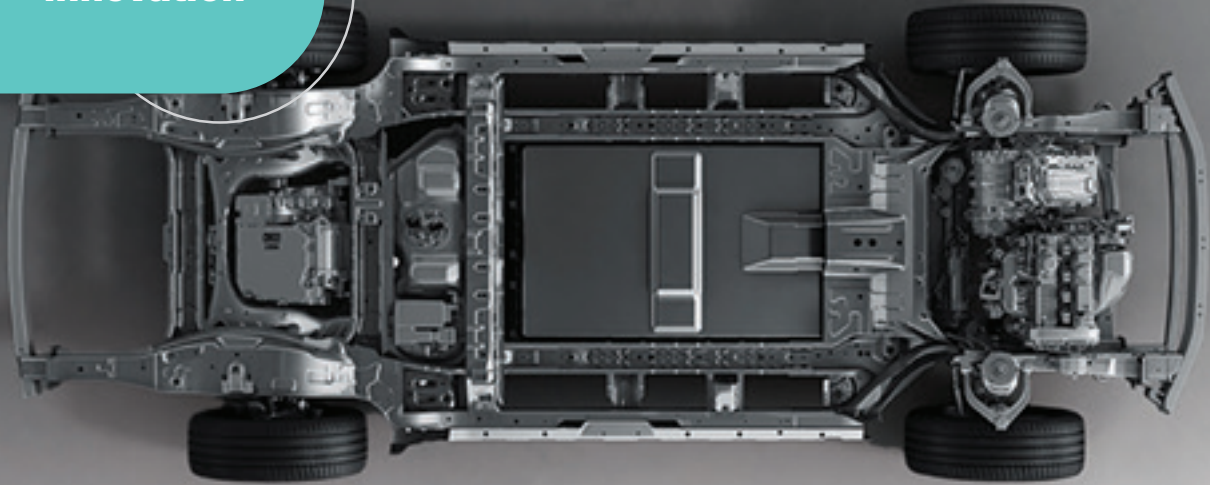
It is an intuitive, easy-to-use tool, which provides engineers with reliable recommendations to guide them to selecting the best materials solution for the application they are designing. We start with a checklist based on the set of questions that the customer needs to answer for the application. This tool recommends the material and the compound that the engineer can start working with and testing.

AI: What next for DSM?

Sidiki: We will continue with the inspiring innovation and strong application focus path that we are on, and I think we will become even more inspiring in the future by increasing our digital service even more. We will have many more new technologies and applications to offer. There is a strong focus on the mobility segment, which is seeing it's fastest changes over the last 100 years. It is an industry which is never boring. **AI**



E-axle with high-speed bearings based on DSM Stanyl TW200F6 (Source: SKF).



Tenneco smoothing the ride of luxury Chinese electric vehicles

By: Nick Palmen

Electric vehicle manufacturers in China are focusing on the quality of the ride for their luxury vehicles.

It was announced in November 2022 that a third Chinese luxury electric vehicle will feature Tenneco's Advanced Suspension Technologies (AST) Monroe® Intelligent Suspension CVSAe™ electronic dampers.

The Li Auto L9 luxury SUV is the second series model from the Beijing, China-based manufacturer of smart electric vehicles and the third model from a Chinese OEM to feature CVSAe technology.

"Automakers in virtually every region around the world have recognized the significant advantages of CVSAe technology," said Henrik Johansson, vice president and general manager, AST, Tenneco.

"This solution provides an uncommonly broad tuning range that enables OEMs to dial-in a precise ride and handling profile for virtually any size or type of passenger vehicle.

"This is particularly important for electric vehicles, which place unique demands on suspension components due to the weight and positioning of their battery packs."

Continuously Variable Semi-Active Suspension (CVSA) with external valve technology senses the road and driving conditions to independently adjust four dampers in real time for a more comfortable and controlled ride.

An externally mounted electronic valve is linked to the vehicle's driving mode control, so the system can perfectly match the driver's needs.

An electronic control unit (ECU) processes sensor inputs and independently adjusts the electronic valve within each of the system's four dampers, resulting in optimal handling and comfort characteristics.

Drivers can choose their preferred driving mode, ranging from comfort-intensive to sporty.

Already selected by leading global automakers for more than 75 vehicle models, the technology requires minimal electrical power, making it ideal for battery-electric and hybrid models.

CVSAe technology is compatible with coil spring- and air suspension-equipped vehicles and can be deployed with shock absorbers and/or MacPherson struts.

CVSAe damper modules for the L9 will be manufactured in Tenneco's plant in Changzhou, China.

This new facility began production in 2021 and features the latest development, manufacturing and testing capabilities for advanced suspension systems for both traditional powertrain as well as BEV applications. **AI**

For more information visit:

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Meeting the need for **sustainable** high-performance **polyamide** solutions

By: Nick Palmen

Recent developments in lightweighting, metal replacement, thermal management and e-mobility have reinforced the global need for sustainable and high-performance polyamide-based solutions.

One of the leaders in polyamide-based engineered materials solutions and services the automotive market, among others, is Belgium-based DOMO Chemicals. Automotive Industries (AI) spoke to Louise-Anne Fillot, Product and

AI: How do you leverage your portfolio of products?

Fillot: Customers can benefit from a complete portfolio for cooling applications, starting with our well-established PA66-based solutions with improved coolant resistance TECHNYL® A 218 V30 34NG. We have a new, sustainable variant produced with recycled polymer: TECHNYL® 4EARTH® A1E 218 V30 BK 34NG LP.

It exhibits coolant resistance at a level similar to our virgin-based reference TECHNYL® A 218 V30 34NG product, and meets all standard requirements for e-vehicle cooling applications, as well as combustion engines with cooling temperature requirements up to 135°C.

We also have PA6.10 or PA66/6.10-based solutions for outstanding performance, plus a new PA6 solution developed specifically for e-vehicles that has been successfully tested after coolant ageing for 12 000h at 80°C.

DOMO is able to perform predictive simulations with high accuracy based on in-house developed high quality material data cards, both for our TECHNYL® products, and our sustainable TECHNYL® 4EARTH® product range. This is unique in today's market.

In addition to our simulation capabilities, the DOMO APT laboratory allows customers to evaluate the performance of parts under real-life conditions including fluid or hot air circulation under controlled temperature and pressure, vibrations or specific loading conditions. We can also develop molded demonstrators or produce prototypes with 3D printing. ▶

Maarten Veevaete, Director
Application Center at
DOMO Chemicals.



Application Development Manager for Automotive Market at DOMO, and Maarten Veevaete, Director Application Center at DOMO Chemicals.

AI: How is DOMO supporting the shift to a low-carbon automotive manufacturing economy?

Fillot: We start by ensuring we have a complete understanding of the new applications. We develop tests for samples or parts and can perform advanced simulations. This expertise, associated with our formulation expertise, is a key contribution we bring to our customers.

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So, we really complete the loop from product formulation to the final application.

AI: How sustainable is the new product?

Veevaete: As all other TECHNYL® 4EARTH® branded solutions, it has a lower CO₂ footprint because it is based on recycled material. DOMO has a technological leadership in transforming post-industrial technical textiles from the production of automotive airbags, carpets, clothing and film for the packaging industry into premium-quality engineering plastics.

Different recycling technologies are used depending on the feedstock, offering environmental benefits while still providing top-quality products and solutions with technical performance comparable to traditional TECHNYL® Engineered Materials grades. The recycled feedstock, the selected processing technology or the energy mix at the production facility all influence the final CO₂ footprint.

TECHNYL® 4EARTH® reduces the environmental impact of polyamide parts to levels never before achieved. We provide specific life cycle assessment (LCA) for all our materials, which helps our customers to select the most suitable sustainable solutions for their applications.

AI: What are the new extrusion solutions for EV cooling and air conditioners?

Fillot: TECHNYL® SHAPE is specifically designed for extrusion solutions for air conditioning and electric vehicle (EVs/HEVs) cooling circuit lines. Depending on the burst strength requirement of your application,

Louise Anne Fillot –
Product Development Manager
Automotive Market



DOMO experts will suggest the most suitable solutions within the TECHNYL® SHAPE product family, selecting among PA6, PA6.10/PA66 and PA6.10-based solutions, all with high barrier properties to refrigerants. What is important is to have a full picture of how the system behaves and that's why we pay so much attention to the testing and the validation of the whole system, and not only measuring properties on ISO specimens.

AI: What about lightweighting?

Veevaete: Chassis and body structure lightweighting solutions offered by TECHNYL® can replace metal components. TECHNYL STAR® is a high strength, high flow polyamide, while TECHNYL® MAX is a robust, glass fiber reinforced polyamide. These formulations are well-suited for structural components such as transmission and motor mount cross beams, battery system mounts, air shutter grills and seat structures, as well as alternator and stator parts, and battery casings.

We are also working at fuel cell technology applications such as high-pressure hydrogen tanks. Based on a patented PA6 technology with excellent melt stiffness for blow molding and extrusion applications, DOMO is able to provide compounds with optimal processing properties, superior hydrogen barrier properties as well as excellent low temperature impact behavior.

The newly launched TECHNYL® LITE offers solutions for

the outer protecting layers of those high-pressure tanks. To produce TECHNYL® LITE, DOMO is using another patented PA6 technology to impregnate endless glass or carbon fibers. The unidirectional tapes show outstanding mechanical properties which make them extremely suitable for the outer protective layer of high-pressure hydrogen tanks. In this way the complete high-pressure tank are made out of PA6, combining lightweighting aspects with increased recyclability.

TECHNYL® LITE is also suitable for other new mobility applications or sports and leisure applications. Due to its outstanding mechanical performance, its higher temperature resistance and improved bonding characteristics, TECHNYL® LITE is the material of choice for all kind of sustainable metal replacement and lightweight applications.

AI: What about the circular economy?

Veevaete: Most of the established large volume recycling grades available on the market are based on post-industrial feedstock. The ultimate goal of circular economy is to have automotive components being recycled for use in automotive applications at the end of life. For this, you need to have the right supply chain in place to ensure that you can track the materials throughout their life.

We are working with OEMs, brand owners and the Dutch startup Circularise, on establishing the systems needed. The goal is to allow a fully transparent supply chain through blockchain technology, allowing for a much easier collection system at the end of life of final parts.

The idea is to develop a digital twin of every batch that we produce. This is captured in the Circularise app, which shows the information needed by the consumer and the OEM, without disclosing sensitive information. The identifier for each batch will show the producer, the content, origin of the material, its environmental footprint and certifications.

For DOMO, this means we can supply our customers with all the information needed to back their sustainability claims. Meanwhile, another goal has also emerged: to be able to track the parts molded with DOMO materials and to recover them for reuse. We strongly believe that such a system could make the difference, but we are also well aware that a common effort within the whole industry is needed.

DOMO's track record and market leadership in recycled polyamide compounds will help accelerate those developments. We are working on pilot studies to establish the feasibility of new mechanical and chemical recycling technologies for end-of-life parts, and using the recycled polymer and fillers for automotive applications.

AI: What is next?

Veevaete: Domo will continue working with our customers to develop materials for new mobility requirements. The automotive world is busy transitioning from internal combustion to battery or hydrogen-powered vehicles. Whichever technology is selected, polyamides will keep playing a key role because of their properties. The technology transition is facing many challenges such as lightweighting or new cooling requirements – for which DOMO has an extended TECHNYL® product range available. We will continue extending our sustainable TECHNYL® 4EARTH® product range to provide sustainable alternatives for internal combustion engine and e-mobility applications. **AI**

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innovation

New **HARMAN** products enhance safety, wellbeing and in-cabin entertainment experiences over the life of the vehicle

By: Nick Palmen

A new range of safety, comfort and experience-enhancing products were unveiled at the 2023 HARMAN EXPLORE event, which runs annually alongside CES in Las Vegas.

The automotive technology company, a subsidiary of Samsung Electronics, has undergone a major transformation in the past 18 months with the intention to be the leading automotive electronics supplier for the in-cabin user experience by 2030.

To meet this goal, HARMAN has evolved its business model, introducing a new strategy to create road-

of our digital lives and deliver the same connected experiences we enjoy at home, at work, and everywhere in between.

"At HARMAN EXPLORE during CES 2023 we showcased our latest products that are created with consumer experiences in mind and built to withstand the rigor of automotive operation. From leveraging real-time data to improve safety, to infusing consumer electronics into the cabin, we demonstrated how thoughtfully applied technology can transform simple transportation into vehicles that connect our digital and physical lives — today as opposed to years from now."

HARMAN's line-up of new products introduced during HARMAN EXPLORE are road-ready and have demonstrated they deliver compelling in-cabin experiences.

New life-saving features to enhance safety and wellbeing on the road

READY CARE is the industry's first closed-loop interior sensing and tailored intervention product that measures a driver's eye activity, cognitive load and vital signs to determine the level of focus and attention on the road ahead.

Using neuroscience, artificial intelligence and machine learning, Ready Care classifies a driver's behavior into a focused versus distracted state and initiates a personalized in-cabin response to help mitigate dangerous driving situations, such as stress, anxiety, distraction and drowsiness.

Through the September 2022 HARMAN acquisition of CAARESYS, Ready Care now incorporates in-cabin sensors ▶

**Christian Sobottka, President,
Automotive at HARMAN International**



ready automotive products that can be deployed and make a meaningful impact on today's consumers. Its aim is to deliver products and maintain a pace of innovation in the cadence of the consumer electronics sector rather than that traditionally seen in the automotive industry.

"The consumerization of automotive has rapidly and drastically changed expectations for what vehicles need to deliver," says Christian Sobottka, President, Automotive at HARMAN International. "We all expect our vehicles to become an extension

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and Telematics

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Assistance Systems

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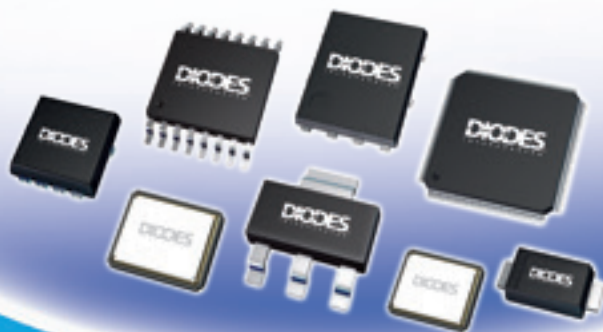
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Interior and
Exterior Lighting

Diodes Incorporated's range of automotive-compliant products includes:

- Precision timing, serial connectivity solutions for infotainment, telematics and Advanced Driver-Assistance Systems (ADAS)
- Efficient power management solutions
- Simple, efficient LED driving solutions
- High-power-density motor control solutions

Automotive compliant- AEC-Qualified, in IATF 16949 manufacturing sites supporting PPAP.

that offer child presence detection (CDP) and contactless measurement of human vitals such as heart rate, breathing rate and inter-beat levels to determine a driver's state of wellbeing. Ready Care can detect occupant life presence in the vehicle after exiting and will enable OEMs to provide an alert or driver notification to inform them of the situation. CDP will become a future requirement of the NCAP government car safety program in automotive.

Upgrade in-vehicle audio with new premium features at any time

READY ON DEMAND is a software platform for delivering branded audio value, feature enhancement, upgrades and monetization opportunities with an easy-to-use interface. Consumers can upgrade and personalize their vehicle with audio features and immersive experiences at any time throughout the life of the vehicle – in the same way they add new apps to their smartphones.

Ready on Demand provides a deeper connection to the consumer through the smooth integration of branded audio DNA in the user interface. Experience packages and feature extensions are available on-demand and can be purchased at any point in the vehicle lifecycle.

It includes a marketplace with an opportunity for partnership synergy with the automaker. This presents an opportunity for OEMs to create recurring revenue streams after the vehicle sale, for not only the initial purchaser of the vehicle but second and later owners as well. HARMAN has developed an initial set of on-demand experiences including packaged bundles of engaging, carefully selected audio and sound features. Exclusive OEM brand-specific features can be tailored within the packages.

Delivering fast and seamless in-vehicle hardware and software upgrades that equip vehicles for today and tomorrow

Just as a smartphone needs software updates to ensure users are receiving the latest in security features and applications, vehicles need regular updates. **READY UPGRADE** is a set of fully upgradeable software and hardware products that allow OEMs to perform upgrades throughout the life of the vehicle. OEM benefits include a full suite of low-code and no-code software development tools to greatly reduce new feature time to market and cost, accelerating the creation of differentiated in-vehicle experiences without having to invest in large software development efforts. Defined integration interfaces and a complete HMI and software development toolchain, including emulation and build environments, dramatically accelerate the timeline for Digital Cockpit HMI design.

Transforming the driving experience with large field-of-view head-up display, wedgeless design and augmented reality software

READY VISION provides an immersive audio-visual experience to assist the driver and create a safer and more informed journey with its Augmented Reality (AR) head-up display hardware and AR software products. Ready Vision bridges the physical and digital worlds by displaying intuitive turn-by-turn directions on the windshield. It also uses computer vision and machine learning for 3D object detection to deliver non-intrusive collision warnings, blind spot warnings, lane departure, lane change assist and low speed zone notifications with high precision. The Ready Vision AR HUD hardware design enables a large field of view, long virtual depth, optimal eye box and high brightness. Together with a compact package volume and wedgeless windshield design, it provides major cost saving for OEMs.

Alongside, the AR software AI and machine learning-based framework integrates with computer vision to display the right information at the right time, with low latency for real-time 3D object detection. Ready Vision prioritizes the display of relevant objects without obstructing the driver's view.

The AR software integrates data from multiple sensors such as navigation, ADAS and microphones to create timely visual and audio alerts. Ready Vision incorporates HARMAN's flagship directional and spatial audio to help enhance driver perception and support their ability to respond to threats faster, while enabling them to keep their eyes on the road with intuitive and clear prompts.

Bringing consumer electronics display experiences into the vehicle

Launched with Neo QLED Auto, **READY DISPLAY** optimizes performance, price and design to fit a wide variety of vehicle needs. Consumers today expect from their vehicles the engaging and advanced visual experiences that they get from smartphones and similar technologies.

Through its Samsung synergies HARMAN applied consumer electronics into Ready Display to deliver a product that meets consumer expectations and OEM development needs with a stunning, cost-effective visual experience.

Samsung-powered optics deliver HDR-level performance, higher efficiency and readability under harsh environmental conditions like temperature and sunlight. Ready Display offers reduced thickness and high compatibility with vehicle designs compared to competitor technology. It also supports the latest system requirements for graphic content processing, and protection, for optimal performance, safety and security.

Enhancing the audio experience inside and outside the vehicle

To meet customer demands for increased awareness of exterior sounds inside the cabin and to enhance communication possibilities for drivers, passengers and emergency vehicles on the road, HARMAN introduced its **SOUND AND VIBRATION SENSOR AND EXTERNAL MICROPHONE**.

The completely sealed piezo-based Sound and Vibration Sensor can be invisibly integrated into a vehicle's exterior while the External Microphone is designed to withstand environmental elements and can be configured as a single or multi-element array.

HARMAN's latest line-up of road-ready products delivering consumer experiences at an automotive grade are ready to be integrated by automakers today. **A**

For more information, visit <https://car.harman.com>





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Henkel's newly inaugurated Inspiration Center in Duesseldorf, a state-of-the-art global innovation and customer center.

Digital transformation keeps **global leader** in pole position

By: Nick Palmen

It is no longer news that the automotive industry is in a state of disruption. The move to electric vehicles has opened up the market to new players which are not encumbered with a 'this is the way we do things in the auto industry' mindset.

Existing OEMs and Tier suppliers have to rethink their business models and approach to research and development in order to stay relevant and competitive.

Roger Calixto de Araujo – Battery Systems, Adhesives Automotive Components at Henkel



Automotive Industries (AI) asked Roger Calixto de Araujo - Battery Systems, Adhesives Automotive Components at Henkel – how the company is adapting.

De Araujo: It is a huge challenge to change from the traditional way the automotive industry has handled the development of new products. In order to stay competitive, you need to be able to develop really fast, to shorten your timelines and to be cost-effective.

Added to that you have the evolution of customer expectations coupled with new ownership models that focus on e-mobility.

This evolution leads to greater customization expectations by each customer. In order to meet the challenges, we have to use digital innovation to be both competitive and sustainable.

AI: How is Henkel handling digital transformation?

De Araujo: Henkel is the largest additive manufacturer in the world and has the capability to adapt and take advantage of the opportunities. An example is the establishment of our Innovation Centre at our headquarters in Dusseldorf. This has changed the way we develop our products. Engineers, salespeople, customers and business development specialists come together and share the same environment. This lowers all the fences that traditionally separate people and departments.

Another example is an integrated research and development data collection tool we call Albert. It collects data from every experiment that we do in all our different labs and harmonizes it so that we can identify opportunities by analyzing and interpreting the information.

In the battery and e-mobility fields Henkel saw the need to have dedicated experts. The dedicated battery expert team is reviewing all the different aspects of battery development and adapting the products and the expertise Henkel has accumulated into this new field. We are looking forward to bringing modelling simulation as much as possible into battery development to really speed up the integration of designs and also to be more efficient, cost effective and faster.

AI: What areas is the battery team targeting?

De Araujo: The four areas are battery safety, battery cell technologies, battery sustainability, and design integration. On the safety aspect, Henkel materials can definitely play a huge role in managing fire and thermal propagation prevention. As an examples we are carrying out the development of fire protective coatings for battery lids, and thermal isolation solutions across battery cells, like potting materials and Fire Protection Pads.

For the battery cell technology, we are focused on the development of conductive coatings to improve active material adhesion to the current collectors and enhance the electrical conductivity of those interfaces, also the development of dielectric coatings for battery cell housings as an enabler for better mechanical and thermal performance. Our experts are keeping, as well, a close look into how we can play a role into disruptive technologies trends like solid state batteries and fuel cells

On Sustainability area, product-wise, one of our focus topics lies in enabling a circular economy for batteries with our solutions. Having options to repair, repurpose or to reuse batteries is crucial to lower the dependency on critical raw materials by extending the product lifetime. In that sense, facilitating the possibility to disassemble batteries in an efficient way is key. Henkel has a huge role to play here by developing adhesive solutions, that allow for debonding on demand. We are working towards allowing the repair, repurpose, and reuse of battery components – and ultimately provide solutions for an efficient way of recycling the valuable materials from batteries at end of life..

Looking at design integration, battery designs are gradually assuming other functions on a vehicle level rather than being simply a power source, the trends on integrating the battery pack to the vehicle structure is a good example. When you start bringing those multifunctionalities together, opportunities for more efficient materials to the allow for the best performance in the battery system attributes.

AI: What are the other main battery trends?

De Araujo: Mainly those trends are related towards increasing energy density within batteries, and prevention of uncontrolled thermal events. You can tackle those problems from a variety of ways, from cell chemistry and size, passing through the battery design, and the control software strategy. We see now some major changes in the approach to battery design, with OEMs approaching it differently. But whatever technology is being proposed, like immersion cooling, phase changing materials, new chemistries, etc. You must fine-tune what you actually want to deliver to your final customer. For instance, we have this relationship between vehicle range and charging performance. Increasing the size of the battery packs means more weight, which may not be the most efficient solution for increasing vehicle range. Another solution could be to develop batteries that can recharge fast. In essence, you will need smaller and lighter batteries that wouldn't require long charging times when big range is needed – what might be acceptable to costumers while on a road trip. Finding the right balance for the final customer has a lot to do with the type of use intended for the vehicle, and what materials are inside the battery. Henkel has the right materials to ensure that our costumer can hit this sweet spot.

AI: What role does modelling and simulation play?

De Araujo: In order to be more dynamic and to have faster turnaround times we need to go digital. Our team of modeling experts is bringing together deep development on four major workstreams through the modelling and simulation of batteries.

The first is application modelling – how we dispense and apply high viscosity liquid materials like adhesives. This modelling helps us to determine, for example, how much force is needed to compress the material to provide the desired bond line thickness.

It reduces time to market because, instead of doing lab trials and so on, I can model the material behavior, how the flow and rheological characteristics of the material are throughout dispensing and assembly processes, and also allows us to optimize the formulation of materials.

The next focus is on the thermal modelling of batteries. We want to really master the thermal pathways within battery systems. We know that, in some cases, we need to extract as much heat as possible. But, for safety reasons in some regions, we also have to ensure that the insulation is as good as possible.

This may seem contradictory, but we have to understand where we want the heat to go and how we want it to flow. We also need to model the thermal characteristics and battery behavior in



Technical experts carrying out simulation and testing work.

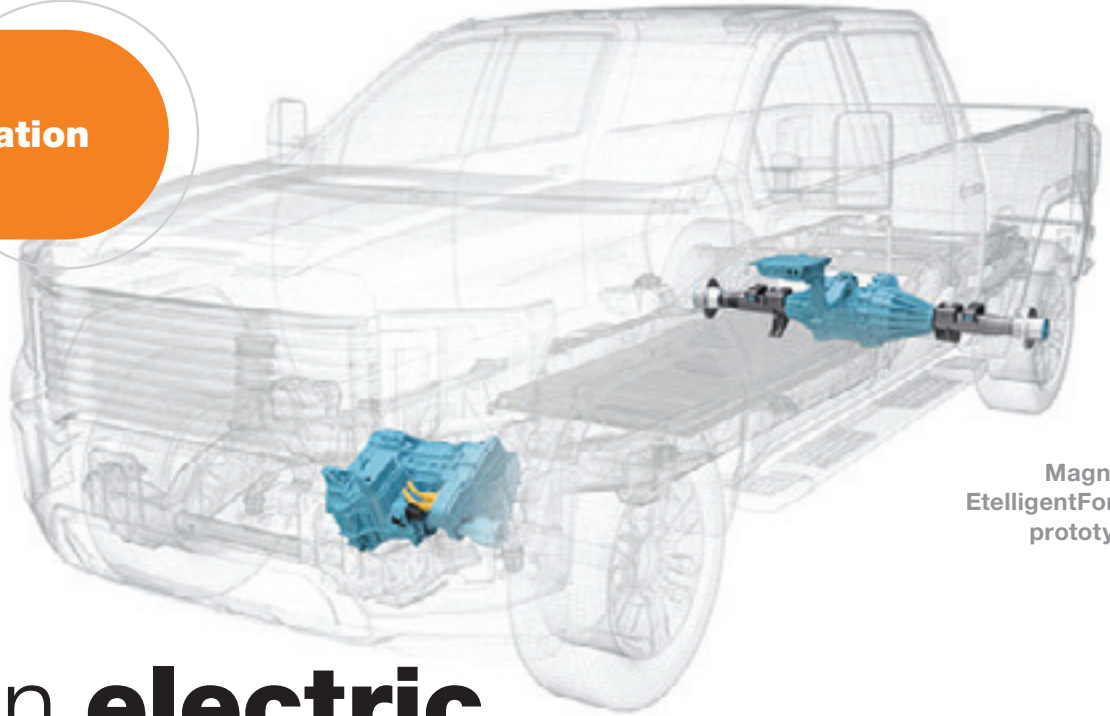
extreme scenarios such as thermal runaway. Of course, this has a lot to do with specific customer designs. But, in essence, we want to fully understand the thermal behavior in order to work with our customers to provide solutions for the most efficient design.

The same is true for mechanical and structural modelling. We need to understand the stresses on the battery packs and cells as they become structural elements of a vehicle. How are the loads transferred? What role are the adhesives playing when it comes to safety if there is a crash? We need to understand how those different elements interact. Modelling is crucial in order to do that.

Modelling also speeds up the formulation of materials. We can predict in a very detailed way how a material will behave in terms of rheology, thermal conductivity, stiffness, curing times and so on before we have a physical product.

AI: What's next for Henkel?

De Araujo: It is to continue to be the leading provider of adhesive technology. We want to be seen as the experts when it comes to eMobility material solutions. In that sense there are a lot of changes on the horizon. Henkel is prepared to grab all those opportunities in order to be recognized as the best solution provider for e-mobility. **AI**



Magna's
EtelligentForce
prototype

Plug-in **electric conversion** for existing truck platforms

By: Nick Palmen

Faced with pressure to green their operations and reduce operating costs, distributors are moving away from internal combustion engine powertrains.

A study published by ResearchAndMarkets forecasts that the global electric commercial vehicle market size will grow from 353 thousand units in 2022 to 3,144 thousand units by 2030, at a CAGR of 31.4%. The increasing use of electric commercial vehicles for last-mile delivery of goods from warehouses to end-

Automotive Industries (AI) asked Carsten Reisinger, Director, Global Product Management at Magna Powertrain, to tell us more about the company's Magna EtelligentForce system.

Reisinger: The Magna EtelligentForce is a battery-electric 4WD powertrain system for pickup trucks and light commercial vehicles. It is designed to maintain these vehicles' full capabilities and not compromise payload or towing capacities.

We call it a drop-in solution. You can fit it into an existing vehicle. Just replace the traditional axle with the electric equivalent. For sure, there are some other modifications needed, such as installing a battery pack instead of a fuel tank, but the conversion is relatively easy.

Based on customer surveys, Magna developed the new eBeam product family for class 1 to 5 vehicle applications for private and commercial use. There were several objectives:

Firstly, an electric rear axle must not have any disadvantages compared with ICE-based powertrains and drivetrains. Secondly, a cost-effective solution was crucial.

Thirdly, the new technology should enable full electrification within the typical ladder frame of existing pickup platforms.

EtelligentForce features Magna's eDrive technology at the front and its eBeam electrified beam axle at the rear. It is designed for high-payload vehicles, capable of towing up to 14,500 pounds

**Carsten Reisinger, Director,
Global Product Management at
Magna Powertrain**



users is expected to boost the electric commercial vehicle market in the near future. Companies are considering the addition of electric vans and pickup trucks to their fleets to reduce fuel expenses and mitigate emissions, according to the study.

This is putting pressure on OEMs to provide electric vans and trucks as soon as possible. A "drop-in" solution for existing ladder framed vehicles is being offered by Canadian auto parts manufacturer Magna.

– on par with its internal combustion counterparts in this truck segment. It can provide a total peak power of up to 430 kW - 250kW from the rear eBeam and 180kW from the front eDrive.

As a bonus, this solution omits the need for architectural changes to the vehicle and is totally customizable for automakers to prioritize key performance attributes. Magna's eBeam replaces traditional beam axles, accommodating existing suspension and brake systems, and avoiding the need for expensive redesign of existing truck platforms. These benefits help automakers simplify the transition toward electrification of these vehicle segments.

AI: So, there is no need for expensive restructuring of existing truck platforms?

Reisinger: Correct. When we built our demonstrator, no structural changes were needed to fit the electric axle. We are using the same suspension components. We are using the same dampers the same mounting points, so no modification was needed. If you want to convert an ICE drive train into an electric truck, you need to do all the other modifications like removing the ICE powertrain and adding the battery. But with this exercise, it is really an exchange of components, with no need to do any further modifications.

AI: What about the battery?

Reisinger: The design provides space in front of the eBeam for battery packs

AI: And assembly?

Reisinger: Switching from the assembly of existing ICE vehicles to electric propulsion will not require any significant changes in assembly procedures of the OEM production line. Our colleagues in Graz are producing a traditional ICE model and an EV on the same production line. The eBeam is likely to be 50-60lbs heavier than an axle it is replacing, but there is no real difference for assembly staff so long as the hoist can cope with the extra weight. Then it is just a question of plugging in connections

for the batteries, cooling system and general electrical interfaces.

AI: Will the e-version be cost-competitive?

Reisinger: For owners there will be definite savings in maintenance of the drive and powertrain. And there is it is difficult to answer that if you focus on the components specifically on the drive or the powertrain system, then I will say you would expect less maintenance of an electric powertrain system than one driven by an ICE motor.

AI: When will production start?

Reisinger: Magna is currently building a new EV Center in Troy, Michigan, to support this development. Series applications are planned for 2025.

AI: What has been the response from the OEMs?

Reisinger: So, there is a lot of discussion with various OEMs in North America, Europe and Asia. I have to add the interest is coming from the fact that there is growing demand for electric vehicles in this segment. Magna EtelligentForce makes it possible to meet the demand without redesigning the chassis and building a new assembly line.

AI: What other electric vehicle components is Magna working on?

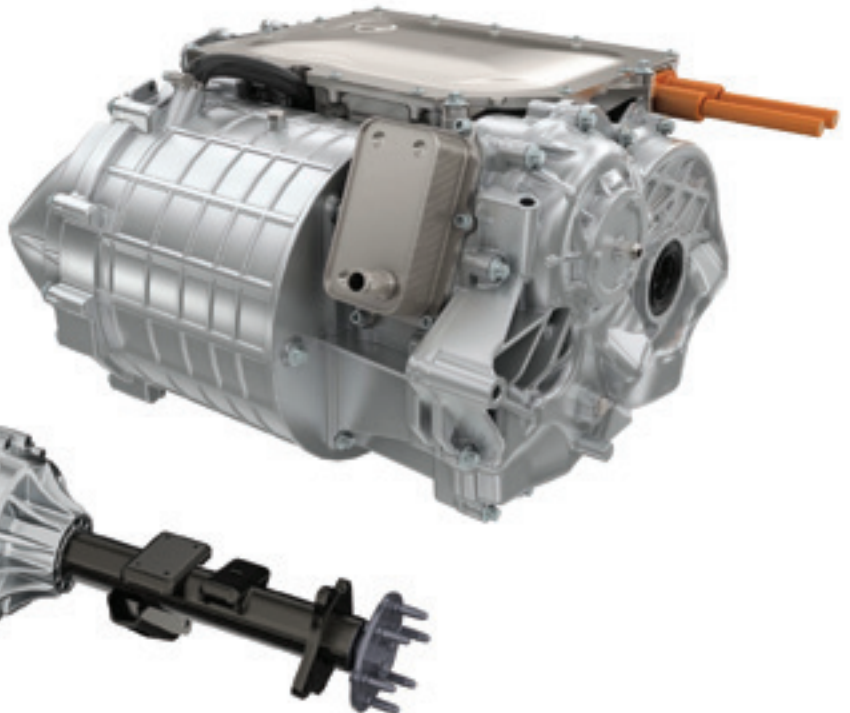
Reisinger: Magna is one of the preferred partners for all automotive electrified systems. Our products include inverter systems, ECUs and power closures. Our complete system expertise is based on a combination of engineering and development know-how to drive as efficiently and economically as possible.

AI: What is next for Magna?

Reisinger: I can speak for our powertrain products, and we are looking forward to introduce our new eDrive technology in serial production in the near future. It will be one of the highlights for the company. Looking further ahead, we are planning to introduce software as a product to our product portfolio. **AI**

RIGHT: The Magna eDS Mid+ drive features next-gen eDrive technologies and decoupling on the front

BELOW LEFT: Magna's eBeam drops into place of traditional beam axles, reusing existing suspension and brake systems



Wales harmonizes support for power device and sensor technology

By: Ed Richardson

Industry, government and academia are working together in Wales to accelerate development of compound semiconductors through the world's first dedicated compound semiconductor cluster.

"For high power applications, the advanced performance offered by compound semiconductors make them essential for smaller and lighter components allowing extended ranges for EVs," says Chris Meadows, director of CSconnected, a trade association for organizations in the sector.

Compound semiconductors are made from two or more elements, whereas silicon conductors are made from a single element. These advanced semiconductors are more power efficient than silicon. They enable high speed and optical communications, which makes them ideal for real-time connected applications, such as machine to machine communication.

Automotive applications include magnetic position sensors for managing ignition timing, cam and crank sensors, wheel speed sensors (for anti-lock brakes and other types of active wheel control), and in brushless electric

Welsh expertise in the field is illustrated by global businesses such as IQE, which is leading the way in developing the global market and spearheading the development of epitaxial wafers in Wales.

By establishing clusters of expertise Wales has developed significant capabilities in important economic sectors, including automotive, fintech, renewable energy, cybersecurity, compound semiconductors and high-value manufacturing. Collaborative clusters enable industry, academia and government to co-create high-tech ecosystems, according to Chris Meadows, director of CSconnected, the compound semiconductor cluster.

"Wales identified a gap in the market for this type of semiconductor and has created an ecosystem that allows the sector to thrive. Once you have the critical mass, the infrastructure starts to form that attracts other organizations—and the talent that you want to be part of the ecosystem."

"Compound semiconductors will enable vast improvements in the performance and efficiency of electric vehicles. The semiconductors will work with new battery and other fuel source technologies to improve this efficiency and help to significantly increase the range of electric vehicles," he adds.

In 2020, CSconnected received government funding provided through UK Research and Innovation's flagship Strength in Places Fund (SIPF).

The 55-month CSconnected SIPF project has a total value of £43million, supported by £25million of UKRI funds. It builds on Wales's regional strengths and integrates research excellence with a unique regional supply chain in compound semiconductor manufacturing.

On the research, development and innovation side, Wales has Cardiff University, Swansea University, the Institute for Compound Semiconductors, the Compound Semiconductor Applications Catapult and the Compound Semiconductor Centre (a joint venture between IQE plc and Cardiff University).

For compound semiconductor wafer production, fabrication, packaging and equipment manufacturing it has a range of internationally recognized semiconductor businesses.

Chris Meadows, director of CSconnected



"Essentially, automobiles are transforming into mobile computers. Heads-up displays, autonomous driving assistance, sensors, mobile phone and communication integration, and high-performance components are now included in their engines. This is made feasible by compound semiconductors, which are driving automotive improvement through innovation," says KBV Research in a report on the global compound semiconductor market.

"Although these semiconductors used in automobiles account for a small percentage of total semiconductor production, they are of high value and conform with the stringent technical and quality standards. Application-specific system definitions and manufacturing consistency provide the foundation for a compound semiconductor's applicability in a motor vehicle application. The bar for quality is really high," it states.

AI MODELLING

An example of the support provided by academia is the development of a more efficient way of modelling and designing power electronic converters using artificial intelligence (AI) by a team of experts from Cardiff University and the Compound Semiconductor Applications (CSA) Catapult. Headquartered in South Wales, the organization focuses on three technology areas: power electronics; RF and microwave; and photonics.

Co-author of the modelling study Dr Wenlong Ming, Senior Lecturer at Cardiff University and Senior Research Fellow at CSA Catapult, said: “accurate and fast transient modelling/simulation approaches are essential to efficiently and to rapidly optimize the performance of wide bandgap power electronics systems. We are delighted to work together with CSA Catapult to address this gap.”

PARTNERSHIPS

CSA Catapult has also entered into a strategic innovation partnership with Siemens to focus on the development of disruptive power electronics and building advanced skills in the UK. There will be a dedicated Siemens power electronics innovation hub at CSA Catapult to facilitate engagement with the UK power electronics ecosystem such as universities, Catapults, RTOs, industrial partners, start-ups, and grant funding organizations.

Another related project is the £20M ESCAPE consortium which aims to establish a globally unique and cohesive end-to-end supply chain capability for silicon carbide (SiC) power electronics. Consortium partners include such as McLaren Applied, AESIN, Clas-SiC, Compound Semiconductor Applications Catapult, Compound Semiconductor Centre, Exawatt, Lyra Electronics, MaxPower Semiconductor, Microchip Inc, Tribus-D, TPS, and the University of Warwick.

The project will support the drive for electrification in the UK and globally, enabling the transition towards net zero emissions, according to a consortium spokesperson.

FUEL CELL RASA

Theory and engineering expertise hit the road at Riversimple, which has spent 20 years developing the technology and business strategies that have led to the construction of a carbon-fiber hydrogen fuel cell-powered Rasa vehicle at its headquarters in the Powys County.

Founder Hugo Spowers is an internal combustion engine convert. “I used to build racing cars – I loved it, but I got out for environmental reasons. We need to move on from combustion engines. I started looking at all the options – I didn’t even know about hydrogen fuel cells, initially, but when I did, I realized that we needed to build and sell a car in a different way. We sell mobility as a service, much like a mobile phone. You pay a monthly direct debit and that covers all your costs – and when I say all, I really mean it, including insurance and fuel.

“Coming to Wales has been much better than we ever expected. We didn’t realize just what advantages it would have. We get a lot of support from the Welsh Automotive Forum. It’s fantastic for us, being able to leapfrog and establish cross-sectoral collaborations. We’ve also got a fantastic relationship with the Welsh Government, and they really have been extremely supportive. This is a much better environment than if we’d stayed across the border; for what we’re doing, it’s easier to do it here in Wales.” **AI**

THE WELSH AUTOMOTIVE SECTOR IN BRIEF

Automotive innovation is steered by the independent Welsh Automotive Forum (WAF), which was established in 2001 to develop a common approach in achieving sustainable continuous improvement for the local industry.

The Board of Directors comprises senior executives from the industry and Robert O’Neil is the Chief Executive. The role of the Welsh Automotive Forum continues to deepen and widen with this transitioning sector and is developing strong links with the UK Government and the Driving the Electric Revolution Team and Compound Semiconductor Applications Catapult.

The industry in Wales consists of two niche vehicle makers, about 18 Tier 1’s with the majority international global organizations and an OE Engine Plant, with a further 75 + companies in the service and supply chain, many of which are small and medium enterprises.

In total, some 10,500 people in Wales are directly employed in this sector with other jobs being generated by the multiplier effect.

A success story for Wales has been Toyota’s Deeside plant which open in 1993 and today produces an engine every 44 seconds. It is the first Toyota plant outside of Japan to produce hybrid electric engines which are exported to plants Toyota plants building the C-HR, Corolla and Prius Plus. Building on this, the latest WAF project is to establish Wales as a leader in the electric and hydrogen vehicle supply chains of the future, forming part of the wider Welsh Governments plans to deliver its Net Zero target by 2050. **AI**



Glyndŵr Innovations designs and produces nano precision, complex optical components and assemblies.

End-of-Life: A New Beginning

By: Jon Knox

Global aluminum sheet producer and the world's largest aluminum recycler Novelis has identified "three main levers" to help "take automotive material circularity to the next level."

THEY ARE:

- Optimizing circularity of OEM pre-consumer scrap through closed-loop recycling programs and advanced sorting technologies.
- Achieving higher thresholds of recycled content in automotive aluminum alloys.
- Developing eco-systems to recover vehicle end-of-life (EOL) scrap and optimizing it for recycling back into high-quality automotive alloys

Derek Prichett, Novelis SVP,
Corporate Development



Automotive Industries (AI) discussed the strategy and other developments with Jamie Zinser, VP, Global Automotive, and Derek Prichett, SVP, Corporate Development, at Novelis.

AI: Why the three levers?"

Prichett: Novelis is the largest producer of flat rolled sheet aluminum and the largest recycler of aluminum in the world. Our sustainability goals include the reduction of our carbon footprint by 30% by 2026 and to be carbon neutral by 2050 or sooner.

Scope 1 and 2 initiatives are under way to decarbonize our manufacturing processes, reduce energy usage and optimize logistics.

Reducing Scope 3 emissions includes three main levers: increasing the recycled content thresholds of our alloys by

optimizing closed-loop, pre-consumer scrap and opening the doors for new scrap markets with end-of-life circularity.

A key enabler to maximizing recycled content is alloy segregation. Until recently, this technology has been slow and expensive. Our partnership with Sortera helps solve this problem.

AI: What is pre-consumer scrap?

Prichett: Pre-consumer scrap is defined as waste materials that were created during the process of manufacturing or delivering goods prior to their delivery to a consumer. In this case, we are referring to the aluminum sheet metal scrap generated during the automotive stamping process.

AI: How is Novelis optimizing pre-consumer scrap?

Prichett: Novelis recognizes that some OEMs and Tiers are unable to segregate their aluminum scrap by alloy at the stamping plant. When automotive scrap alloys are mixed, the scrap value is lessened, and more primary aluminum is required to achieve the desired chemistry of new products.

More prime reduces recycled content and increases CO₂ emissions.

In the worst case, mixed scrap cannot be recycled into new automotive sheet and is downgraded into secondary alloys. Novelis realized that finding a cost-effective solution to alloy segregation was required to maximize scrap value, avoid material downcycling, increase recycled content and lower CO₂ emissions. Sortera's technology provides this solution to the market.

AI: How is Novelis achieving higher levels of recycled content in your alloys?

Zinser: Novelis is achieving alloys with higher recycled content by ensuring the required scrap is available through closed-loop and end-of-life initiatives.

For now, we do not have to design or redesign any alloys. Simply by obtaining more scrap segregated by alloy, we can increase recycled content in the alloys we already make with no changes to OEM specifications.

WHAT THIS BRINGS:

- Enables closed-loop recycling, with alloys containing up to 40% recycled content
- Enables some limited percentage (max 10%) of end-of-life scrap recycling on top of the closed-loop recycling, but only for clean, very well sorted scrap
- Typical max recycled content capped at 50%

Our goal is to strive for ever better segregation of end-of-life scrap. When we reach our maximum threshold for consuming end-of-life scrap, new alloys can be created that allow for greater scrap consumption.

- Advantage: new products designed for a low carbon footprint, allowing the incorporation of significant quantities of post-consumer scrap (they require the development of new specifications, and they need to be qualified by OEMs)

WHAT THIS BRINGS:

- Possibility to use sorted twitch – up to 30% on top of the 40%-50% of closed-loop recycling clean scrap

- Our target is to reach a recycled content of close to 80% for our automotive alloys

AI: Please give us some detail on the new sorting technologies.

Prichett: Novelis has entered into a partnership with Sortera to focus on sorting technology that uses artificial intelligence (AI)-based sensor sorters, as well as X-ray fluorescence and laser-induced based spectroscopy, to upgrade shredded, nonferrous scrap feedstock and remove unwanted contaminants.

The first phase of the project will focus on the separation of closed-loop recycling, pre-consumer scrap into appropriate alloy streams to avoid downgrading. The second phase of the project will focus on end-of-life separation of twitch into appropriate material value streams (sheet aluminum by alloy, extrusions, castings, etc.).

Our investments in Guthrie and Bay Minette are important drivers for creating the new demand for the segregated scrap created by Sortera.

AI: How will these enable new scrap markets?

Zinser: The key to new scrap markets in automotive is through end-of-life. This issue is material agnostic. The entire industry must work collaboratively to determine how to gain access to these markets, avoid downgrading of materials for

recycling purposes and start considering design for sustainability practices. (i.e. how do we design a vehicle to be recycling friendly through design for dismantling practices, utilizing recycling-friendly materials, etc.).

A vehicle at the end of its life is shredded and the metals fractions are segregated into steel and aluminum. Currently, all the aluminum (cast, extrusion and sheet grades) are sold together as a product known as 'twitch'.

Twitch historically is exported and downcycled into secondary aluminum products for engine blocks and transmission housings. Sortera's technology focuses on separating the fractions into cast, extrusion and sheet and then segregating them into their original alloys.

This process enables each aluminum type to be recycled by its respective industry and thus creates new sources of high-quality recycled content. Novelis has the recycling assets to consume end-of-life sheet scrap provided



Jamie Zinser, Novelis VP, Global Automotive.

to us by the scrap industry and through this we are creating a new market demand for this scrap.

AI: What is the bottom line in all of this for OEMs and Tier suppliers?

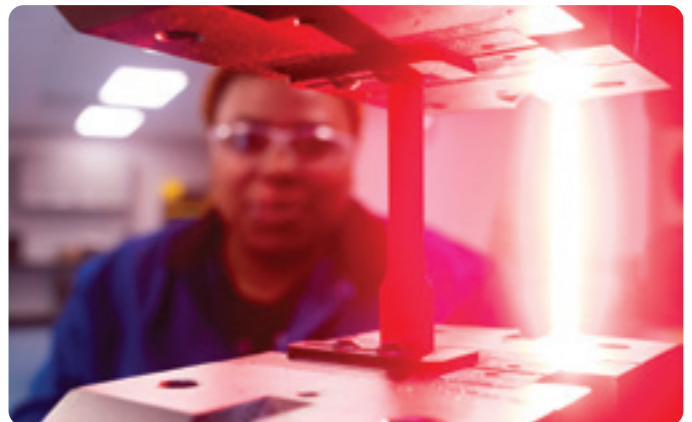
Zinser: In order to achieve circularity in automotive, new technologies need to be developed to maximize recycled content. Novelis recognizes that our investment in Sortera is one step in creating this new ecosystem. Creating new facilities with the technology to consume EOL scrap is another step.

A further step is working with OEMs to develop new recycling-friendly alloys.

These steps and partnerships are important as aluminum demand is being driven by the metal being an enabler of the transitions in mobility and drive trains along with the move toward creating a circular economy for automotive. No company can meet this challenge on its own. Novelis is encouraging companies in all the downstream and upstream value chains to join us in accelerating the decarbonization of the aluminum sector. **AI**



Scanning aluminum for composition.



Testing an aluminum alloy.



innovation

High-performance cost-effective **sensor fusion** and **perception solution** accelerates **ADAS** and **AD** adoption

By: James Hilton

Information from onboard sensors such as cameras and radar is only as good as the software which analyzes and processes it.

Advanced driver assistance systems (ADAS and ADS) depend on flexible, robust and accurate processing of vast amounts of data every millisecond. There are broadly two approaches to handling the information – object fusion and raw data or low-level fusion architectures. With object fusion, the sensor does much of the processing, while the other feeds raw data into a processor.

A leader in the field of sensor data processing is LeddarTech, which has built its solution around low-level data fusion architecture. Its low-level data sensor fusion and perception solution has received multiple awards and attracted the attention of major global automotive Tier 1-2s and OEMs.

**Charles Boulanger, CEO
of LeddarTech.**



So much so that the company has decided to devote its existing resources much more heavily towards its automotive software offering. “We initiated our foray into automotive software several years ago, and our development has led to a unique award-winning solution that is highly regarded by an industry struggling to solve the challenges of accelerating the large-scale adoption of greater autonomy,” says Charles Boulanger, CEO of LeddarTech.

The software enables the detection and identification of a range of objects on the road, including vehicles, pedestrians, bicycles, drivable road, obstacles, signs, and lane lines. LeddarVision also detects very small obstacles, with better detection rates and fewer false alarms than legacy “object fusion” solutions. Unclassified obstacles are also detected, providing an additional layer of vehicle safety.

LeddarVision is sensor-agnostic thus enabling flexibility for OEMs and Tier 1-2s to determine the sensors they wish to employ. “The conclusions of market analysts and customers clearly support that we are in a unique position with a software solution that OEMs need to enhance ADAS and AD performance. The market’s need for a sensor fusion and perception solution that can be easily integrated and includes all the benefits of LeddarVision has never been greater, and our use of raw data fusion makes our offering even more attractive to customers,” says Boulanger.

LeddarVision™ is at the core of LeddarTech’s fusion and perception software solution. It is a high-performance, scalable, cost-effective sensor-agnostic solution that delivers highly accurate 3D environmental models.

LeddarVision supports all SAE autonomy levels by applying AI and computer vision algorithms to fuse raw data from sensors employed in L2-L5 applications.

LeddarTech has recently released two new ADAS highway assist products to the LeddarVision portfolio with Front-View-Entry (LVF-E) and Front-View-High (LVF-H), two distinct comprehensive low-level fusion and perception software products that optimally combine sensor modalities for Level 2/2+ ADAS applications achieving a five-star NCAP 2025/GSR 2022 rating.

The two products are designed to meet the challenges Tier 1-2 suppliers and OEMs face when developing Level 2/2+ ADAS applications, such as solving safety issues and finding scalable fusion and perception software that offers high-performance cost effectively.

“Our mission at LeddarTech is to improve safety and the quality of life by enabling ADAS and AD applications, and this is accomplished with the release of these two products that achieve five-star NCAP 2025/GSR 2022 ratings.

“I look forward to announcing additional products in 2023 that will continue to meet the needs of the industry and improve the quality of people’s lives,” adds Boulanger.

LVF-E (LEDDARVISION FRONT-ENTRY)

Created for customers seeking to develop entry-level ADAS safety and highway assistance L2/L2+ applications, LVF-E is a comprehensive front-view fusion, and perception stack for entry-level ADAS L2/L2+ highway assist and 5-star NCAP 2025/ GSR 2022. LeddarTech's low-level fusion (LLF) technology pushes the performance envelope, doubling the effective range of the sensors and enabling for the first time a solution with only a single 1.2-megapixel 120-degree front camera and two short-range front corner radars in a 1V2R configuration. Low-cost sensing, together with efficient implementation on the TDA4L platform, achieves the lowest system cost for L2/L2+ entry-level ADAS. B-sample is planned for Q2 2023, targeting vehicle SOP in 2025/6.

LVF-H (LEDDARVISION FRONT-HIGH):

The premium companion fusion and perception stack in the front-view product family. With sensor configuration extended to 1V5R based on a single 3-megapixel 120-degree camera, single front medium-range radar and four short-range corner radars, the stack extends the perception support to highway assist applications, including 160 km/h adaptive cruise control, 200-meter range and semi-automated lane change. It also enhances the NCAP 2025 support for overtaking/ reverse/ dooring scenarios.

Furthermore, with efficient implementation on the TDA4L platform and a single Hailo-8 deep-learning accelerator, low-cost sensing achieves economic front-view L2/L2+ premium ADAS. B-sample is planned for Q3 2023, targeting vehicle SOP in 2026.

HIGH-PERFORMANCE AND COST-EFFECTIVE

LeddarVision's low-level fusion (LLF) technology pushes the performance envelope, doubling the effective range of the sensors. The products' lowest-cost sensing feature and efficient implementation on the TDA4L platform achieve the lowest system costs.

Superior accuracy in object separation and longitudinal position measurement on highways enable higher-performing adaptive cruise control implementation.

SAFETY

LVF products address five-star NCAP 2025/GSR 2022 safety applications. They include a built-in redundancy feature to accommodate sensor failures, degradations and conflicts. The range provides increased safety due to superior accuracy in object separation and longitudinal position measurement.

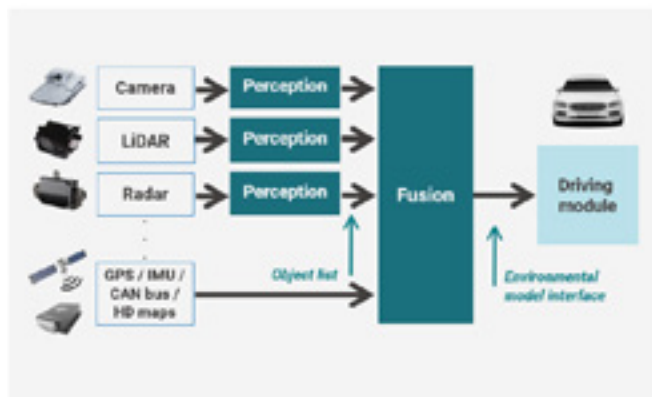
AWARDS

LeddarTech's low-level fusion and perception software has recently garnered significant international attention. The company has received numerous awards in the past few months, including the Konnect CARIAD award in Israel, the Shenzhen Automotive Industry Outstanding Innovation Award in China, the TechAD Gold Award in Detroit and the CES 2023 Innovation Award.

LeddarTech was recognized in November of 2022 as one of the 20 Fasted Growing Companies of 2022 by the US-based publication CEO Views and also as one of Canada's Top Growing Companies of 2022 by the Globe and Mail's Report on Business in September.

Since it began in 2007, LeddarTech has been responsible for several remote-sensing innovations, with over 140 patents granted or applied for that enhance ADAS and AD capabilities. **AI**

Object-Level Fusion Architecture

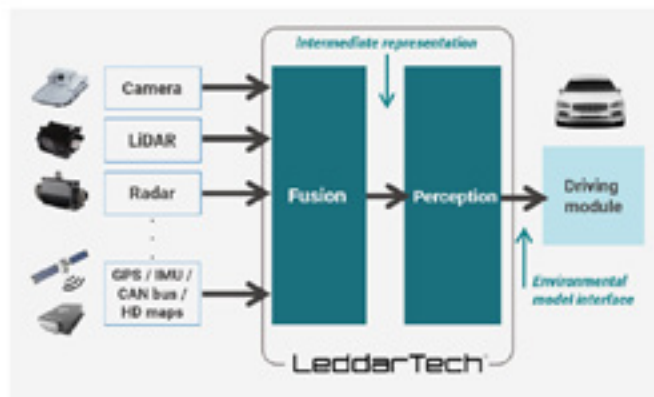


Object-Level Fusion Limitations

Each sensor detects and classifies objects. Sensors' decisions are then fused. Raw information from the sensors is lost.

- Increased missed detections and false positives.
- Conflicting sensor output and false alarms require complex heuristics.
- Higher-cost sensors and higher efforts required for modifying sensors.

LeddarVision: Low-Level Fusion Architecture



Raw Data Fusion Benefits

Raw data from sensors is first fused together. Detection and classification algorithms then run on the fused model. Decision is based on all sensors' input.

- Sensors complement each other for better detection and less false positives.
- Conflicting and degraded sensor output is inherently solved, with built-in redundancy and more reliable operation.
- Hardware/software decoupling for cost savings.

SikaBaffle®
3D printed parts



Advances in specialty chemicals enriching the manufacturing mix

By: Tony Davidson

Advances in bonding, damping, sealing and reinforcing technology are helping to make vehicles safer, stronger, lighter, quieter and greener.

Those solutions are now being applied to the new generation of manufacturing systems, such as additive manufacturing (aka 3D printing) by organizations like specialty chemicals company Sika.

Automotive Industries (AI) asked Thomas Gasparri, Sika Head of Applied Engineering for Europe, what contribution the company is making to the commercialization of 3D printing in automotive manufacturing.

Thomas Gasparri, Sika Head of Applied Engineering for Europe



Gasparri: Sika offers innovative additive manufacturing (AM) solutions to OEMs and component suppliers using our range of proprietary adhesives and heat-reactive materials. We supply 3D printed solutions where it makes economic sense, especially during the design and development phase. Additionally, we design parts specifically for AM, which allows us to increase the manufacturing speed and benefit from the design freedom offered by the technology. It enables new concepts where one part fulfils functions previously covered by multiple parts.

AI: For what applications is it best suited at present?

Gasparri: Jigs and fixtures, functional prototypes (one-

offs and small volumes), visual models, mock-ups for laboratory validation, short-run production of fully functional parts (low volume and derivatives), and spare parts where service contracts need to be honored after vehicle production volumes end. An additional advantage comes from the ability to make interim volume tooling based on mathematical models reversed from the part. This is a sweet spot where the cost of full steel Injection molding tools is not justified between the prototype/design phase and high production volumes.

AI: When will it become viable for serial manufacturing?

Gasparri: As a technology it is viable today in select industries but is typically predicated on production volume requirements or the intricacy and performance requirements of a part design. A key factor restricting the adoption of 3D printing is the high cost associated with 3D printing materials (such as heat-resistant materials for automotive applications).

In addition, the production still requires a lot of skilled manual intervention (such as slicing and post-processing). "Slicing" is the process of converting a 3D model into a set of instructions for the 3D printers. "Post processing" refers to processes such as sanding or polishing that need to be performed on a printed part.

There is also some difficulty in achieving the consistent and repeatable quality standards that are needed to mass-produce identical products (part-to-part variation).

However, reducing raw material costs and improved automated processes (from slicing to post-processing) continue to improve AM viability for serial manufacturing.



SikaDamp Autopad II enables reliable, repeatable application of damping pads using AI and robotics

AI: What Sika products are used in packaging?

Gasparri: Our SikaBaffle® products are 3D, heat-reactive thermoplastic parts designed to seal a body cavity. SikaBaffle® products are mainly injection molded parts. Sika has developed smart features to increase our packaging efficiency and reduce transport-related CO₂ emissions. Where geometries lend themselves, parts can be stacked or nested within each other for not only increased volume in containers but using the reverse math model for robots in automated assembly through pick and place in the build process through pre-determined motion paths.

AI: What are the advantages in terms of space and efficiencies in the manufacturing process?

Gasparri: They include markedly improved sustainability (reduced transport-related CO₂ emissions), as we can increase the number of parts inside the packaging, reduced need for storage space through maximized volume and automated assembly processes using pick and place.

AI: What are some of the advances being made in manufacturing processes?

Gasparri: Here are some examples of how Sika is supporting the automation of vehicle assembly processes:

AutoPad II – Automation efficiency in high-performance damping solutions

SikaDamp® solutions comprise a broad family of sound deadeners based on the elastomer modified bitumen or butyl which can also be coupled with a constraining layer. Magnetic SikaDamp® parts can be automatically applied (up to 45 pads / minute) for a targeted noise damping function which can enable weight reduction (using the right material in the right place). They can be applied on vertical and overhead surfaces (i.e. roof) with ease. Using standard geometries reduces engineering cost, part numbers and logistic costs.

SikaDamp Self adhering Damping products applied by robots

Other types of SikaDamp® parts (self-adhesive & peel-and-stick products) can also be applied, thanks to a patented EOAT (end of arm tooling).

These parts are usually applied manually (with a roller). Improper application may generate air pockets between the adhesive and the substrate which may result in adhesive failure and lower damping performance.

Our EOAT eliminates trapped air bubbles during the bonding process, makes automation possible and guarantees stable performance level by consistently applying the correct pressure to mating surfaces.

Automatic assembly of SikaBaffle parts

Our SikaBaffle® products are 3D, heat-reactive thermoplastic parts designed to seal a body cavity. SikaBaffle® products are mainly injection molded parts. Sika has developed smart features to enable automation at the OEM facility. These features allow the use of only one standard gripper. This concept is re-usable throughout the same plant, and also across all plants.

- Provision of digital data for product handling from the receiving container
- Automation of processes for placement in the BIW per geometries and available programmable math data

All the proposed automatic applications (above) can be considered as Industry 4.0 compatible if properly integrated in the customer process. They are available today.

While our products are not digital themselves, all the data supplied with them (for example on the labels) can be used for programing automated processes. We recognize and leverage our long history of value creation through automation efficiency long used in our bulk products and continue to push the digital transformation to our “parts” technologies, contributing to delivering performance beyond the expected. **AI**

Sika estimates that its solutions can deliver:

- 40% weight reduction in the car body
- Saving of 80 million liters of fuel a year globally through lightweighting
- 10 billion fewer welds needed using Sika structural adhesives
- Reduction of 50 000 tons of steel a year through the use of SikaReinforcer

Recycling polyolefin plastics that are **too valuable to go into landfill**

By: James Hilton

Nothing beats plastics for versatility, safety and durability. However, these very qualities can make plastics an environmental burden at the end of life.

Leading plastics company Borealis has set itself ambitious targets for making plastics more sustainable through recycling. The objective is to maximize value and efficiency across many lifetimes, minimizing its impact on the planet, the company says.

Automotive Industries (AI) asked Franck Lagoutte, Global Commercial Director Mobility, Borealis, how the company is using recycled content.

Lagoutte: Borcycle™ M is our transformational technology for mechanical recycling that gives polyolefin-based, post-consumer waste another life. This technology is a key enabler to considerably increase the use of post-consumer recycled polymers in the automotive

Franck Lagoutte, Global Commercial Director Mobility, Borealis.



industry and reduce the environmental footprint of high-quality aesthetic interior trim and cladding parts, for example.

Our Borcycle™ M grades feature close to virgin-like mechanical performance, excellent surface aesthetics, high scratch resistance, low volatiles, fogging and odor levels. The purity of the mechanical recycled polymer fraction allows the manufacturing of molded in color parts, even for very bright colors, without the need for surface treatment like painting or the use of film back injection molding technology.

AI: What is Fibremod™?

Lagoutte: Borealis Fibremod™ compounds consist of high performance short and long fiber-reinforced polypropylene materials designed to meet the needs of automotive manufacturers. They provide a complete spectrum of mechanical and chemical resistant properties, offering cost efficient solutions through weight saving, parts integration, processing efficiency and reduced energy and material consumption.

The e-powertrain is a focus area for Fibremod family, where Borealis has developed a new product portfolio with six different halogen-free flame-retardant polypropylene compounds for lithium-ion batteries.

AI: What other progress is being made in the development of high-performance recycled PP compounds for automotive applications?

Lagoutte: Polyolefin plastic materials are versatile resources that should be reclaimed and reused. Borealis is committed to driving the transformation to a circular economy of plastics because plastics are too valuable to ever be wasted.

We use our expertise to develop and implement circular economy solutions with added value for our customers in all industry sectors. The Borneables™ portfolio of polyolefin products is made of renewable-based feedstock derived entirely from waste and residue streams such as used cooking and vegetable oil (and thus not in competition with the food chain).

The ISCC PLUS accreditation of Borneables grades is based on the mass balance method that allows the customer to track and quantify the effective renewable content at each manufacturing step. Our customers can replace fossil fuel-based feedstock with an identical volume of sustainably sourced, renewable feedstock – without extra switching costs, and while maintaining the same high application quality.

AI: How quickly is the industry adopting this technology?

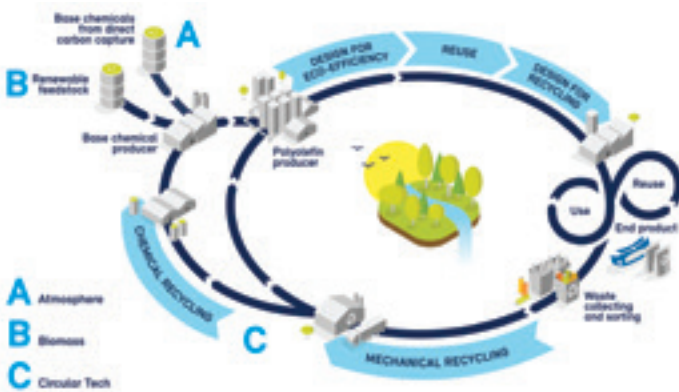
Lagoutte: For interior, exterior and under-the-bonnet applications, our customers typically start with mechanical recycled PP solutions. As they become more confident that the products meet their performance requirements, they start using other circular solutions, such as our chemical recycling (Borcycle™ C), and bio-feedstock PP (Borneables™).

We expect the market demand for circular solutions to grow as the industry strives to comply with legislation in the face of limited resources. That is why Borealis secured up-stream supplies with the corresponding feedstocks.

AI: What is next for Borealis and Bourouge?

Lagoutte: Underlying the Borealis Strategy 2030 is an evolved purpose: “Re-inventing Essentials for Sustainable Living.”

The Borealis vision of a circular plastics economy.



A strategic evolution centered on sustainability: The sustainability targets cover GHG emissions, energy use, flaring, and circular economy products and solutions for Borealis polyolefins and hydrocarbons businesses.

Greenhouse gas (GHG) emissions: Borealis aims to reduce its Scope 1 and Scope 2* emissions from 5.1 million tons (base year 2019) to less than two million tons by 2030. Plans include increased use of electricity from renewable sources and carbon capture projects which will come on stream in the second half of this decade. The reduction target includes divestment of the Borealis nitrogen business, which comprises fertilizers, technical nitrogen, and melamine.

Energy consumption: In 2021, around 25% of the electricity Borealis used in its operations was derived from renewable energy sources such as wind and solar power. By 2025, the share of renewables in the electricity mix will increase to 40%. By 2030, 100% of the electricity used in its polyolefins and hydrocarbons operations will be of renewable origin.

Circular economy products and solutions: Around 100 kilotons of products currently manufactured by Borealis in Europe are circular. These include recycled and renewable polymers and chemicals as well as renewable hydrocarbons. By 2025, Borealis targets a six-fold increase in the share of circular products and solutions, or 600 kilotons. By 2030, the volume of circular products and solutions is set to reach 1.8 million tons globally, turning plastic waste into a valuable resource.

Expansion and transformation: The Borealis Group's aspiration to become a truly global player has begun with global expansion, including Borouge 4 (UAE), Baystar (US) and Kallo (Belgium). The Strategy 2030 emphasizes the importance of serving the rapidly growing Asian market and expanding the Borealis Group footprint in North America. Additional strategic partnerships as well as mergers and acquisitions are planned. Organic growth opportunities in the form of newly established operational facilities are also under consideration. **AI**

* Scope 1 are direct GHG emissions that occur at the source and are controlled by Borealis. Scope 2 are GHG emissions stemming from the generation of energy purchased by the company.

** Scope 3 are indirect GHG emissions that are a consequence of company activities but occur from sources outside or not controlled by the company.

AWARD-WINNING TECHNOLOGY

Borealis received two awards at the 21st Society of Plastic Engineers (SPE Central Europe) ceremony held in October 2022.

The first was for an industry-first all-thermoplastic tailgate made from Borealis Fibremod™ PP Long Glass Fiber (PP LGF) for the latest Volkswagen Multivan. It was developed through collaboration between Borealis and Magna.

"The Fibremod™ portfolio of lighter-weight polypropylene (PP) compounds gives Tier 1 suppliers and OEMs the freedom to design and manufacture more sustainable and lightweight solutions for their increasingly electric fleets," said Borealis in a statement issued at the awards.

Fibremod GB416LF was tailored for use in tailgate carriers and visible structural parts. The high-flow, 40% fiber-reinforced material, meets stringent emission and mechanical performance requirements, and can eliminate the need for additional surface finishing steps such as painting, making it even more sustainable.

Leading Tier One supplier Magna used Fibremod GB416LF to ensure that a range of challenging demands on this part could be met. The tailgate consists of several components; the outer frame and the inner part made of Borealis Fibremod GB416LF, glued together to meet the design and load requirements.

Painted exterior parts are glued to the tailgate structure as well. As a loadbearing part, the tailgate must be extremely robust in order to withstand static and dynamic loads. Part of the tailgate also lies in the vehicle's interior, meaning compliance must be assured for emissions, fogging, and odour.

Finally, to achieve overall weight reduction for the new Multivan – which weighs around 200 kg less than its immediate predecessor – the tailgate itself must also be lighter. Using Fibremod GB416LF enabled Magna to meet these challenges head-on.

The second award was for advanced mechanical recycling technology which enables the use of "yellow bag" plastic waste for the manufacture of high-quality aesthetic interior parts which comply with OEM requirements.

The technology is seen as a key enabler to considerably increase the use of post-consumer recycled polymers in the automotive industry and reduce the environmental footprint of up-market aesthetic interior trim and cladding parts. It contains 30% by weight post-consumer recycled PP. The high purity of the polymer makes it suitable for the manufacture of molded color parts without the need for surface treatment. **AI**



Holding the Borealis SPE awards are Daniel Bahls (left) and Franck Lagoutte.

Tailoring deals to accelerate the transition to electric vehicles

By: Clinton Wright

The switch to electric vehicles is creating new opportunities for companies to expand, diversify or pivot through mergers and acquisitions.

But it takes special skills to successfully connect entrepreneurial management teams with the best growth partner and/or new owner. A leader in the field is IMPROVED Corporate Finance B.V., a global corporate finance and merger and acquisition (M&A) boutique. It has positioned itself as a specialist financial advisor in the technology, energy, and mobility sectors (TEM).

The specialist advisory boutique has supported some of the world's top entrepreneurial management teams in the sector in various landmark cross-border M&A and growth financing transactions. In the United States these include, amongst others, the divestment of Plugsurfing from Fortum to FLEETCOR; the sale of GreenCom Networks to

specialist dealmakers and TEM industry experts who interact with the global ecosystem on an ongoing basis. This ensures we fully understand the strategic ambitions of our partners, are aware of the latest market dynamics, and can provide the best tailor-made corporate finance advice possible.

We are growing the awareness of IMPROVED in the United States, building on a strong expertise and track record in mid-market M&A and growth financing transactions in technology, energy and mobility, especially EV charging.

AI: How optimistic are you about the TEM sectors?

Verbeek: Renewable energy adoption has accelerated significantly over the past two years and is outperforming expert forecasts every year. Much more is needed to reach net zero by 2050. A recent published Swiss Re study estimates that total investments of more than US\$270 trillion are needed to reach the climate target of net zero emissions by 2050.

The report predicts that, at the current pace of transitioning, net zero will be reached only by 2069, stressing that we need far greater ambition and global collaboration to fight climate change. The report identified four verticals for the required investment: transport, energy, building and industry – with the majority of investments needed in the transport and energy sector, US\$114 and US\$77.9 trillion respectively. Accelerated by the distorted energy supply caused by the war between Russia and Ukraine, the world finds itself in an energy crisis, and the need to speed up the energy transition and reduce dependency on fossil fuels is significant.

AI: What do you see as IMPROVED's role in helping TEM companies?

Verbeek: IMPROVED is dedicated to support TEM entrepreneurs, investors and corporates in landmark transactions, and accelerate iconic innovation. Twenty-five percent of Americans say their next car will be an EV.

Frank Verbeek, Managing Partner and founder of IMPROVED Corporate Finance



Enphase Energy; the sale of Rhombus Energy to BorgWarner; the sale of ViriCiti to ChargePoint; the sale of Recargo, Inc. to EVgo; the merger agreement between Wallbox Chargers and Kensington Capital Acquisition Corp.; FreeWire Technologies' investment from Riverstone Holdings; and Fixico's investment from Autotech Ventures.

Looking to further expand its expertise and presence in the United States, IMPROVED recently opened an office in San Diego, California, and appointed expert dealmaker Mark Bradt as Managing Director to lead its team in the country.

Automotive Industries (AI) asked Frank Verbeek, Managing Partner and founder of IMPROVED Corporate Finance, what lies behind its success in the TEM sector.

Verbeek: We have a strong and unparalleled team of

For the entire infrastructure around this transition to be ready, it makes a lot of sense to get the required expertise in-house. And for highly innovative companies that can partner with leading corporates and investors, combined with the right ambition, the needed capital, and the necessary global footprint, it will mean nothing more than exponential growth in the long-term.

AI then asked Daniel Lyons, Managing Director, IMPROVED Corporate Finance, to provide an overview of the current market.

Lyons: Despite current market conditions, electrification and energy transition continue to offer many opportunities and will continue to see an increasing pool of capital being committed over the coming years, driven by accelerating government support. We envisage both M&A and growth financing activity to remain high, if not increase in terms of total volume. Hence, we are growing rapidly, expanding our global team and ready to support industry leaders on a global scale. We recently opened offices in the UK and the US, with other branches being planned.

AI: How do you see the future of EVs?

Lyons: Electrification of mobility is set to continue at pace. Regulatory activity, investments by vehicle OEMs, utilities, oil and gas suppliers, Tier 1 companies and infrastructure rollout coupled with wider consumer adoption show no signs of abating. If anything, rising energy prices have highlighted the benefits of EVs to a wider audience, resulting in greater interest across more markets, especially for larger commercial fleets.

We have now reached the tipping point for EV adoption in passenger vehicles, but are also seeing a rapidly increasing electrification and EV adoption when it comes to light to

scale flexibility solutions to support a decentralized energy grid.

These trends will lead to even more deal activity in the segment, as infrastructure owners seek capital for rapid expansion, operators unlock scale economies through consolidation, and strategics seek inorganic means to enter or strengthen their positions. As such, while volatility has become the norm in equity markets, we are seeing continued interest amongst financial and strategic investors in the private markets for high quality assets or companies in the E-mobility and energy transition sectors.



Daniel Lyons, Managing Director, IMPROVED Corporate Finance

AI asked Mark Bradt, Managing Director, IMPROVED Corporate Finance, to share some of his past experience.

Bradt: I have spent many years within Houlihan Lokey's Global Technology Group on the West Coast of the U.S. I have been in M&A for long time, and have advised on a large number of transactions across the M&A and growth equity spectrum. Over the past decade, I have supported an array of entrepreneurial teams of fast-growing international Tech companies, including a significant number of software businesses, on sell-side, buy-side, carveout and growth equity, and/or equity recapitalisation transactions.

AI: Why did you decide to join IMPROVED?

Bradt: I am very excited to have joined the global IMPROVED team given their history of market-leading corporate finance services and expertise in key sectors across the technology, energy and mobility domains. We are at an inflexion point in the development of an array of new technologies that will propel the world toward a more sustainable future. To be able to support key stakeholders, investors, founders and management teams in driving iconic innovation and realising their visions, is a unique and meaningful opportunity.

AI: Where will you be based and how will this impact IMPROVED's US operations?

Bradt: I am based in San Diego, California, the US capital when it comes transport electrification and energy transition - supported by a strong team of industry experts who are part of IMPROVED's highly active Associated Partner network - Hans Gieskes, Omar Hatamleh, Mark Joseph, Prachi Vakharia, and Jonathan Mayer. I will be leading operations and further expand IMPROVED's deal-making efforts in the US - and beyond. **AI**



Mark Bradt, Managing Director, IMPROVED Corporate Finance

medium heavy duty vehicles. The extremely beneficial unit economics (when compared to internal combustion vehicles) makes it a lot of sense for large commercial fleet owners to electrify their fleet as soon as possible.

AI: What are the challenges facing the EV market?

Lyons: The biggest near-term challenge facing the sector is manufacturing vehicles fast enough and rolling out a reliable and global EV charging network to keep up with demand.

At the same time, increasing energy demand and pressure on the grid calls for accelerated adoption of smart sharing and energy management solutions, and further acceleration utility

Reach out to the specialist team to discuss how they can best support in realizing your strategic objectives.

- Frank Verbeek, Managing Partner: verbeek@improvedcf.com
- Daniel Lyons, Managing Director: lyons@improvedcf.com
- Mark Bradt, Managing Director: bradt@improvedcf.com

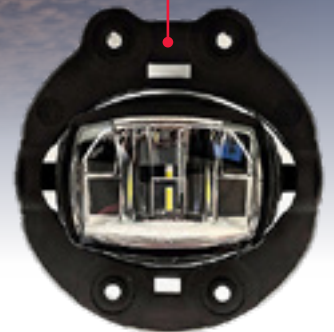
innovation



Jeep Grand Cherokee 2022 advancing with Myotek LED FOG LIGHTS
Myotek is a LUXIT GROUP company

Lighting as the main driving force behind vehicle design

By: Jon Knox



Customers expect automotive lighting to do more than simply light the way or provide in-cabin illumination when needed.

The value of global automotive lighting market is expected to grow from US\$11.96 billion in 2021 to US\$25.77 billion in 2022, and to reach US\$39.03 billion in 2026 at a CAGR of 10.9%. That is according to the Automotive Lighting Global Market Report 2022 published by the Business Research Company.

It says the demand for safety features along with the adaptive lighting system has increased due to an increase in the number of road accidents worldwide. Vehicles with adaptive and advanced lighting can provide

headlights in passenger cars reached 60% 2021. The penetration rate of LED headlights in electric vehicles was as high as 90%, and the penetration rate in conventional and electric vehicles is expected to increase to 72% and 92%, respectively, in 2022.

Mordor Intelligence research found that vehicle manufacturers are showing great interest in integrating LED lights in vehicles, as these lights consume less power and have a longer life when compared to halogen and HID lights. Furthermore, LED lights offer durability and strength, have high-quality light-emitting diodes, and are superior to all other forms of lighting technology.

One of the main drivers of research and development in automotive smart lighting is the adoption and growing sales of electric vehicles. LED lighting, due to its lower power consumption than conventional bulbs, helps to extend the range of electric vehicles. They also permit the inclusion of advanced features in existing facelifted and future vehicles.

Automotive manufacturers are developing new lighting technologies and are focusing on all small exterior lighting applications. They are entering into partnerships to be ahead in the competition within the market, according to Mordor Intelligence.

Automotive Industries (AI) asked Stephane Védie, Chief Executive Officer of the LUXIT Group, what role lighting is now playing in the design of vehicles.

Védie: If I may be a little provocative, I would say that lighting

Stephane Védie, Chief Executive Officer of the LUXIT Group



optimum road illumination and detect objects on the road, thereby enabling the driver to take appropriate actions.

TrendForce's "2022 Global Automotive LED Product Trend and Regional Market Analysis" report predicts that there will be greater use of LED headlights coupled with the development of advanced technologies such as intelligent headlights, logo lamps, and intelligent ambient lights.

According to TrendForce, the global penetration rate of LED

may now be the main driving force behind vehicle design. Not only is it critical to safety, it is also important for V2X communication, styling, and user experiences.

Welcome and farewell functions, BEV charge indicators, and on-road tell tail markings are quickly becoming the new norm.

With lighting playing an even greater role in the autonomous vehicle future, it is a great time to be a part of the lighting industry and contribute to the automotive megatrends.

AI: Where is the technology taking us – what opportunities are being created for designers to differentiate their vehicles?

Vedie: Lighting has been the “vehicle jewelry” for years, but now it is truly becoming a major part of the vehicle DNA.

Advances in light sources and optics are enabling designers to execute current trends such as exceedingly low profile light sources and “hidden until lit” features. Lit emblems, badges, and grilles enable the designers to provide additional brand recognition to the OEM.

AI: How does lighting support active safety enhancements, such as cameras, radar and lidar?

Vedie: When it comes to camera-based ADAS technology, lighting is a major contributor for systems to accurately detect and recognize objects. Adding light to various areas of the system can improve detection and reaction time that further mitigates crash avoidance.

Additionally, lamps provide the ability to integrate cameras, radar, and lidar to provide a fully integrated look without losing on the aesthetics that the vehicle design is trying to achieve.

AI: Are you seeing the in-shoring of supply for US manufacturers?

Vedie: With the recent supply chain issues that have strongly impacted the automotive industry, our customers are now requesting more localization in the United States with lamp production in close proximity to the OEM plant.

We currently have four plants in the United States and are in the process to acquire additional facilities.

We are able to maintain a competitive advantage in the United States by being the only supplier that is fully vertically integrated. We manufacture our own plastic injection, coating, metallization, die casting brackets and heatsinks, LED PBCA's, and offer fully automated assemblies.

Automation and vertical integration are the keys to be competitive and produce in the United States.

AI: What is LUXIT's technological edge?

Vedie: The ability to continuously design more efficient lighting solutions is our competitive edge. LUXIT invests heavily in top talent, software and equipment to maintain our edge. Our vertically integrated structure and continuously growing global footprint, with automated assembly plants, is a key advantage to introduce new technologies and design elements to our customers.

AI: Are you ramping up production capability to meet demand?

Vedie: Over the past 12 months we have won significant market share with both our Tier 1 and Tier 2 customers. We have been successful in launching new products in record time.

We see that the lighting content per vehicle increases from one generation to the next both for exterior, as well as interior lighting products.

In addition to the content increasing, the technology in the lighting is also increasing, which drives strong revenue growth. We have proven that we are fast, flexible, and competitive.

This is why we are now the market leader in North America for small lamps and auxiliary lighting!

AI: What about quality?

Vedie: Quality is non-negotiable. Our customers expect 0 production claims and 0 warranty returns.

This is undoubtedly challenging, but is also achievable with rigorous training and follow through of our standards and processes. Quality is built in during the design of the product by our strong feasibility team and design for manufacturing process. Our leadership team brings extensive lighting experience with best practices from all of the major players in the industry.

AI: Where to go from here for LUXIT?

Vedie: For our Tier 1 customers, we are launching new products such as lit badges, lit grilles, and DLP projection lamps.

We are continuing to grow our interior business as well. Our momentum is great as we continue to grow our partnership with all major US car automotive OEMs.

For our Tier 2 business, our customers continue to have strong demand. Not only are we delivering components to them, but now there is a need for more sub-assemblies and complete projector modules.

Our Tier 2 business is moving toward a Tier 1.5 business model.

Continuing to be the market leader in North America as well as driving technological improvements is our top priority. **AI**



The Dodge Durango manufactured with Myotek FOG LIGHTS
Myotek is a LUXIT company

Semiconductor innovation supports **shift to hybrid and electric** vehicles

By: Jon Knox

Increasing demand for hybrid electric and electric vehicles, as well as the rollout of autonomous driving are being made possible by rapid advances in automotive semiconductor technology.

Fortune Business Insights predicts that the accelerating demand will see the global automotive semiconductor market being worth around US\$103.85 billion by 2029 – up from US\$53.06 bn in 2021 and US\$59.22 bn in 2022.

One of the leaders in the field is Texas-based Diodes Incorporated. Automotive Industries (AI) interviewed Emily Yang, Sr. Vice President, WW Sales & Marketing at Diodes Incorporated.

AI: In June 2022 Diodes reported its eighth consecutive quarter of growth in the automotive sector, which now provides 14% of revenue. What is driving this success?

Yang: Our total solution strategy along with our focus on connected driving, comfort, style and safety, and

PCIe, GBE and USB. These automotive-compliant product types include PCIe clock buffers and generators, PCIe packet switches and PCIe ReDrivers.

Outside of the signal chain, a focus area is power management products, which include automotive-compliant DC-DC converters, LDOs and Power Switches that provide accurate and robust voltage regulation need by the signal processing devices.

AI: What about the evolution of the power train from internal combustion through hybrid to all-electric?

Yang: the electrification of the power train means that more and more ancillary systems are being moved from being mechanically driven from the engine to being driven by electric motors – water and oil pumps, HVAC compressors, etc. This results in the use of higher volumes of solenoids and actuators to control valves and electromechanical systems. Our broad portfolio of MOSFETs, rectifiers, TVS and gate drive devices enable a “right sized” solution for a wide range of powertrain applications.

Where we are seeing the electrical architecture of a vehicle become centered around the battery pack and DC-DC conversion rather than a mechanically driven alternator then we see new and different opportunities in battery management systems and voltage conversion as well as different circuit protection requirements. Our protection products and power management products are a good fit into these areas.

AI: How are you overcoming the technical constraints facing 48 Volt battery systems?

Yang: Automotive electronics have a large voltage headroom for increased reliability – for 12V systems the parts used are

**Emily Yang, Sr. Vice President,
WW Sales & Marketing at
Diodes Incorporated.**



electrification/powertrain. We continue to expand our content in these applications as we deliver new products and create a pipeline with new design activities.

AI: What products have you developed (or are you developing) for Advanced Driver Assistance Systems (ADAS)?

Yang: Higher data rates and faster speed continue to drive the need for advanced protocols including PCI express and gigabit Ethernet. Our precision timing and connectivity business unit continues to develop new products for these protocols including

rated to 40V. For 24V systems parts are rated to 60V and for 48V systems 80V or 100V parts are used. Our expanding range of 80 and 100 Volt single and dual MOSFETs, LED drivers and supporting parts allow designers to create systems directly powered from 48V architectures.

48V can allow for more powerful systems like e-turbos and active anti-roll bars, more efficient vehicles through lighter wiring looms and simplified point-of-load implementations. We consider 48V battery systems as an opportunity rather than a constraint.

AI: Typical passenger cars now have over 100 motors contributing to comfort, style and safety. Do you see a switch from brushed to brushless motors?

Yang: In any mechanical or electronic system, wherever there is a continuous rotational motion involved, there is a motor. And in the modern-day auto, where comfort is as important as driving efficiency, motors play a pivotal role.

Be it the windows, seats, steering, turbochargers, ventilation flaps or brakes, there are electric motors to be found in each of these components. In fact, as you point out there are approximately a hundred electric motors in a typical passenger car. The majority of these motors are either brushed or brushless DC motors (BLDC).

The BLDC motor market is forecast to double by 2030 with the transition to electric powertrains along with growth in vehicle applications such as HVAC, water pumps and oil pumps that are 'continuously operating' driving growth. Whereas brushed DC motors will remain the motor of choice for applications that operate occasionally such as seat motors, window, mirror etc. as it is a more cost effective solution.



DIODES AP automotive PoL Buck Converter series.

requiring the minimal number of external components. They also automatically cope with open-LED and LED-shortened conditions.

A simple way of creating adaptive beam forming lamps is to switch in/ out LEDs, using our bipolar transistor technology and high-power density packaging capability we have a series of dual transistors that provide a compact solution.

For rear lamps and internal lamps linear LED drivers are

Diodes Incorporated

Diodes Incorporated (Diodes) (Nasdaq: DIOD), a Standard and Poor's SmallCap 600 and Russell 3000 Index company, delivers high-quality semiconductor products to the companies in the consumer electronics, computing, communications, industrial, and automotive markets. Its automotive focus is on connected driving, comfort/style/safety, and electrification/powertrain.

Diodes broad portfolio of automotive compliant MOSFET, gate drivers, protection devices and hall sensors is helping our customers optimize their next generation designs.

AI: Lighting is another critical contributor to safety and comfort. How are you supporting the migration to LED and intelligent illumination?

Yang: LEDs have a totally different I-V characteristic to traditional lamps and Diodes' focus for automotive lighting has and is on high efficiency yet simple constant current drive solutions for LED driving. Driving the LEDs across the whole automotive voltage range, including load dumps, and with differing number of LEDs.

For forward lighting applications switching LED drivers are preferred due to their high efficiency. The AL88xxQ series of buck LED drivers combines high efficiency with simplicity, while

preferred due to their lower cost and EMI. The AL58xxQ and BCR4xxQ series of linear LED drivers provide simple high power density solutions for these automotive applications.

Diodes' next generation AL588xxQ linear LED drivers expand the number LED channels driven which support the growing demand for animated rear lamps and also for tunable color interior lighting.

AI: What is the future for Diodes in the automotive sphere?

Yang: Automotive is one of the focus segments for Diodes so we will continue to bring new products to the market that will address the requirements for different application areas i.e. connected driving, comfort, style and safety, and electrification/powertrain. We expect to grow our content in these applications and future applications as continue to work with tier one customers to support their future needs. **AI**



innovation

Award-winning **absolute positioning technology** for autonomous vehicles

By: Jon Knox

Aerospace positioning technology is helping to steer autonomous cars through an award-winning solution.

GMV GSharp for automotive was recognized at the Seventh Edition of the European Automotive Suppliers Association (CLEPA) Innovation Awards in the “safe and smart” category as a groundbreaking solution based on satellite navigation technology that provides highly accurate and safe positioning information. It is now being used in the autonomous vehicles of the most prestigious global OEMs.

Sara Gutiérrez Lanza:
Director of GMV's
Automotive Business Unit



Madrid-headquartered GMV has a long track record of supplying software for the automotive sector. With more than 30 years of experience in GNSS-based technologies and more than 20 years of experience developing safe and accurate positioning systems in various sectors, the company is at the forefront in the development of positioning technologies for autonomous vehicles.

Automotive Industries (AI) asked **Sara Gutiérrez Lanza**, Director of GMV's Automotive Business Unit, what is behind the development of **GMV GSharp**.

Gutiérrez Lanza: GMV has devoted a considerable amount of its R&D budget over the last 15 years to developing its own proprietary High Accuracy safe solution. This solution is now being sold as **GMV GSharp** for multiple markets.

The automotive market is particularly important, in which **GMV GSharp** provides high-accuracy, safe, and reliable positioning

information (position, velocity, and heading) for automobiles, which is later combined with automated driving functions.

Capitalizing on the exceptional experience gained throughout the years in other critical sectors, GMV has incorporated concepts, such as integrity – which has traditionally been used in highly regulated safety-critical sectors, like civil aviation – and adapted algorithms used for safe positioning to the automotive world.

GNSS is the only technology that can be used for absolute vehicle positioning, which is essential for localization. Absolute positioning (i.e., GNSS) is also necessary to define a reference framework in (C-V2X) systems. High precision (and safe) GNSS also contributes to building and maintaining HD maps.

These are a few examples of use cases where GNSS will play a pivotal role. So, our focus on GNSS stems from the belief that it will play an absolutely essential role in driving the cars of the future.

AI: What makes it award-winning?

Gutiérrez Lanza: **GMV GSharp** for automotive is a robust, reliable, and high-performance solution that provides high accuracy and safe GNSS corrections, generated with GMV's GNSS Correction Service, which are later processed by its counterpart; an ASIL-B ready positioning software – positioning engine – that calculates reliable and precise vehicle positioning and other parameters using advanced algorithms developed by GMV, in line with the most demanding automotive regulations and the highest quality standards to develop critical software. To this end, the positioning engine uses GNSS signals, integrated with data from other sensors onboard the vehicle, together with the aforementioned High Accuracy and Safe GNSS corrections.

The GNSS Corrections Service and the onboard positioning software (Positioning Engine) have been developed following ISO 26262, ISO 21448 standards and comply with ISO 21434.

While developing the solution, the rigorous project management practices required in the automotive industry were applied, and the strictest quality standards applicable to automotive software engineering (A-SPICE CL3) were followed.

Moreover, GMV's trustworthy and precise GNSS positioning solution enables autonomous vehicle manufacturers to significantly enhance accuracy and safety at a fraction of the cost of other ADAS sensors.

AI: How is it performing in the trials?

Gutiérrez Lanza: GMV GSharp for automotive is a ready-to-use solution with guaranteed performance resulting from years of work and thorough validation activities.

Following a cutting-edge safety validation methodology and approach that entails simulation, signal edit and replay activities, and more than 40,000 kilometers driven in different scenarios, we can ensure that we offer sub-lane level accuracy (centimetric), combined with an Integrity Risk of up to 10^{-7} per hour, high availability of more than 99.9%, fast convergence, almost instantaneous reconvergence times, and the guarantee to achieve this performance in different scenarios thanks to the hybridization with other sensors in the vehicle such as Inertial Measurement Units, wheel speed sensors, and odometers. This makes our solution unique for the intended applications.

Additionally, GMV continues working to evolve the product to adapt it to the increasing demands of the automated driving market and others.

AI: Why is it important to incorporate high-precision positioning with integrity?

Gutiérrez Lanza: GMV GSharp can be used for highly accurate positioning, but this is not enough. We need the positioning information to be safe and reliable. GMV GSharp incorporates the ability to detect and exclude sources of error and hazards affecting the positioning data in real-time, calculating a confidence area, defined by what is known as the Protection Levels. The probability of erroneous positioning information is extremely low and below a very demanding target probability (the Target Integrity Risk or TIR) within the confidence area. In this regard, the solution is accurate and trustworthy and can be used in automated driving functions.

High levels of integrity are one of the keys to implementing safety-of-life automotive applications.

AI: What other solutions does GMV provide for the motor industry?

Gutiérrez Lanza: GMV has around 20 years of experience in the supply of solutions for the automotive sector, working with automotive OEMs and Tier 1 suppliers. GMV's offer incorporates a wide variety of telematics solutions for connected vehicles, which are running in more than four million vehicles at present, including regulated applications and services such as European eCall or the Japan's Helpline service.

Other relevant applications and services GMV is concentrating on are Co-operative Services (C-ITS), where different use cases entailing V2V or V2X communications are noteworthy.

Last but not least, another market niche where GMV is growing is cybersecurity for connected and autonomous vehicles, supported by its solid background in cybersecurity, which is being synergically leveraged with its solid automotive background.

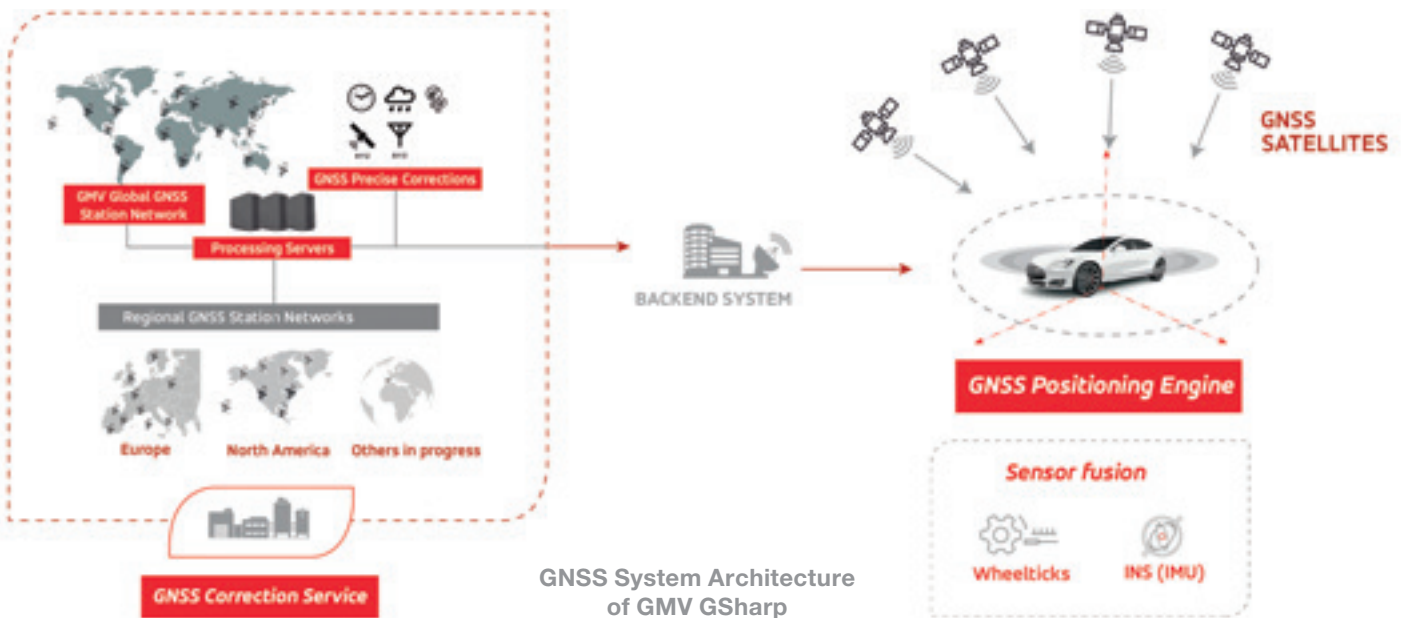
AI: Where do you see future demand, and how are you planning to meet it?

Gutiérrez Lanza: To meet the most demanding requirements of autonomous driving, the system must be capable of progressively increasing the availability of the overall localization function and the level of accuracy. GNSS can provide complementary characteristics to local sensors and fill this role.

We see a promising market ahead. Even with a conservative approach of the addressable market, by the end of the decade, we could expect 13 to 15 million vehicles with levels of autonomy (L2++ and above) requiring a solution such as GMV GSharp for automotive.

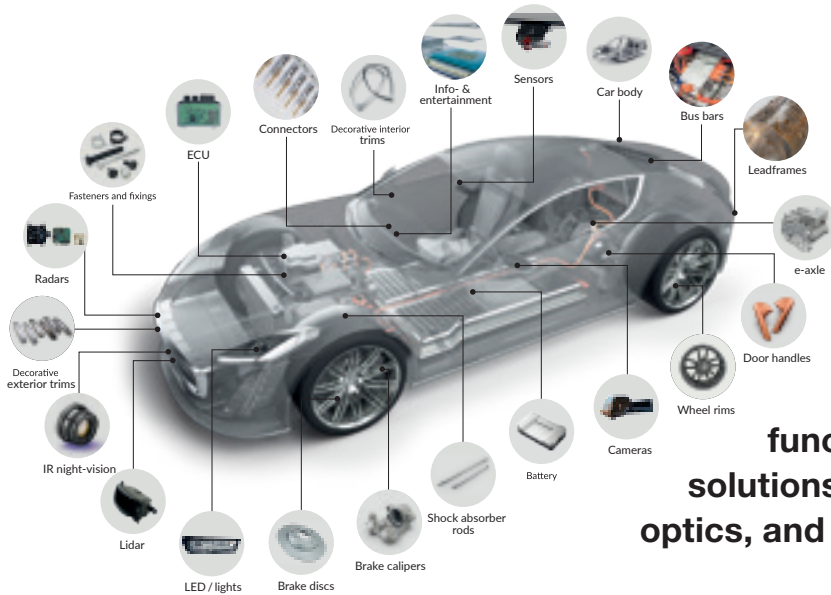
In this sense, a considerable effort is being made to capitalize on all the work done so far and to further progress the product with milestones defined for the short term, with the increase of the Operational Design Domain of the localization function in highways, for the mid-term—in which the performance in urban environments will be significantly enhanced—and for the long term, with potentially hybridizing with communications technologies (e.g. 5G), as some of the options under consideration.

The objective is to clearly lead the supply for safe and highly precise positioning for autonomous driving. **AI**



New technologies for next generation of safer, greener, smarter cars

By: Jon Knox



The future of mobility lies in vehicles that are safer, smarter and greener than ever before. Critical to this transition is the development of new technology for a range of applications and components, including decorative and functional surface finishing solutions, lidar, night vision sensors and optics, and measurement of laser beams.

Automotive Industries (AI) asked John T. C. Lee, President and CEO at MKS Instruments, how the company is responding to these needs.

Lee: The MKS surface finishing and electronics solutions are designed to make mobility more sustainable, sophisticated, and intelligent than ever before. Our chemical solutions enhance durability, improve appearance, and create electrical conductivity and functionality. We make things work, look good and last longer, whether as a final product or a key electronics component.

MKS recently acquired Atotech, a global leader in process chemicals, equipment, software, and ser-

pack. We enable manufacturers to proactively monitor the laser beam making these welds, leading to higher quality, less scrap and thus higher sustainability. Plus, precision welds mean the battery packs last longer.

Once the battery packs are produced, our gas analyzer is used to detect and speciate emissions from lithium-ion batteries to help ensure the quality and make them safer. On the road, our highly accurate thermal imaging night vision systems maximize performance and minimize the risk of collisions.

AI: Please tell us more about your customized solutions.

Lee: Customization is a fundamental MKS strength. Essentially every semiconductor in the world is manufactured with MKS equipment. We have applied this focus on innovation and solving our customers' most difficult problems in all the markets we support.

For example, we are modifying the size of our laser sensors and recalibrating them to enable laser manufacturers and system integrators to use them in automated laser cells. We also collaborate directly with automotive manufacturers on the development of individual laser measurement devices for new production lines.

Our customized surface finishing solutions facilitate new design opportunities and provide ideal functionality. With our OEM-approved technologies, we provide the right solution for

John T.C. Lee, President and CEO at MKS Instruments



vices for printed circuit boards, semiconductor packaging and surface finishing. Our goal is to be the leading supplier of surface finishing to the automotive industry, and to collaborate closely with the industry to further develop current standards. We also help drive design decisions, durability standards, and enable electrification and autonomous driving.

One battery pack, for example, can have 15,000 and more welded electrical contacts to connect the individual cells to a

decorative finishes, corrosion or wear resistant coatings as well as electronic components such as engine control units, ICE powertrains, info/entertainment, Advanced Driver Assistance Systems (ADAS), electronic powertrains or LIDAR and RADAR systems – whatever our customers need.

AI: How do you work with OEMs and Tiers?

Lee: Following the acquisition of Atotech, we offer the largest product portfolio, technical support and services in the market, through 15 global TechCenters, strategically located chemistry and equipment plants, and on-site customer support and consultation.

Our OEM teams understand the needs of OEMs and Tiers and collaborate with their development teams to create new manufacturing solutions, develop new automotive standards and engage in R&D as needed. Customers worldwide value our comprehensive systems-and-solutions approach, innovative chemistry, world-class products and equipment, and superior service.

New processes are first tested in our laboratories and then in our TechCenters. For beta-phase testing, the process is used on a customer's plating line, with all samples tested first by us and then by the OEM for approval.

AI: How do you help ensure consistent quality and minimize defects?

Lee: Our TechCenters offer a host of services, from routine analyses to customized examinations of samples. We collaborate closely with OEMs, customers, and industry partners to undertake sampling, prototyping, and pilot productions under production-scale conditions. We share our knowledge with our customers and industry partners through hands-on training in our TechCenters worldwide.

Our analytical and materials science laboratories handle all kinds of product quality and reliability testing, including performance tests. They are carried out in accordance with international standards and OEM specifications.

For the production line, MKS supplies a wide range of Ophir® laser measurement devices. Many of them are integrated in laser systems or automated production cells to ensure the lasers are operating according to the customer's specifications. The ability to measure the quality of laser beams is vital to ensure that lasers used for welding, cutting or brazing consistently produce high-quality products.

Our measurement solutions are also key when it comes to laser-based sensing applications such as LiDAR and gestures recognition. Ophir measurement devices ensure eye safety and energy efficiency.

We also provide several products used in light and heavy-duty vehicle engine design, testing and certification. Our gas analyzer simultaneously measures, in a benchtop environment, multiple compounds found in exhaust gases, providing engine manufacturers and testers comprehensive insight into the exhaust composition ensuring pollutant and greenhouse gas regulations are met. Our differential manometers measure pressure for engine and emission testing and internal car air leakage.

Our gas analyzer is also used to detect emissions from lithium-ion batteries, before and during a thermal runaway event, providing an important understanding of the breakdown mechanisms and enabling development of new battery designs that can reduce fire/safety hazards.

Our pressure measurement devices, manometers and gauges are used in various applications, including engine testing and certification and for thermal deposition of aluminum on headlamps, hubcaps and any other aluminum coated car parts, and anti-reflective materials on windshields.

AI: What is different about your approach to night vision?

Lee: As the largest automotive IR thermal optics supplier for the European automotive market, our lenses are integrated in the night visions systems of top European cars, with an installed base of hundreds of thousands of lenses.

For maximum performance and minimal collision risk, thermal imaging night vision systems must achieve high accuracy and allow for long distance object detection to provide the driver with sufficient response time.

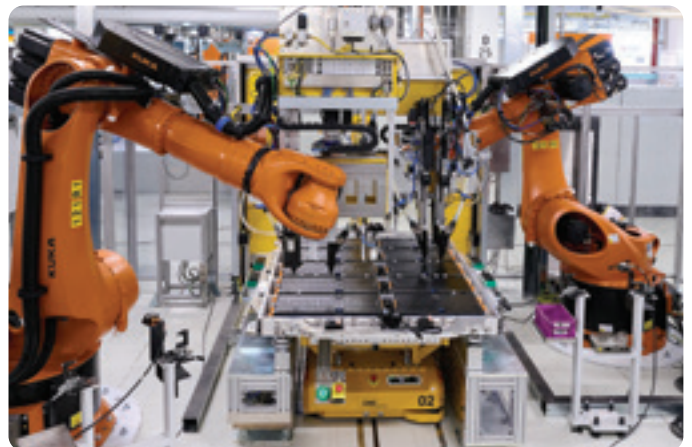
The key to meeting these requirements is the use of high sensitivity and high-resolution optics – such as MKS' athermalized lenses from its Ophir brand. Using innovative optical and mechanical designs, Ophir lenses allow for full operation in all environmental conditions, while also featuring a compact size and competitive costs.

MKS' optics increase pedestrian recognition software performance, allowing a greater ability to anticipate potential hazards. The Ophir IR thermal imaging lenses feature the highest quality components and materials, designed especially to meet the needs of the industry.

AI: Anything you would like to add?

Lee: Solving difficult problems has been a core competency of MKS for over 60 years and the problem sets across our businesses are getting even harder. We are involved in everything from the semiconductors that power smartphones and artificial intelligence, the lasers that enable eye surgery, to the chemistries critical to packaging chipsets for advanced electronics, and the chemistries and equipment for surface modification in the automotive and other consumer industries.

One thread common to all of the applications we serve is that we go to where the hardest problems are. Few can deliver the differentiation and precision required for the best solutions to those problems. By best I mean the solutions that not only best meet a customer's product specifications but do so cost-effectively and at the highest yields. **AI**



MKS technology contributed to the optimization of both the development of the BMW Group's laser welding process and the quality of the manufactured modules. Shown here the production of the high-voltage batteries for the BMW iX all-electric vehicle.

FMEDA-driven SoC Design of **Safety-critical** Semiconductors

By: Francesco Lertora and Robert Schweiger (Cadence)

CLOSING THE GAP BETWEEN SAFETY ANALYSIS AND CHIP DESIGN

Growing complexity of electronics in vehicles is driving the automotive industry to adopt more stringent processes throughout the supply chain.

New tools are needed to close the gap between safety analysis and typical chip design tasks such as safety verification and safety-aware implementation. Because the development of safety-critical semiconductors and IPs is a complex and compute-intensive task, process automation is required to increase confidence in the safety methodology and improve productivity.

ENHANCED SAFETY METHODOLOGY

Legacy safety analysis tools such as FMEDA are not integrated with IC design tools or flows, which means there is no formal way to describe and propagate the safety intent captured in the FMEDA to the IC design flow driving safety tools (top-down methodology). Conversely, there is no formal way to back-annotate simulation-based data from a fault injection campaign into the FMEDA (bottom-up methodology) to replace estimated failure rates with more accurate values.

Key enhancements are necessary to support a top-down and bottom-up safety methodology fully:

- Tight integration between FMEDA and safety IC design flows
- Formal description to specify the safety intent of the chip that all IC design tools support and can adhere to
- Import of the chip design data to establish a formal connection between FMEDA and chip hierarchy
- Back-annotation of simulation results into the FMEDA to improve the accuracy of estimated metrics

The new Midas™ Safety Platform by Cadence meets these requirements through seamless integration with all Cadence IC design flows to enable an FMEDA-driven design, analysis, verification, and implementation of analog/mixed-signal and digital semiconductors and IPs. An integrated framework provides a workflow that guides the safety engineer through all the key steps.

SUPPORTED INDUSTRY STANDARDS

Standards bodies such as Accellera and IEEE have formed dedicated working groups to address the need for common safety standards in addition to ISO 26262.

The Cadence® Functional Safety Solution provides a safety framework with interfaces which work within an ecosystem of tools and flows. It is a modular and open solution that can be tailored to different applications and use cases while having solid foundations in existing standards for functional safety. The Midas platform integrates a safety analysis engine supporting the ISO 26262 (automotive) and IEC 61508 (industrial) standards.

The safety analysis engine can leverage estimated design information (e.g., area, number of flip flops or memory bits) provided by the user or use chip design data of Cadence IC design tools such as Genus™ (Synthesis), Innovus™ (Place & Route) or Xcelium™ (fault simulation) to automatically calculate the hardware safety metrics.

Midas also provides a dedicated engine for the Base Failure Rate (BFR) calculation according to the reliability model for integrated circuits defined in IEC TR 62380 standard. The BFR can be calculated from data such as semiconductor process technology, custom mission profiles, and package information.

FMEDA CREATION

Safety engineers can start with an “Architectural FMEDA” as an initial exploration of safety architectures to identify the optimal set of mechanisms to achieve the safety goals.

Setting up the FMEDA starts with defining the parts and subparts representing the functional building blocks of the SoC to create a hierarchy. One or more failure modes for each part and subpart need to be defined, and a safety mechanism mapped.

If no chip data is available, the base failure rate can be distributed across all failure modes. Once the architectural FMEDA is set up, the safety analysis engine can calculate the hardware safety metrics (SPFM, LFM, PMHF).

Using chip design data, a “detailed FMEDA” can be performed. The design hierarchy is shown as a drag-and-drop hierarchical tree on the Midas platform.

Chip design data such as design instances, numbers for area, gates, and flops are assigned automatically to all failure modes, and the BFR distribution can be adjusted accordingly. A fault injection campaign is then set up in the Cadence Verisium™ Manager App.

Once the safety verification has been completed, the simulation results can be back-annotated to the Midas platform. As the failure distribution and diagnostic coverage values are now based on real design and simulation data, the recalculated HW safety metrics are much more accurate.

UNIFIED SAFETY FORMAT

The Unified Safety Format (USF) is a set of commands to define and verify the functional safety intent in electronic design.

This includes the information required to model, specify, analyze, implement and verify safety-critical systems, semiconductors, and intellectual properties (IPs), enabling the portability of the information across various commercial EDA tools.

USF facilitates the automation of the safety analysis and becomes the common framework to design, verify, and implement safety-critical systems. The safety analysis engine is also available via a command line interface. The Midas platform is fully scriptable and supports different levels of automation.

As with USF, the FMEDA process can be captured, and USF can be modified and reused to automate the FMEDA creation of other projects.

MIDAS SAFETY PLATFORM

The graphical user interface (GUI) of the Midas platform integrates various functional safety tasks:

- Safety analysis authoring (design partitioning, failure modes definition, safety mechanism selection, and failure modes mapping)
- Safety report generation and export of relative metrics (e.g., single point faults metric, latent faults metric) and absolute metrics (e.g., probabilistic metric for random hardware failures)
- Safety configurations to create, save and restore different safety scenarios where one or more parameters can be changed
- Support custom attributes mapping to a safety object (e.g., parts, subparts, failure modes, and safety mechanisms).

SAFETY VERIFICATION FLOW

The Midas platform leverages Cadence as an EDA vendor, providing a safety solution and safety cockpit to enable FMEDA-driven safety verification and safety-aware implementation. Tight integration of the two provides a flexible verification solution, enabling the validation of assumptions made in the safety analysis phase.

The Verisium Manager Safety provides a unified fault campaign management to automate and manage complex fault injection campaigns driving all safety engines such as Xcelium, Jasper™ Functional Safety Verification (FSV) App, Spectre® AMS Designer and Spectre.

The platform covers tasks such as fault campaign execution, test selection and ranking, fault classification, coverage, fault debugging, fault campaign reporting, and back-annotation of simulation results into the Midas platform.

The safety verification flow starts with fault analysis using the Jasper FSV App. The app can identify untestable, unobservable, and equivalent faults that can be ignored in the subsequent fault simulation. This significantly reduces the fault list, accelerating the overall safety verification process. After fault analysis, the Xcelium Safety App simulates all remaining faults, leveraging the serial or concurrent fault simulation engines.

The Midas platform also integrates with the Spectre Simulation Platform and Legato™ Reliability Solution, addressing analog and mixed-signal fault identification and simulation. Analog design information can be fed from the Spectre Simulator.

SAFETY-AWARE IMPLEMENTATION FLOW

The Midas platform enables an FMEDA-driven safety-aware implementation, where the synthesis and Place & Route tools work in tandem.

USF allows the definition of safety mechanisms such as dual-core lockstep, safety islands, triple modular redundancy (TMR), and logic isolation. Once defined, the safety mechanism can be generated by the Genus Synthesis Solution. A USF file describing the implementation of the safety mechanisms can be saved and read by the Innovus Implementation System to drive the physical implementation. **AI**



FMEDA GUI and set-up.

Monitoring vehicle occupants through **rearview mirror-mounted** camera

By: Jon Knox

Driver and passenger monitoring system development has been given a boost through a partnership between two of the industry leaders.

Seeing Machines and Magna have signed an agreement to exclusively co-market driver and occupant monitoring systems targeting the interior rear-view mirror.

It combines the strengths of Seeing Machines, an advanced computer vision technology company that designs AI-powered operator monitoring systems to improve transport safety with Magna, a global mobility technology company.

In terms of the agreement, Magna will invest US\$65 m into Seeing Machines through a combination of cash and a convertible note.

Automotive Industries (AI) asked Paul McGlone, CEO, Seeing Machines, what the benefits are to the OEMs and Tier customers of the collaboration.

Paul McGlone, CEO,
Seeing Machines.



McGlone: Successfully integrating driver and occupant monitoring into the rear-view mirror is very challenging technically. Working closely with the team at Magna, we have managed to do this and it's an industry first.

AI: Why the rear-view mirror?

McGlone: We see it as a – if not the – key location for driver and occupant monitoring system technology. It addresses a few key challenges for OEMs and provides a seamless package

across a diverse line of vehicle models, enabling compliance with Euro NCAP and other regulatory standards associated with driver distraction and impairment. This solution also addresses the issue of increasing electronics and cost

The rear-view mirror provides a very effective cabin camera position as its field of view includes both the driver and occupants of most passenger vehicles. The monitoring of all vehicle occupants will enable OEMs to broaden their range of safety and convenience features across the entire cabin.

AI: Where is the funding for this R&D coming from?

McGlone: While regulation can drive DMS fitment volume, "feature wars" will drive OEM system value and Seeing Machines average selling price (ASP). As one of the leading technology and solution providers in the global DMS sector, we believe this to be a key inflection point for our business.

The balance sheet strength of the exclusive license payment and investment will fund our current business plan and the investment in our technology and intrinsic company expansion that will be required to meet this expanding demand.

Similarly, we will seek to strengthen our technology leadership position in the market. Seeing Machines has its FOVIO chip-based solution that is high performing and able to meet standardized (mass-market) demand. Additional R&D investment is now necessary to maintain and enhance our leadership position by delivering a next generation standardized technology offering to the mass market, in support of expected technology protocols recently released by Euro NCAP.

We would also consider a number of niche technology strategic collaborations to support acceleration of an expanding feature set.

GMV GSharp

SAFE HIGH-ACCURACY RELIABLE POSITIONING
FOR AUTOMOTIVE



GMV's safe precise positioning for autonomous driving

Safe solution compliant with ISO26262, ISO 21448 (SOTIF), ISO 21434
and meeting A-SPICE CL3 quality standards for software engineering.

GMV, a trustworthy technology supplier for automated driving.

- ✓ A long track record in the supply of automotive software to OEMs and Tier-1 suppliers.
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AI: When will the technology be commercialized?

McGlone: Seeing Machines and Magna are already working together on automotive OEM programs which are expected to start production from early 2024.

Further, together with Magna, we announced in April 2022 the launch of a demonstrator that features a fully integrated DMS combining camera, electronics and interior mirror technology. The demonstrator combines Magna's mirror technology, camera design, integration, and packaging know-how, with Seeing Machines approach to optimized and co-designed optical path, embedded processing, and enhanced AI vision algorithms for DMS.

AI: What next for the partnership?

McGlone: We will work closely with Magna to develop the market for driver and occupant monitoring system technology, integrated into the rear-view mirror. That will be the focus until 2025. Obviously, Magna is already invested in the company and that signals interest in our future. Together, we will pursue opportunities that would mutually benefit our businesses and continue to collaborate at all levels to achieve our goal of enhanced safety on roads.

AI: How does the path to full autonomy affect the need for DMS?

McGlone: The dynamic within the industry, in many ways, has been driven by the path to full autonomy which has focused most of the industry's energy and resources towards sensing what is going on outside of the vehicle. But it's the integration of internal cabin sensing technologies, understanding what the driver is or is not doing, that are making huge strides in safety and will ultimately achieve a zero accidents future.

Early driving 'assistance' features, for example the automotive transmission or cruise control system, have evolved and become known as Advanced Driver Assistance Systems (ADAS).



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New FOVIO rollout

Seeing Machines has been appointed by an existing Tier-1 customer to deliver its FOVIO Driver and Occupant Monitoring System (DMS/OMS) for an additional program with an existing large European-based global automotive group (OEM) customer.

This program, to be delivered via Seeing Machines' embedded Driver Monitoring Engine (FOVIO e-DME software library), is geared to lower integration cost and will substantially extend DMS and OMS reach across a broad range of vehicle models (including entry level vehicles), while addressing both regulatory requirements and in-cabin comfort and convenience oriented features. The program carries an initial lifetime value of US\$32M (A\$45M) and is scheduled to start production in 2024.

"This is a great example of our existing Tier 1 and OEM relationships and cooperation leading to the increasingly extended reach of our technology across the global passenger vehicle landscape, which is not only driven by driver safety regulation but also an increasing demand for interior monitoring systems extending the comfort, convenience, and safety of all vehicle occupants," says Nick DiFiore, SVP and GM Automotive.

The emergence of ADAS and external sensing technologies, such as Traffic Sign Recognition, Lane Departure Warning and Blind Spot Detection are now familiar to most of us. Recognizing that drivers are prone to error, safety technology providers are taking a systems approach to assist, enhance and even handle the driving task.

Signals provided by the driver monitoring system could and will provide information that allows for safer and more complex decisions about when and how to intervene in a potential collision.

AI: Any final comments about what's happening at Seeing Machines?

McGlone: A definite advantage of the collaboration with Magna is that, through access to the convertible note funding, our balance sheet is significantly strengthened, and this really does set us apart in our industry.

Developing a new technology, like driver monitoring system technology, takes many years of R&D and the ability to lead the industry with new features that OEMs are looking for, in order to enhance the safety technology and provide convenience options, is something that we are now able to continue to focus on.

The work we have done with regulators and government bodies around the world has helped establish DMS as a key enabling technology for the foreseeable future and this is set to extend beyond Europe and China, to the USA and eventually, everywhere around the world.

More generally, over the past year we have been appointed to six additional automotive programs, bringing our OEM count to 10 across 15 expanding programs. We have also received our first award from the Japanese market.

We have an aftermarket (commercial transport and logistics) and aviation business, both of which are also progressing well, and we think that the future is definitely a bright one for driver and occupant monitoring systems and Seeing Machines is at the forefront of the industry. **AI**

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