VDMA examines laser's added value to the glass industry

At its February meeting on laser technology, VDMA's industrial working group examined how lasers enjoy such pride of place in glass production today, with various companies presenting the applications that most stand out for them - both in terms of low-maintenance and high cost-efficiency.

For many glass products, precision cutting, drilling, coating, melting and texturing state-of-the-art specialist glass are all performed by lasers now as mechanical processes begin to reach their limit.

One example is evidenced by ultra-thin glass processing for displays where glass, often with tiny cut-outs, cannot be cut by using mechanical means. Instead lasers help here to break up coated insulating glass units with finely-drawn patterns without any significant change to the appearance of the glass - thus allowing noticeable improvements to mobile reception inside buildings. Lasers even enable thermal processes. Glass coatings can be heated to hundreds of degrees, thereby enabling change without subjecting the glass itself to such temperatures - a technology that offers enormous benefits, particularly when it comes to processing thermally-tempered glass.

ENERGY SAVINGS

Using laser technology allows processors to save CO2 - even eliminate its use altogether where alternative energies are used. This is because there's neither a need for energy-intensive process water treatment after additional grinding, nor for producing cutting and separation equipment with high levels of material wear.

LASER CUTTING TODAY

Flabeg Automotive Germany GmbH

This Furth im Wald company offers solutions for a wide range of glass and mirror applications in glass finishing, using lasers for cutting and drilling. Laser cutting has two stages. First, the line to be cut is perforated. Then a crack is drawn along the perforation so that the glass can be split off. Stacking the filaments one on top of the other makes this process possible up to a glass thickness of 12 millimetres and a speed of up to 500 mm/s -though only for flat glass.

Laser drilling, on the other hand, has one stage only during which the laser focus is guided through the glass thickness. This process offers more design options for the glass, such as slight curvature. In both processes, the energy input comes from non-linear processes. This causes structural changes to the glass, highly localised in terms of both space and time, so that the glass is not impaired outside the focus.

For the automotive and building glass segments, glass products must offer such special functions as guaranteeing both heat protection and high light transmission at the same time. Some of the layers applied also have different tasks. If they are electrical conductors, for instance, they can be heated and thus used as windscreens.

Saint-Gobain Group

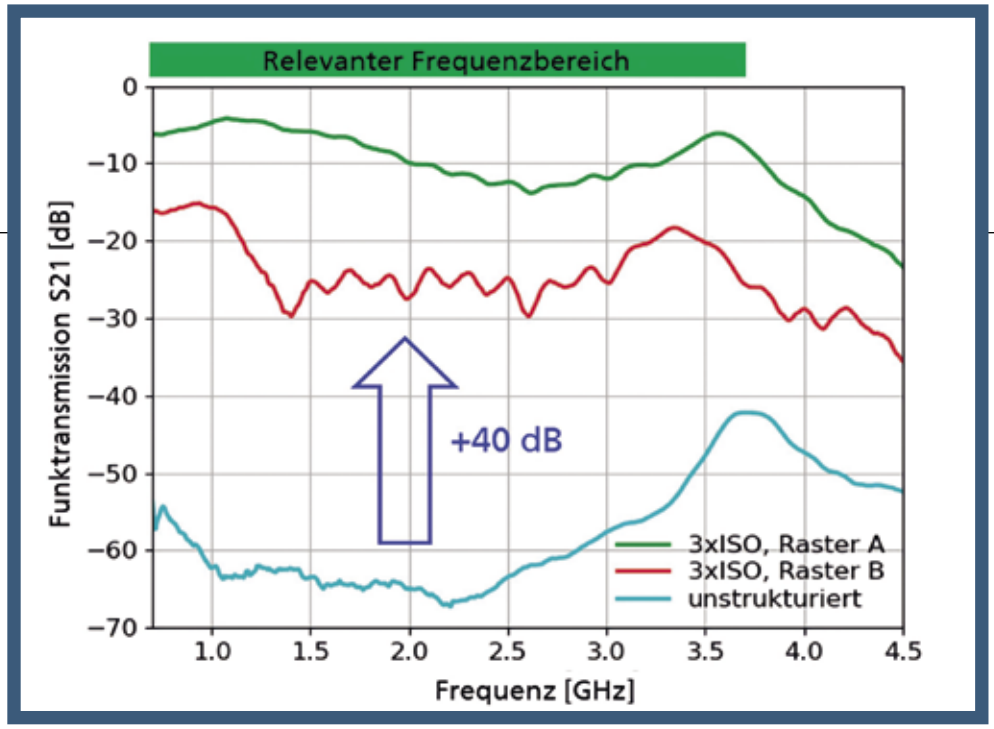
For Saint-Gobain various processes are used in production, usually done through a CVD or PVD process.
A silver-based low-E coating, for example, is amorphous in its untreated state. When heated, it crystallises, and its heat protection and light transmission properties increase. The challenge is to only apply the heat treatment to the low-E layer. Classic processes that heat the entire pane of glass cannot achieve this. The coated pane now passes under a laser line that is just 100 μm wide. This heats the layer to temperatures of up to 500°C, while the glass temperature rises no higher than 150°C.

Schott AG

The renowned Mainz company has gained extensive experience with a wide range of laser processes over the last few years, especially for processing ultra-thin glass. For instance, Ultrashort pulse lasers allow the glass to be hardened, printed and coated in a larger geometry first, before being separated into numerous small items in the final step. This puts significant demands on the separation process: clean cuts with no particle contamination and an edge quality that allows the cut items to be used immediately in the end product are both essential. These products are used in areas that include medical diagnostics, decorative elements or markings in product tracing. Schott's production also uses laser micro bonding – a technology used to weld different materials together that's especially useful for miniature applications in the medical and technical fields. The heat formed in the laser focus area is limited to a small space. As a result, the surrounding material remains undamaged and, when different materials are welded with the glass, their various thermal expansion coefficients are not a problem.

Institute for Solar Energy Systems

Fraunhofer's ISE conducts research into radio-transparent insulating glass. Coated glass is an integral part of modern buildings, providing light while also having a positive effect upon the building's energy budget. However, an unfortunate disadvantage of coatings, across the entire glass surface, is that they reflect not only heat radiation but also the electromagnetic radiation used for mobile communications and data services – even more so than reinforced concrete. In the ISE's view, one solution would be to structure the layer in segments by using a laser to remove the coating in fine lines. Here segment size plays a role in improving radio wave reception in the various frequency bands. The GSM standard with a frequency of 900 MHz, for example, needs segments that are significantly smaller than the wavelength of around 33 cm ($\lambda/4$ = 8.3 cm). On the other hand, 5G applications at around 3.4



GHz need segments that are much smaller than 8.8 cm ($\lambda/4$ = 2.2 cm). But heat protection also needs to be retained at the same time. Different segment geometries demonstrated a significant improvement in the frequency ranges relevant today. Nevertheless, radio wave transmission cannot be increased equally across all frequency ranges, as one grid size remains always fixed.

Corning Laser Technologies GmbH

CLT uses a wide range of laser systems in the development of fully-automated production systems, conducting a wide range of process steps. As well as ablative processes for glass and coatings, such as in drilling and chamfering applications, the company uses lasers to conduct cutting and separation steps in particular. This production technique not only impresses with high edge quality – i.e. in terms of both edge strength and surface roughness – but also enables a high absolute accuracy of the separated parts thanks to precise beam guidance. Lasers thus enhance quality in the production of glass products very effectively. Much more important, however, is the potential to unlock completely new market segments that are not possible – or take a great deal more effort – with conventional methods. Examples here include processing ultra-thin glass ($t < 50\,\mu m$), chemically hardened glass and glass with decorative or technical finishing and coating. Consumer electronics, augmented reality, architecture and the automotive industry are all key fields in which this is used.

However, in order to use a laser system economically in production, the production machines need to be custom-built for the product in question. As well as a fundamental understanding of laser-material interaction, this also demands enormous expertise in the technical implementation of process control. To this end, systems suited for industrial applications and 24/7 use with a high level of automation and options for deep integration are needed, which achieve maximum utilisation of the laser systems and thus the shortest possible cycle times. For maximum efficiency, components for beam shaping and transportation need to be adapted to both the product and the respective laser system. Thanks to Corning's consistent further development of the laser processing technology, it is now possible to process even three-dimensional glass workpieces reliably while achieving yet further options in design and functionality.

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