More Flexibility and Sharp Edges

Laser technologies extend the freedom of day-night design and can also be applied to chrome (III)

Marco Läufle

Today, many components have to present an opaque surface in daytime design and be transparent in nighttime design, like this backlit element manufactured by KTB for the instrument panel on the passenger side of the Audi A6. (Source all images: Kunststofftechnik Bernt)

Manufacturers swear by plastic for panels, knobs and controls in modern vehicles because the material is lighter than metal and the manufacturing and processing costs are comparatively low. In order to still meet the requirements for good haptics, scratch resistance and a noble design, the plastic components are electroplated to give them a metallic surface. However, the industry is facing new challenges that make it necessary to adapt the electroplating processes.

Among other things, the demands on the design and functionality of these control elements are increasing. For example, many of them have to be provided with partly multicolored symbols and be easily recognizable at night, i.e. they must be designed in a day-night design. Kunststofftechnik Bernt meets these challenges with an adapted process chain in which several lasers play a special role. The laser technology allows a high degree of flexibility in design. In addition, symbols, fonts and structures can be implemented very sharply and cleanly to generate a high-quality appearance.

Multicolored symbols that are backlit, finely structured surfaces and high-quality gloss with a convincing feel: these are just a few of the requirements that automobile manufacturers place today for a customizable interior ambience. For electroplating companies that process and finish the necessary parts before final assembly, this increasingly means developing and adapting their own processes to meet the increasing quality demands. Precision and attention to detail in production should be felt and visible in the vehicle. This makes it all the more important that the contrast between the surfaces and symbols does not run or that they appear unclean or are unevenly backlit in the night design. But this requires new, mature processes that go beyond normal printing methods or the simple manufacture of the components using multicomponent technology.

With multicomponent technology, it is possible to let the transparent component pass through to the A-side surface and thus create backlit symbols or structures. However, there are considerable limits to the richness of detail and the fineness of the structures with this technology. Conventional printing

Since KTB has its own injection molding facilities, raw parts consisting of three components can also be produced on site. In addition to 2 K components, these can also be easily structured and processed with a laser. Here: a 3 K panel in the multifunction steering wheel of the Mercedes S-Class

technologies generally use pad printing to print a covering coating on the surface of the component to keep the illuminated structures free of the metal layer. However, these methods have the disadvantage that the edges of the translucent structures look washed out and imprecise. Laser technologies offer an alternative. Although they involve a higher initial investment, the running costs can be limited, as the otherwise necessary production and provision of new or different tools can be dispensed with. Laser marking allows several different variants with different symbols to be created on the basis of a component. In theory, this technology also allows the personalization of components.

However, an injection-molded part cannot simply be coated with the desired metal optics and then directly processed with a laser. The applied finish is simply too thick and if the entire metal layer were treated, the underlying plastic would melt.

For this reason, Kunststofftechnik Bernt uses a process in which the component is ejected from the system after pretreatment before the actual electroplating process and then processed with a laser.

The pretreatment layer (electroless nickel) is a very thin layer that can still be easily processed with the laser without excessive heat input into the plastic component. Due to the fast and punctual processing, very fine geometries and symbols can be defined and worked out. The high precision ensures good reproducibility, so that automation is both sensible and possible for large quantities.

Hidden line: more flexibility in day-and-night design

But there are further challenges: today, many components have to present a closed surface in daytime design and be transparent in night-time design. This is achieved with many fine structures, such as rectangles with an edge length of less than 0.5 mm. The production of such structures requires laser systems of the highest precision and very fast scanning heads. Kunststofftechnik Bernt has several such precision lasers. In principle, this method is suitable for all components that are to be illuminated in day-night design. How precisely the laser can structure can be shown with a magnification of a typical component. If, for example, the elongated area of a decorative panel is to be fitted with fine diamonds measuring 200 × 200 µm and spaced 50 µm apart, the laser can be moved very close to the edge surface without risking inaccuracies. The high repetition accuracy means that this component can be used to produce around 40,000 squares in a few minutes, precisely and reproducibly.

3-shot molding technology: multicolour day-night design

Since Kunststofftechnik Bernt has its own injection molding facilities, raw parts consisting of three components can also be produced on site. In addition to 2 K components, these can also be easily structured and processed with a laser. An additional component is useful, for example, to avoid creaking noises and to enable active steering wheel lighting. Active steering wheel lighting means that individual symbols are illuminated separately from the others. This requires light-tight bulkheads that prevent extraneous light from illuminating the other symbols. In both cases, an intermediate layer is required which serves either as a noise buffer or as a light barrier. The lowest layer under the symbols is formed by light guide components made of transparent polycarbonate (PC) which scatter the light and direct it to the surface. The middle layer is black PC, which acts as a light barrier or light labyrinth. It separates the illuminated areas from the non-illuminated areas. The third component is a plastic (for example ABS/PC), which can then be electroplated. Fully automatic camera control in the injection molding, laser and final quality control process stages checks the radioscopy and the symbol position.

Company

Kunststofftechnik Bernt

Kunststofftechnik Bernt GmbH is a competent, reliable and certified development partner and supplier of high-quality plastic parts. The company has extensive expertise at all stages of the value-added chain, from parts development and tool design to mold making, plastic injection molding and surface finishing in its own plastic electroplating shop. The range of services extends from precise technical functional parts to surface finishing; often it includes the production of complete assemblies. New technologies and process applications such as lasers and automation components are also used. Customers include companies with a focus on the automotive, household appliance and sanitary industries. The company is based in Kaufbeuren and employs around 300 people.

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In the Litho-Graphics method, a UV-curing covering varnish is applied in the area of the symbol. This can be done with different methods. In addition to a spray application such as lacquering, for example, printing with Tampoprint has proven to be a successful method.

Illuminated brush: brushed surfaces with surface light effect

In addition to an extended day-night design, car manufacturers are increasingly requesting brushed surfaces on the fascia panels and other components to achieve a noble, aluminum-like appearance. Kunststofftechnik Bernt has developed the Textured Plating Technology for this purpose. Here, injection molded parts are produced with a tool in which the visible side (often the nozzle side of the tool) is structured by laser processing in such a way that the resulting molded part receives a brush structure. However, when such a part is conventionally electroplated, the copper layer in particular provides a certain levelling of the structure. This is intentional with normal components, since slight surface defects and, for example, conjoinings are concealed, i.e. become less visible. However, brushed components look more artificial and not really brushed. In a coating process specially developed by Kunststofftechnik Bernt for this application, this levelling is reduced to a minimum, resulting in components that only a specialist can distinguish from components that are actually brushed.

With Illuminated Brush, lighting can now be combined with this technology. The use of lasers on the component has the decisive advantage that the brush structure can be illuminated over a large area by removing the electroless nickel layer in the direction of the brush structure. The process can be applied to the entire component as well as just to parts of it.

Litho-Graphics: curing symbols and graphics with laser

A further development of the proven laser process from Kunststofftechnik Bernt is pursuing two main goals. On the one hand, a process should be offered at lower cost and on the other hand, flexibility with regard to design and coloring should be increased. However, accuracy and edge sharpness should be at a similar level if possible. This has been achieved with the development of the Litho-Graphics process. In this method, a UV-curing covering varnish is applied in the area of the symbol. This can be done with different methods. In addition to a spray application such as lacquering, for example, tampon printing has proven to be a successful method. As far as accuracy and edge sharpness are concerned, this process cannot reach the level of laser technology by far. However, this is not necessary at all, as the UV coating is only cured with a UV laser exactly where the symbol is needed. Excess, uncured varnish is then cleaned off. On the cost side, the fact that the components can now be electroplated in one process and do not have to be discharged from the electroplating plant after pretreatment is a positive factor. This is due to the fact that the process described above can be carried out directly on the raw injection molding part. At the same time, it is also the laser in Litho-Graphics that ensures the flexibility, accuracy and edge sharpness of the process. Multicolor capability has now been added during the development of the process. In the printing process, up to four different colors can be applied in one step. In addition to the classic motifs such as the window regulator symbol, typical multicolored identification marks can now also be added, such as the manufacturer's brand symbols or flags that are translucent.

REACH: chrome (III) as a possible alternative to chrome (VI)

Since September 2017, chromium (VI) can only be used under very strict regulations and for a limited time. Current plans assume that authorization will be granted until at least 2024. Kunststofftechnik Bernt is already working intensively on alternatives. Since September 2019 all the technologies described above, as well as conventional components, have been available with a chrome (III) coating. The first components are already in series production.

Conclusion

Increasing demands on the design as well as stricter requirements by the legislator with regard to the choice of materials should ideally be met in electroplating by adapting the individual process steps and incorporating new technologies, even if these may initially mean a higher investment. Taking laser technology as an example, it is clear that the greater flexibility in processing achieved as a result can have a positive effect on the running costs and the final quality of the product. In addition, by combining already optimized processes, it is also possible to deliver additional functionality with high design and material quality. For example, 3K technology, brushed surfaces and different day and night design technologies can be combined well.

Author

Marco Läufle, born in 1987, completed his training as a process mechanic specializing in plastics and rubber technology in 2005. After a few years of industrial practice, he began further training as a technician in the field of plastics technology, which he successfully completed in 2010. He has been working for Kunststofftechnik Bernt as a project manager and key account manager since 2012. During this time, he has already set accents in the development and implementation of innovations. Since 2019, he has been exclusively responsible for process development and innovation.

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