GF Machining Solutions

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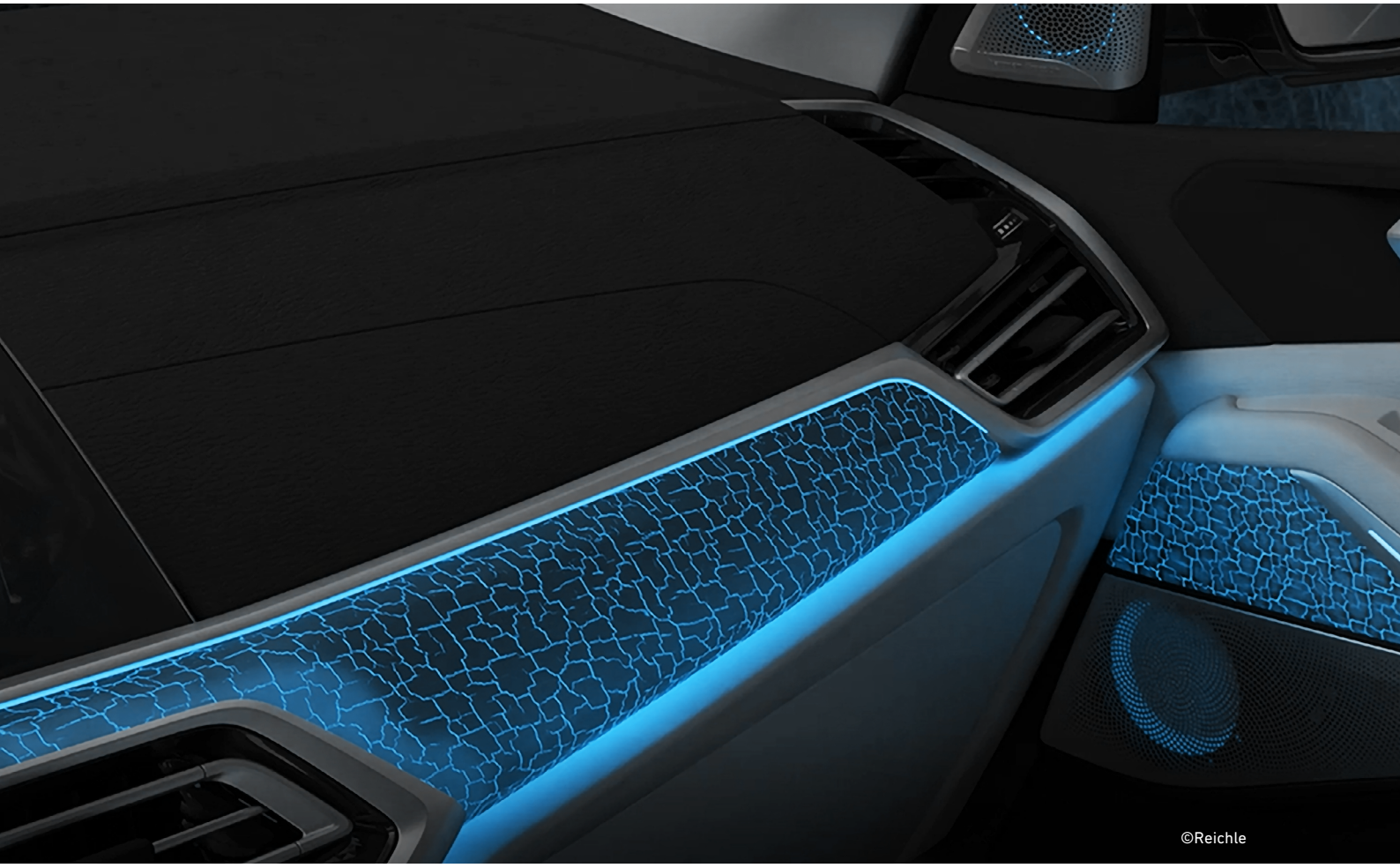
When a new mold manufacturing era begins

Revolutionize car design with Laser texturing

Introduction



The automotive world has always been extremely competitive and manufacturers struggle not only to differentiate themselves from each other, but also to market different ranges within their own vehicle portfolio.

This differentiation and this competition obviously go through the performance and price of the vehicles, yet aesthetic aspect and design has become important characteristics. This is even more true with the appearance of new electric vehicles, which allow the emergence of new aesthetic codes. However, it is also true with the increase in ecological considerations, which push manufacturers to work with new materials that are more "eco-friendly" and allow the creation of new atmospheres or new emotions.

It is in view of these growing challenges that many automotive players are now turning to laser ablation. This Laser technology allows the manufacture of complex patterns and other functional characteristics on the cavities and inserts of injection molds, replicated afterwards on finished products.

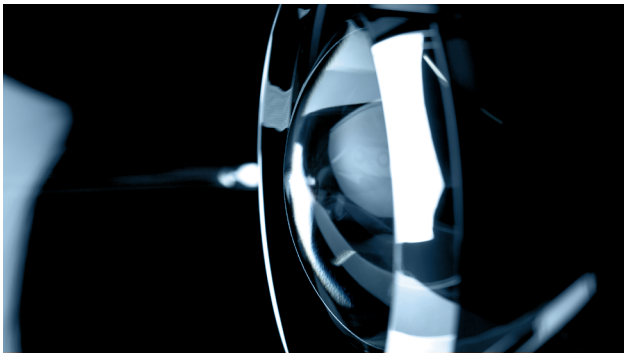
Textured surfaces serve both functional and aesthetic purposes. For example, grainy textures and streamlined shapes of automotive interiors and exterior components convey a superior image and feel of high quality and value at minimal additional cost.

With the advent of Laser texturing, product designers are developing precise and complex textures through five-axis Laser texturing driven by computerized imaging and computer numerical control (CNC) technology. Laser texturing makes it easy to produce intricate patterns and other functional features on mold cavities, finished products and a wide range of other items while the speed and convenience of laser allows rapid response to changing demands for personalization and time to market. Molds for automotive components as large as door panels, bumpers, and even entire interiors can be laser-textured directly, quickly and accurately.

Now, textures generated with 3D CNC laser guidance offer designers a dramatically expanded range of pattern choices and precision, some of which were not possible with previous texturing technologies.

New design in car lighting

In addition to stylistic choices, lighting designers are also incorporating more advanced textures due to recent advancements in efficient light illumination technologies. These technologies are also deployed in side lights, interior ambient lighting and center height stop signals lighting modules.
Not only does every car manufacturer want to have a different pattern than the competition, but each manufacturer also wants the general consumer to be able to distinguish one style from another.
Our Laser texturing technology allows complete control of lens mold features. It provides distinct demarcation between textured and unaffected areas, something that can be difficult or impossible to achieve when using chemical etching methods.



If you want to know more,
watch our testimonial with Microrelleus

New design in tire mold

Tire OEMs and mold makers need to achieve distinctive and contrasted branding; the side wall is the perfect place for that. Traditional processes are currently too limited to manage production targets and match design features. Learn why tire supply chains are moving towards GF Machining Solutions' Laser technology ideally complemented with complete preprocessing by Milling.

If you want to know more,
download our brochure

Challenges

Automakers were early adopters of Laser texturing. They quickly identified solutions to overcome the challenges they are facing, both from a design point of view and from a production point of view. These challenges can be summarized by the following six points:

Aesthetic and functional textures

Traditional technologies prevent designers from using all their creative ability. They act as a limiting factor to the development of new designs for both exterior and interior parts. In addition, the emergence of functional surfaces, for example, with anti-scratching capabilities are pushing non-laser techniques to their limits.

When using traditional methods such as chemical etching, designers cannot master entirely the complete design structure that is created inside the mold. This is because of the etching process and how the acid reacts with the mold. In addition, it is difficult to achieve very low gloss or high gloss levels on certain plastics.

Complex manufacturing processes

Today, textures are made with very complex production lines offering only limited flexibility. When observing traditional manufacturing processes, one can notice that there is often a multitude of different steps. Each step requires a certain skill. This often creates complex, long and expensive production conditions. Applying only an acid film on a mold might require dozens of hours with a lot of skillful manual work required.
This long lead time generally creates a lot of stress for the mold maker who is expecting to get the textured tool as soon as possible. This back and forth for the texturing process can sometimes takes months.

Challenges

Repeatability of results

One of the most important challenges when creating textures is the repeatability of results. With conventional techniques, it is very complex and almost impossible to obtain the same texture results from one mold to another, even in the same factory and even more depending on the different production conditions, such as the use of different polymers, injection technologies, including recycled plastics.

Environmental consideration

One of the major problems when using the widely used chemical etching technique for creating textures is the use of acid and as a consequence the waste treatment required. This is a growing issue for both etchers, contractors and economic, social institutions and political organizations.

Skilled workforce

Traditional technologies often still involve many manual steps. This leads to longer manufacturing times and non-repeatability of results. In addition, many companies face difficulties in attracting qualified employees, experts in the manual creation of texture.

Material selection

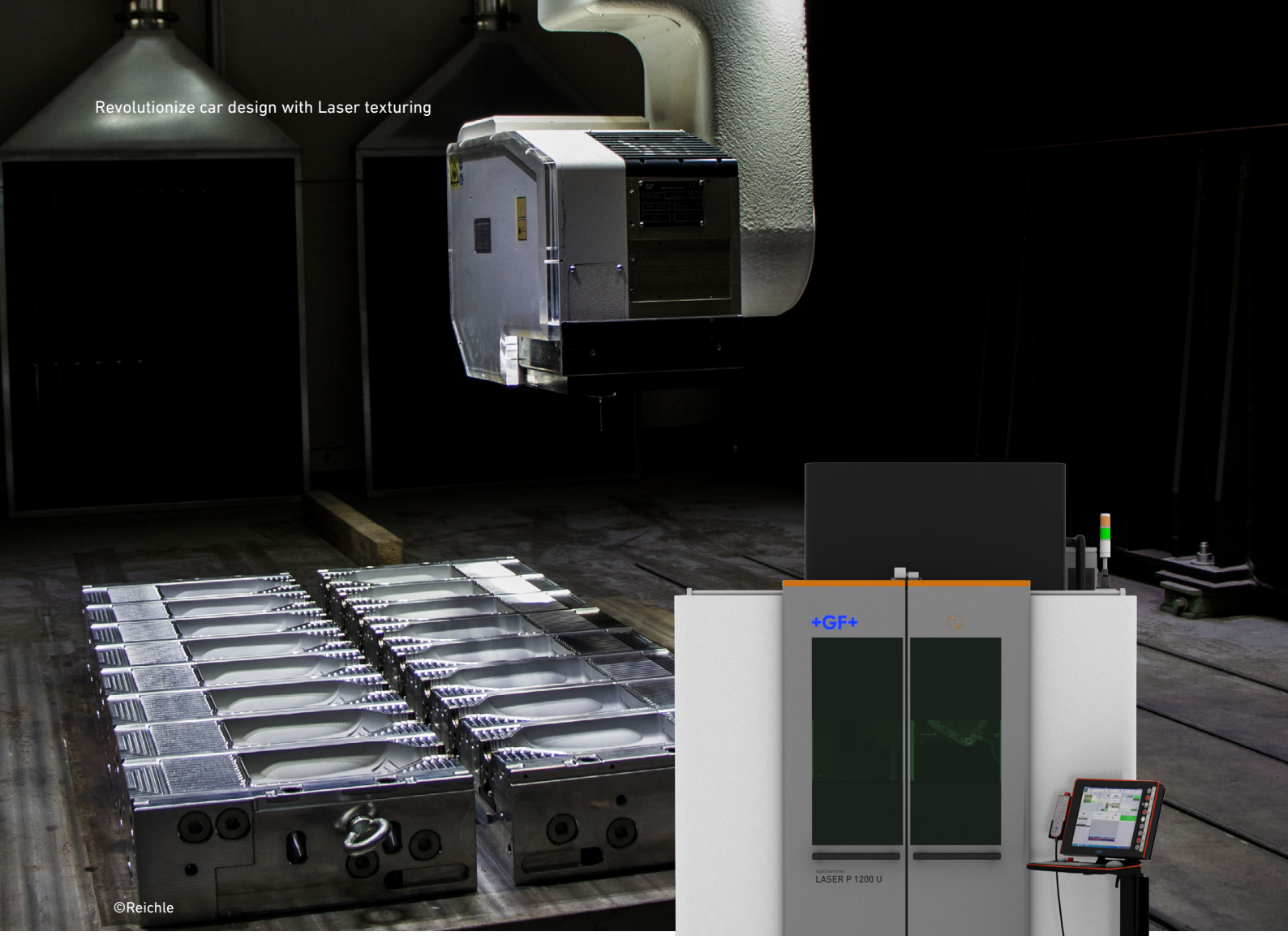
Chemical etching process requires specific steels therefore limits the choice of materials.

Solutions

Our Laser technologies

Current Laser texturing technologies such as the GF Machining Solutions Laser texturing systems offer fully digitized manufacturing processes for generating detailed and nuanced texturing, micro-structuring, and marking. The technology is faster, more accurate and more repeatable than mechanical and chemical processes, in addition to being environmentally friendly. Multiple textures can be applied on the same component, with no need for masking that is required in multiple applications of chemical etching.

The Laser systems use high-quality digital images and CAD data, allowing for completely reproducible results in both large and small job lot sizes. The system's dedicated workstation software enables in-depth job preparation control (CAD/CAM), including UV mapping for applying textures and 3D simulation. Digital images can be bitmap/grayscale files created in Photoshop or STL files derived from a natural surface via reverse engineering with a 3D scanner. Versions of the machines can handle workpieces up to 4 × 3 m in size.



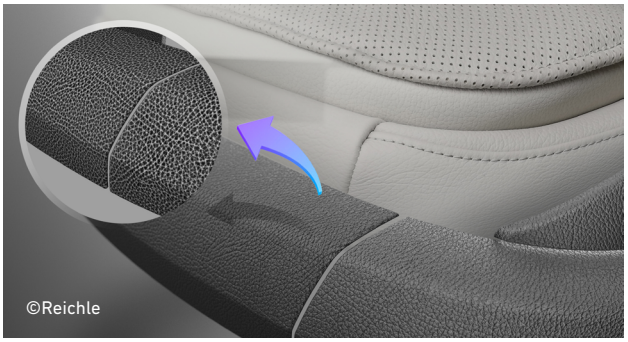
LASER P 1200 U

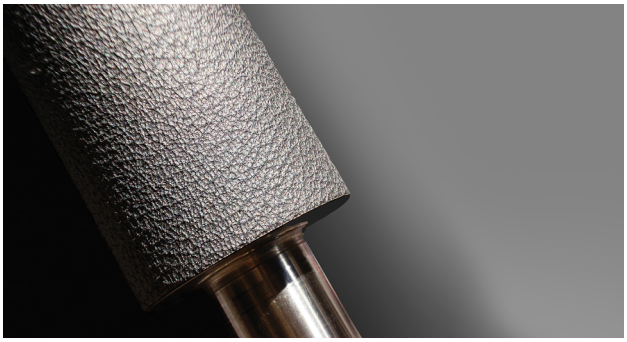
After the machine's workstation software merges a virtual workpiece with a virtual texture, the application engineer can preview the final design results. Programming of Laser texturing operation basically requires only the same programming skills as would need to machine a simple component on a conventional CNC machine tool.

The machines uses a pulsed fiber lasers to render the desired patterns or textures. Fiber lasers are extremely precise and can remove several microns of material at a time. Machines can make very light and shallow cuts or no cut at all, sometimes using the laser to only change the visual aspect of a part's surface for strictly aesthetic reasons if desired.

The choice of Laser texturing technology (laser pulse duration, power, texturing pattern) is driven by the surface the manufacturer wants to produce. While these machines employ nanosecond lasers, GF Machining Solutions also offers machines that use femtosecond, or a combination of both of those laser pulse technologies. Nanopulse duration lasers will both ionize metal and locally heat the surface being treated, while the ultra short pulse duration of femtosecond lasers prevents materials from entering a fusion state during texturing, making them ideal for use on heat-sensitive parts.

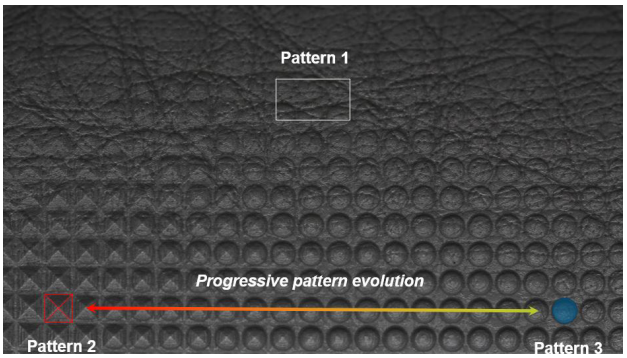
Aesthetic and functional textures





Traditional technologies do not allow designers to use all their creative ability. This has become a limiting factor to the development of new exterior and interior designs in the past years.

For interior and exterior of cars, surface texturing is moving more towards geometric grains, and less towards the use of classical leather grains. In addition, we observe an increase in the complexity of textures, with more gradients, from shiny to a matte effects, or with a different depth. Another big trend in car interior is related to fading aspects within plastic parts.

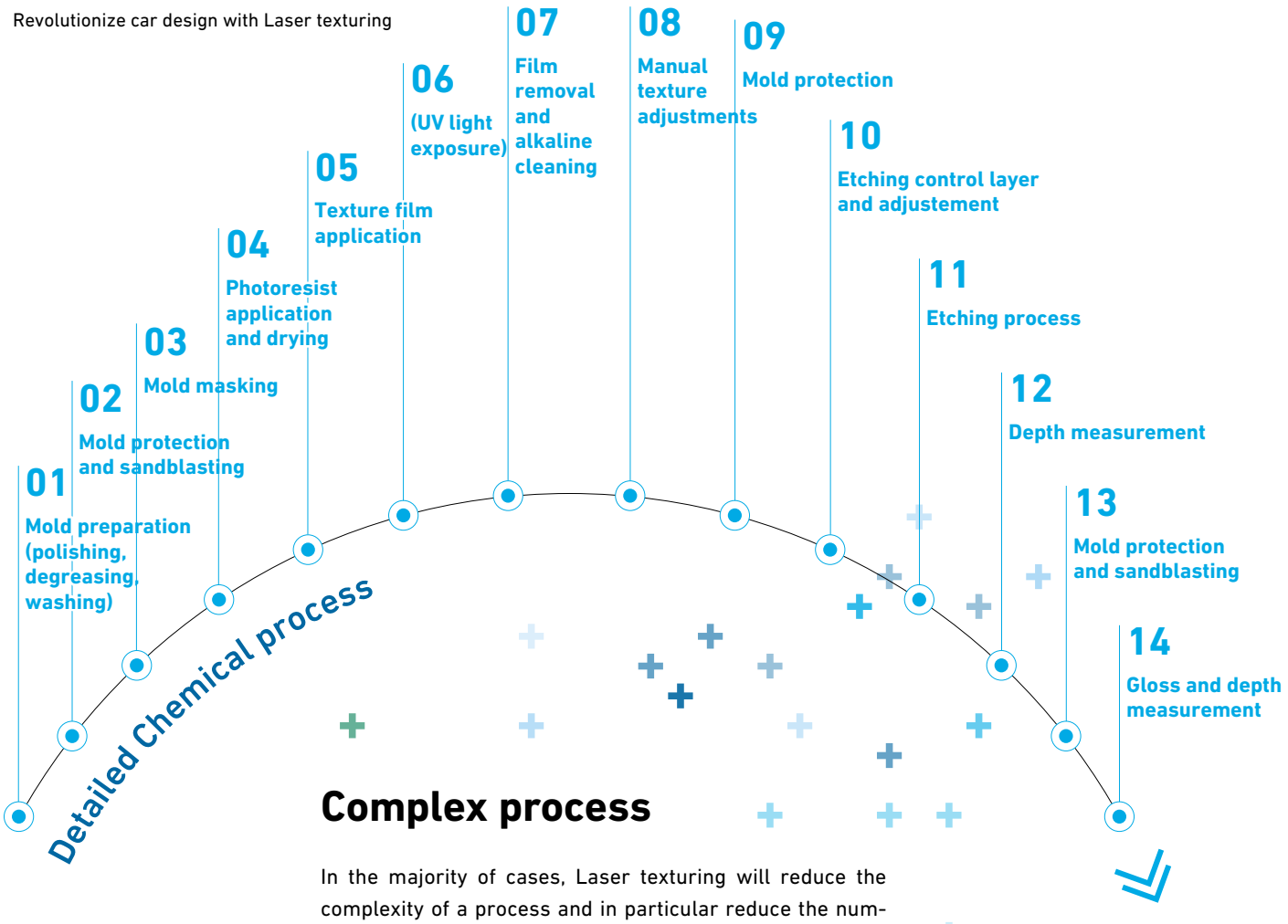


The picture above demonstrates how a completely digital process provides the opportunity to seamlessly blend different textures into one. This example shows a leather texture being blended into a dimple texture, all on a single workpiece.

This complexity and the ability to have high quality renderings can only be done thanks to laser ablation.

An additional advantage that laser ablation offers is the ability to have different depths within the same mold. If a user desires two or three different textures within one mold and would like one to be set at a different depth than another, it is as simple to achieve as indicating the depth difference while programming the part.

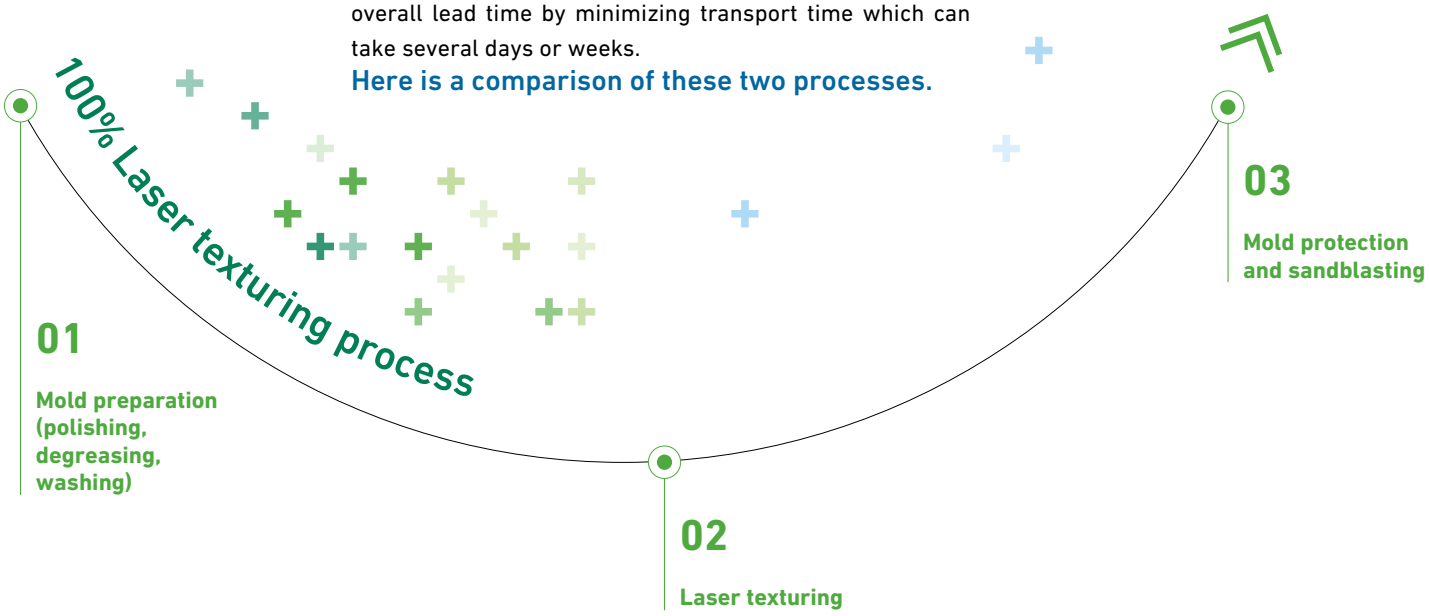
In addition, industry actors seek to obtain so-called functional surfaces. A good example are scratch-resistant structures, which are becoming increasingly popular in the automotive industry. It is not impossible to achieve them with other technologies but it is much more complex and more expensive. There is also the search for critical areas on exteriors parts such as spoilers or doorsills, which are designed to be water repellent, and where matt surfaces are designed to reduce reflections from the dashboard towards the windscreen.
A fully digital process enables the creation of new textures that were not previously possible because of the limitations of chemical etching.



Complex process

In the majority of cases, Laser texturing will reduce the complexity of a process and in particular reduce the number of steps. This is even more true when compared with chemical etching. Laser texturing is essentially a digital process. The initial step is to map the pattern as a grayscale bitmap, with the darker sections representing deeper ablation. The grayscale bitmap is then superimposed over the 3D mold data. The injection mold is finally positioned inside the laser machine and the texture is applied following the defined program. Thanks to 3D rendering, textures on final plastic parts can be simulated and fine-tuned ahead of receiving the physical mold. In addition, this approach reduces overall lead time by minimizing transport time which can take several days or weeks.

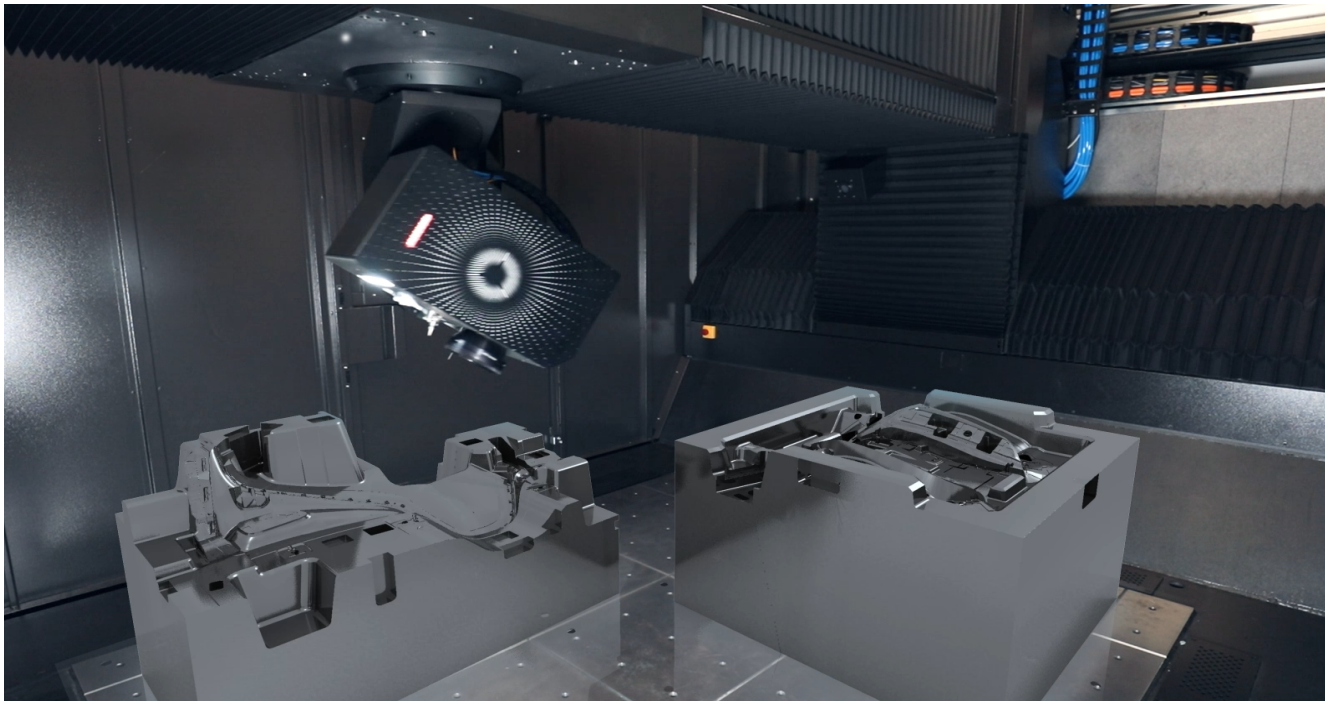
Here is a comparison of these two processes.



Repeatability

Obtaining a high repeatability is difficult with conventional techniques. Laser ablation allows to circumvent this issue, as it is essentially digitally-controlled. With a traditional manual process, variability is inevitable in graining depth and gloss level.

Laser ablation allows a user to maintain a smooth and flawless texture across parting lines in a mold. If there are two separate molds that eventually will be put together, the manufacturer can ensure the texture will transition from one part to the next with a seamless appearance.



When automobile parts are globally sourced and produced, complicated and labor-intensive processes such as chemical etching often do not translate well across countries and continents. Because the digital commands guiding CNC Laser texturing programs are the same worldwide, Laser texturing can reliably produce the same part features at multiple suppliers.

Revolutionize car design with Laser texturing

Transparent design process

Laser texturing files can be created from scratch in-house or include surfaces derived from natural sources via reverse engineering with a 3D scanner. CAD/CAM software for the laser process allows transition-free patching, UV mapping for applying texture and 3D simulation, resulting in a “what you see is what you get” situation for programmers. In addition, there is a better connection and exchange of information between the manufacturer and the designer, helping to reduce the lead time.

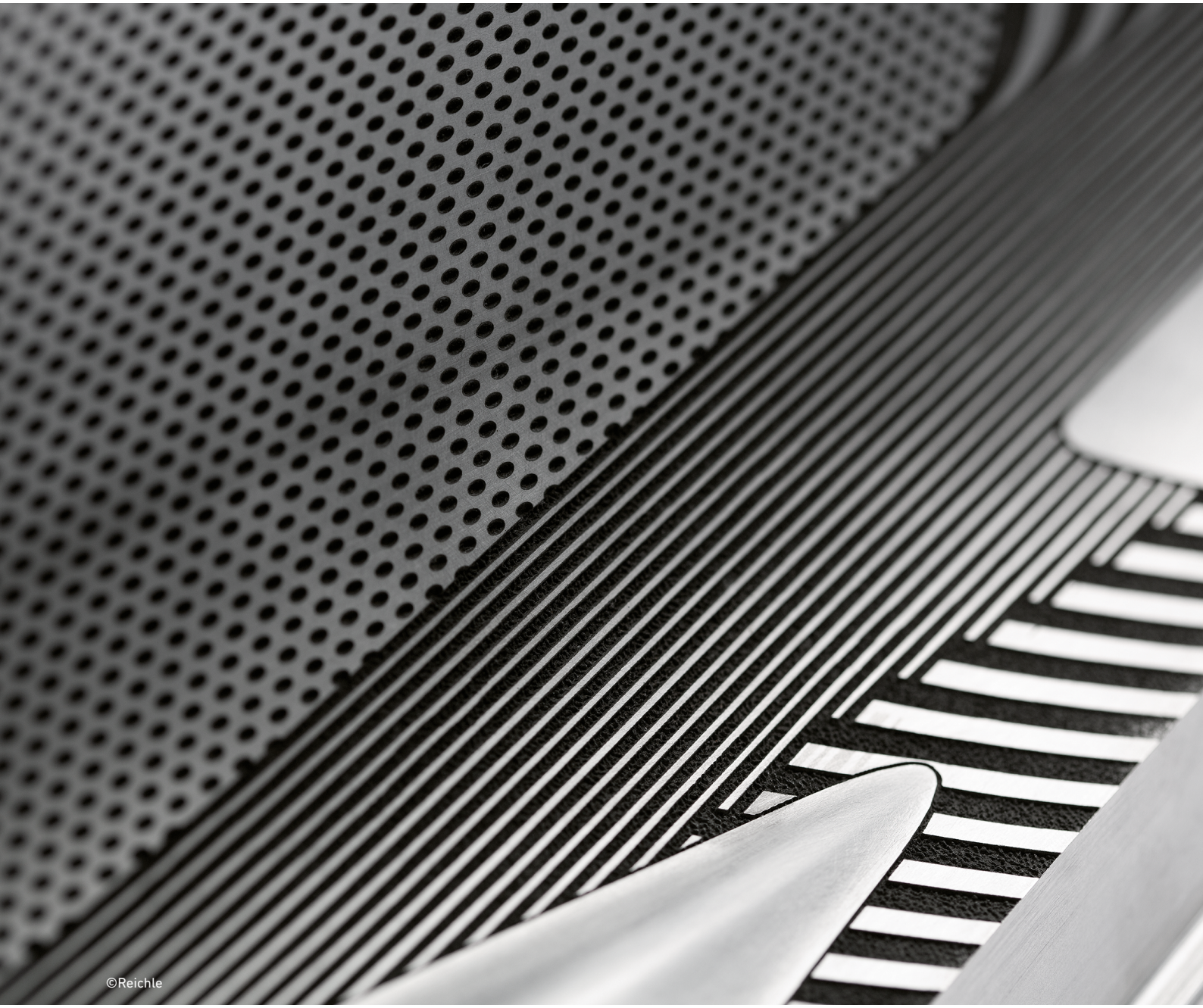
Today we see traditional etchers making the move to catch up on new texture demands. Conversely, the digitally-controlled process used in Laser texturing gives manufacturers much more freedom in creating new textures. In parallel, tier 1 mold makers are ready to invest and internalize this added-value operation. This is driven by several levers:

- Keep knowledge internally and maintain a confident relationship with their own customers. This is crucial in today's competitive landscape where innovation and new products launches are essential.
- Make sure quality is stable without the need to subcontracte this operation to a third party

Sustainability

With chemical etching, large quantities of etchant are required. These products are not ecological and their usage is facing critics in term of environment consideration and sustainability. With Laser texturing solutions, you eliminate complety the usage of acids.

Jialong's testimonial on "Targeting sustainability with laser"
Jialong Sculpture is a leading company in Laser texturing services to the automotive industry in China.. The company has invested in multiple Laser texturing solutions from GF Machining Solutions, including two LASER S 2500 U. In this video, Yiming Gong, CEO, presents how the Laser technology has impacted his business and is moving the company away from chemical etching. Watch the testimonial



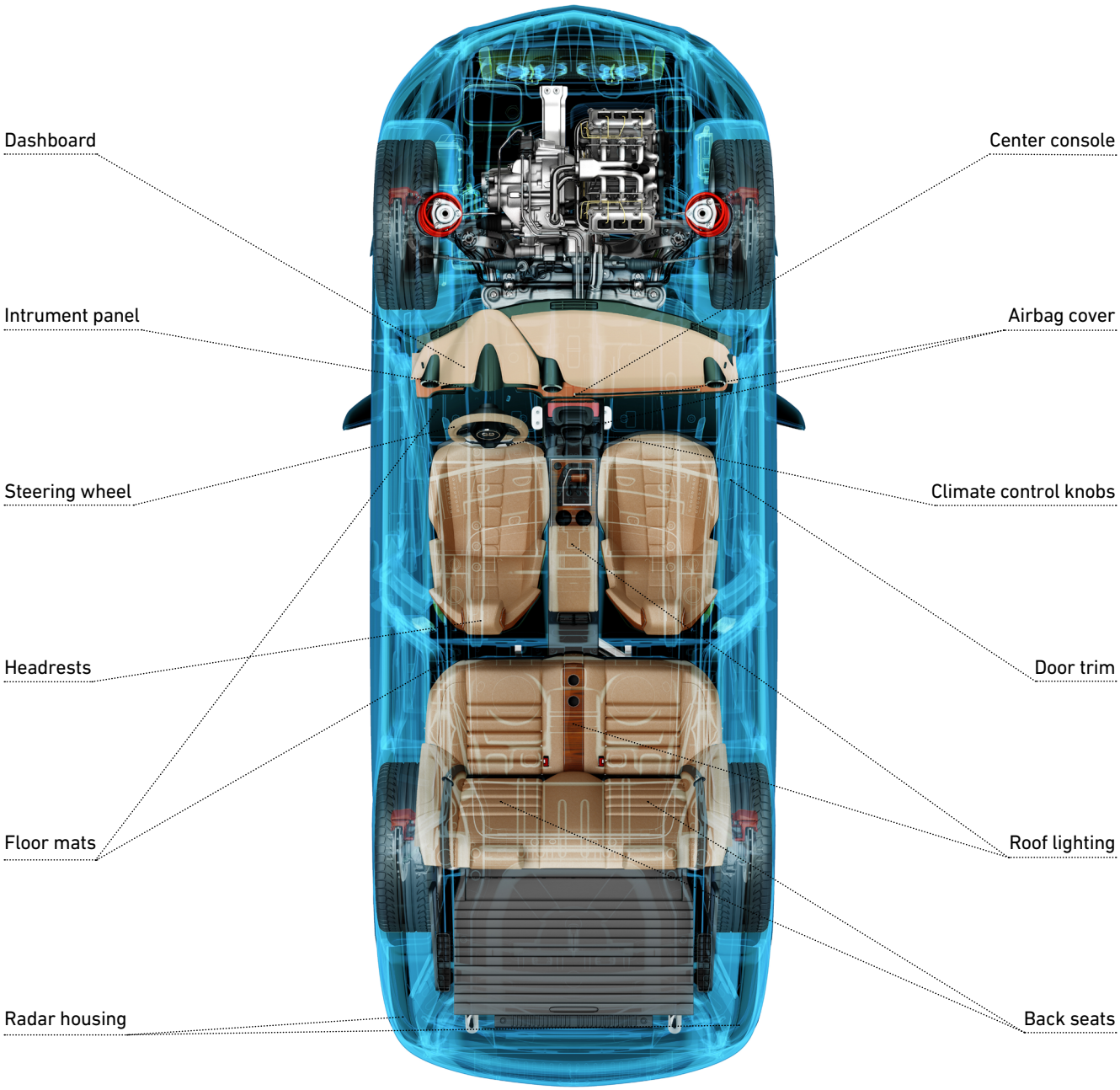
Labor skills

Many companies face difficulties in hiring employees skilled in creating textures manually. Thanks to the fully digitized process of Laster texturing, a large part of the operation is performed through CAD/CAM and laser setting.

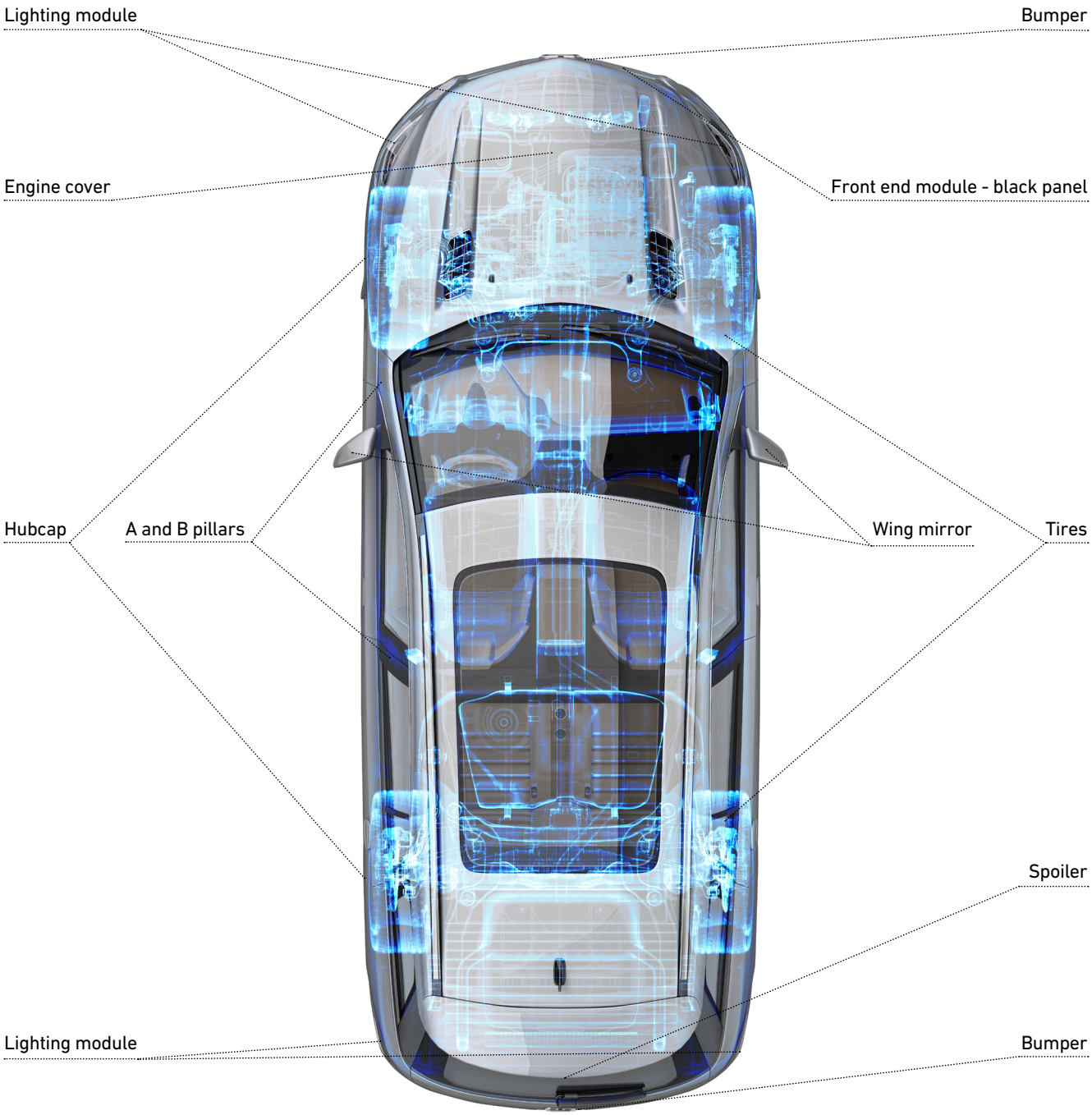
Material selection

Laser ablation enlarges the choice of material that can be machined such as high-carbon or chromium alloy steels.

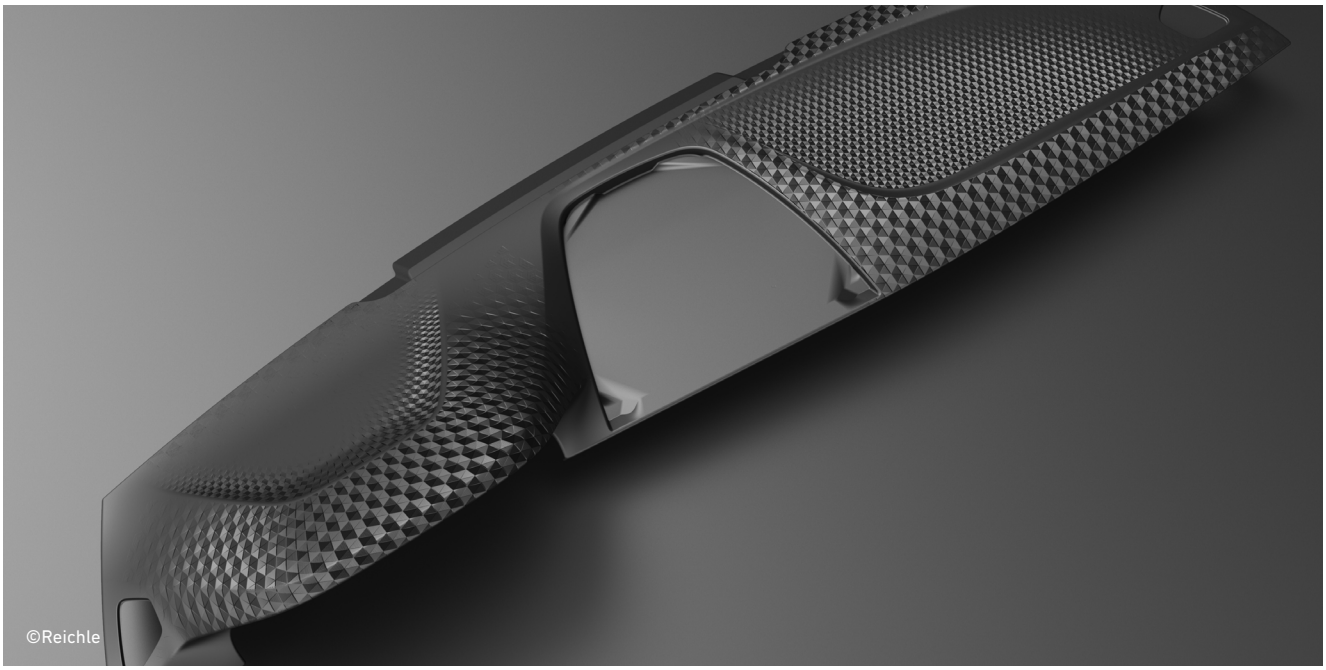
Applications



Applications



Conclusion



Laser ablation for the creation of textures is becoming increasingly important in the automotive industry for car interiors and exteriors. Current Laser texturing technologies such as the GF Machining Solutions LASER S five-axis texturing system offer fully digitized manufacturing processes for generating detailed and nuanced texturing, and developing completely new designs, in line with the industry's trend.

The technology is faster, more accurate, and more repeatable than mechanical and chemical processes, in addition to being environmentally friendly. Multiple textures can be applied on the same component, with no need for the masking that is required in multiple applications of chemical etching. Any EDM VDI textures and any etching grains can be created while maintaining an extremely high repeatability between not only molds, but also between factories located on both sides of the world. Going digital to avoid etching provides substantial advantages, such as reducing the need for harsh chemicals and reducing turnaround times.

The Laser technology allows manufacturers to win the market race to advanced mobility and new energy vehicles, as well as helping designers access new possibilities.
GF Machining Solutions is proud to be pioneer and to share its experience in helping the automotive supply chain lead and grow within this competitive market.

Your contact

GF Machining Solutions
Roger-Federer-Allee 7
2504 Biel/Bienne
Switzerland

www.gfms.com