CERION: innovative laser processing and finishing of glass

The future, as seen by the company of this article – Cerion – is where glass and light meet each other in unexpected ways. Ideas can be realized with laser technology – decoration, drilling and cutting of glass without contact – with the power of laser beams. Cerion gives us a few of the numerous applications that lasers can have in the glass sector.

Whether matting glass on the surface or its internal structure with 3-dimensional design, or drilling and cutting into complex shapes – lasers are the latest solution. Lasers also offer pioneering and optimal solutions for the structuring or removal of glass coatings, as well as for machine-readable and aesthetically challenging marking of glass.

PROJECTS – ARCHITECTURAL AND DESIGN

School of Music, DE-Norderstedt

The new building of the School of Music in Norderstedt, near Hamburg, is a project with a high design standard. The building was completed in 2011. The generous glass façade consists of about 30 insulating elements in composite technology, 150 kilos each. A graphic designer provided a stripe decor, which should extend across the entire façade and never repeat a variation of strip width and spacing in its otherwise strict formal Thus, each

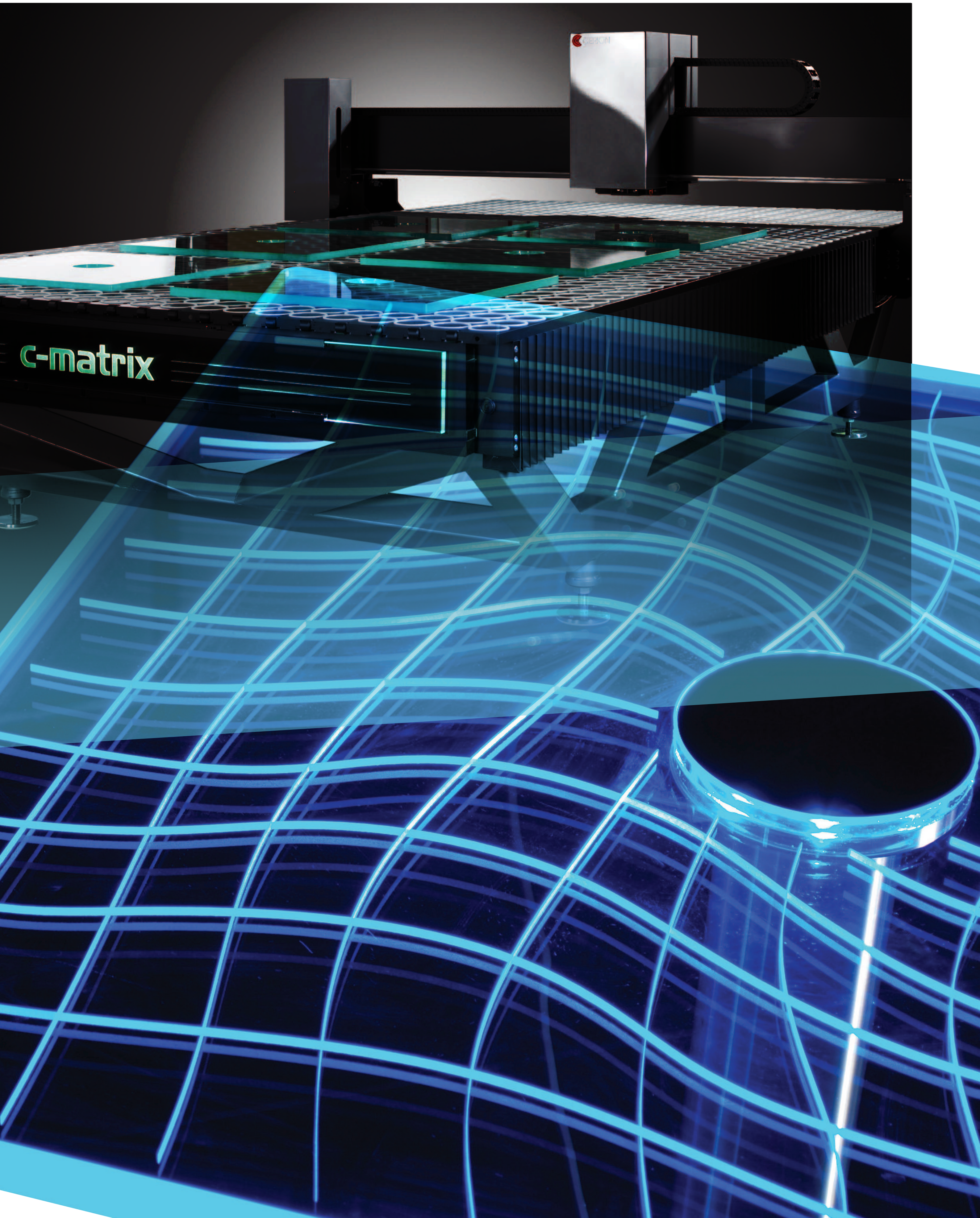

c-matrix

Figure 1

Figure 2

façade element is an individual and unique part of the picture. Laser matting can fully exploit its advantages on this design. The degree of matting could be adjusted accurately and the cumbersome masking of the glass elements with foil for sandblasting was omitted. The desired stripe graphics could be completely calculated as the total decor in the powerful software of Cerion, the subsequent laser processing operated independently. The façade is structured identically internally and externally. In this project, a total area of approximately 300 square meters were processed using lasers. (Figure 1)

Ceiling at "Haus am Gingko", DE-Heidelberg

In front of the Robert Bosch Museum in Heidelberg, a glass balustrade of 10 heavy laminated glass elements, each weighing 450 kilos, was installed in 2007. Each of these elements has had a pattern 3-dimensionally engraved in the middle glass plate using laser. White LEDs irradiate light from the bottom of the glass and the engraved letters shine brightly. The letters illuminate and float out of the glass. Thanks to innovative laser technology a very unique effect was achieved. The glass surface is smooth and unchanged, therefore insensitive to dirt. Wind and weather cannot harm this innovatively designed object. (Figure 2)

US-Salt Lake City

The transfer terminal at the airport in Salt Lake City was rebuilt in 2012. The renowned artist Catherine Widgery decided to use laser-structured glass plates to equip an elevator tower and the adjacent staircase building. The design, which was applied to both surfaces of the glass elements on about 400 square meters, showing ice crystals and water droplets, reflects the harsh climate of the region. Due to the unique brilliance of the structured glass surfaces processed with Cerion technology, Catherine Widgery deliberately chose to use lasers. None of the conventional printing or matting processes could convince in comparison. Laser matted glass surfaces give a very unique visual appeal and are especially convincing when used for creatively challenging projects (Figure 3).

LASER DEVICES

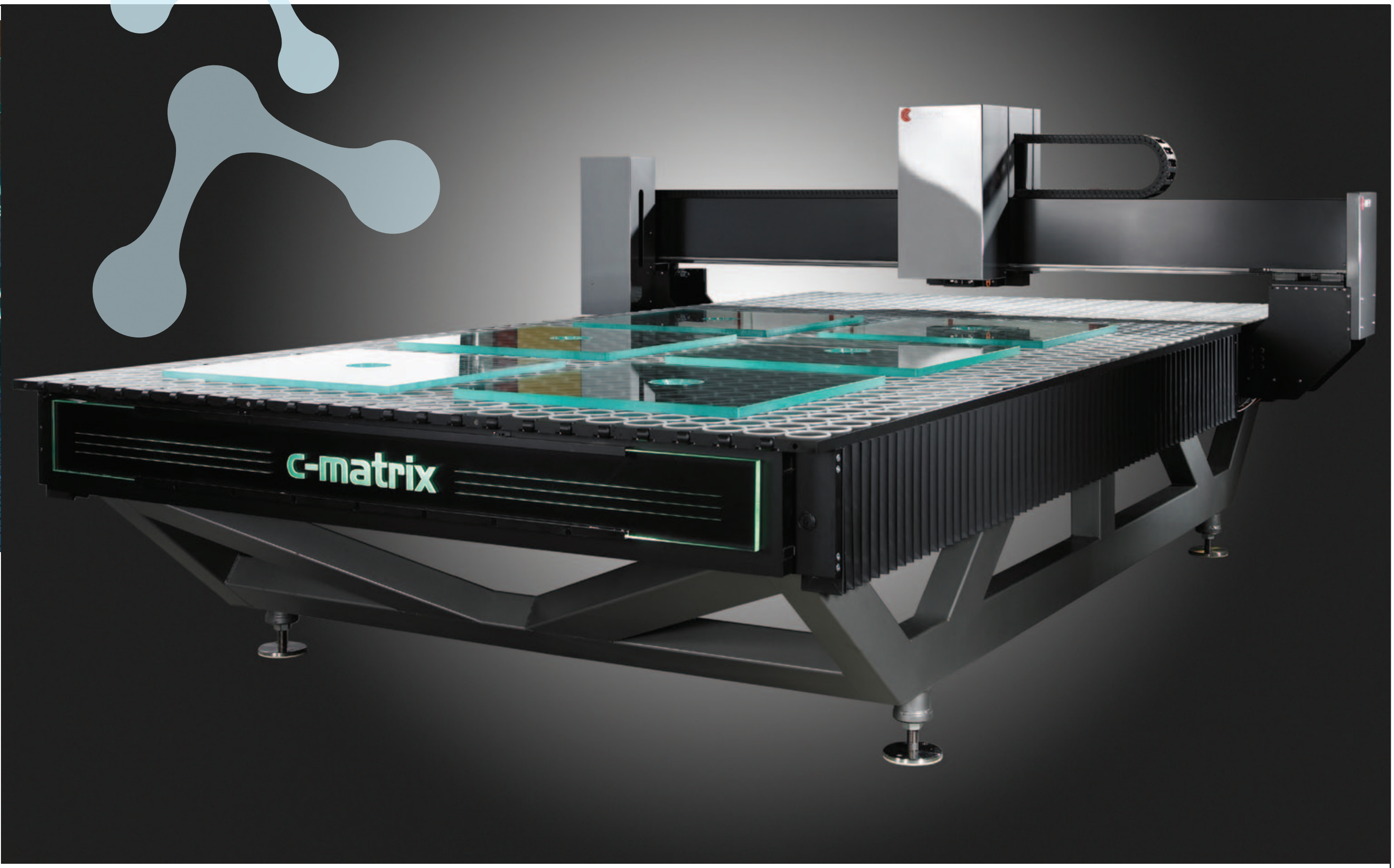
Laser machines can operate as hybrids or single-laser versions. Thanks to

Figure 3

the equipment with two laser sources, subsurface engraving with a solid state laser (532nm) or surface engraving using CO_2 laser (10.600nm) or the hybrid system, can both be performed on the same machine.

What distinguishes the work of a laser? What are the advantages?

Less manual work, smooth or less sensitive surface, incorporation of 3D designs, grayscale, photographic quality, good supplement to other techniques, low operating costs, little or no preparation on the glass, no rework. Elaborate graphics and software make the process easy to use and powerful, almost without staff. The development of laser machines is based on targets. Firstly, meeting the requirements of the customers to an optimum. Furthermore, innovation, durability and efficient operations and low operating costs play a major role. The purchase of a laser machi-



ne is connected to a higher investment than, for example, that of purchasing a sandblasting system.
In general, the operation of a laser machine is significantly less expensive compared to conventional techniques and requires only a fraction of the personnel resources otherwise required, not to mention the clean process itself (Table 1).
Last but not least, great emphasis is placed on ease of use, perfectly matched hardware and software as well as good design.
Therefore, laser machines are available in a horizontal and vertical design to allow easy handling depending on the glass size. The largest machine is vertical and has a working space for glasses of 4 x 10 metres; 3.3 x 15 metres in project.
In the past year, the c-vertica machines have been successfully introduced to the market – also low budget machines are available for door size application. Furthermore, as an option, the c-vertica can be equipped with a magazine trolley to realize full automation 24/7 operation with little staff necessary.

Table 1

Table 1: Design: Decor	Sandblasting:	Laser process:
Process:	Glass sheet	Glass sheet
	Load program for design on plotter	Load program for design on PC and convert
	Cut-out design on foil (M/W)	
	Remove foil not part of design (W)	
	Prepare rear with protection cover (W)	
	Sand blasting (M/W/D)	Laser processing
	Blow-off dust and wash (M/D)	
	Remove foil and wash again (M/W/D)	
	Fingerprint protection (M)	
	Quality check	Quality check

Legend: (M=Material needed / W=Waste / D=Dirty operation)

Software

On Cerion laser machines, glass processing is performed in 2- and 3-dimensions. The data required for this process is generated by the powerful software. This program offers a variety of import functions for two-dimensional graphics and photographic files, as well as for 3D data. With only a few steps to resize and edit the data and convert it into a suitable output format for the laser process. An extremely useful feature is the preview feature, which allows you to save the data with an integrated 3D viewer. Customers can check the data for the purpose of review and approval before processing the order. Every detail, down to the individual laser pixel, can be zoomed and viewed.

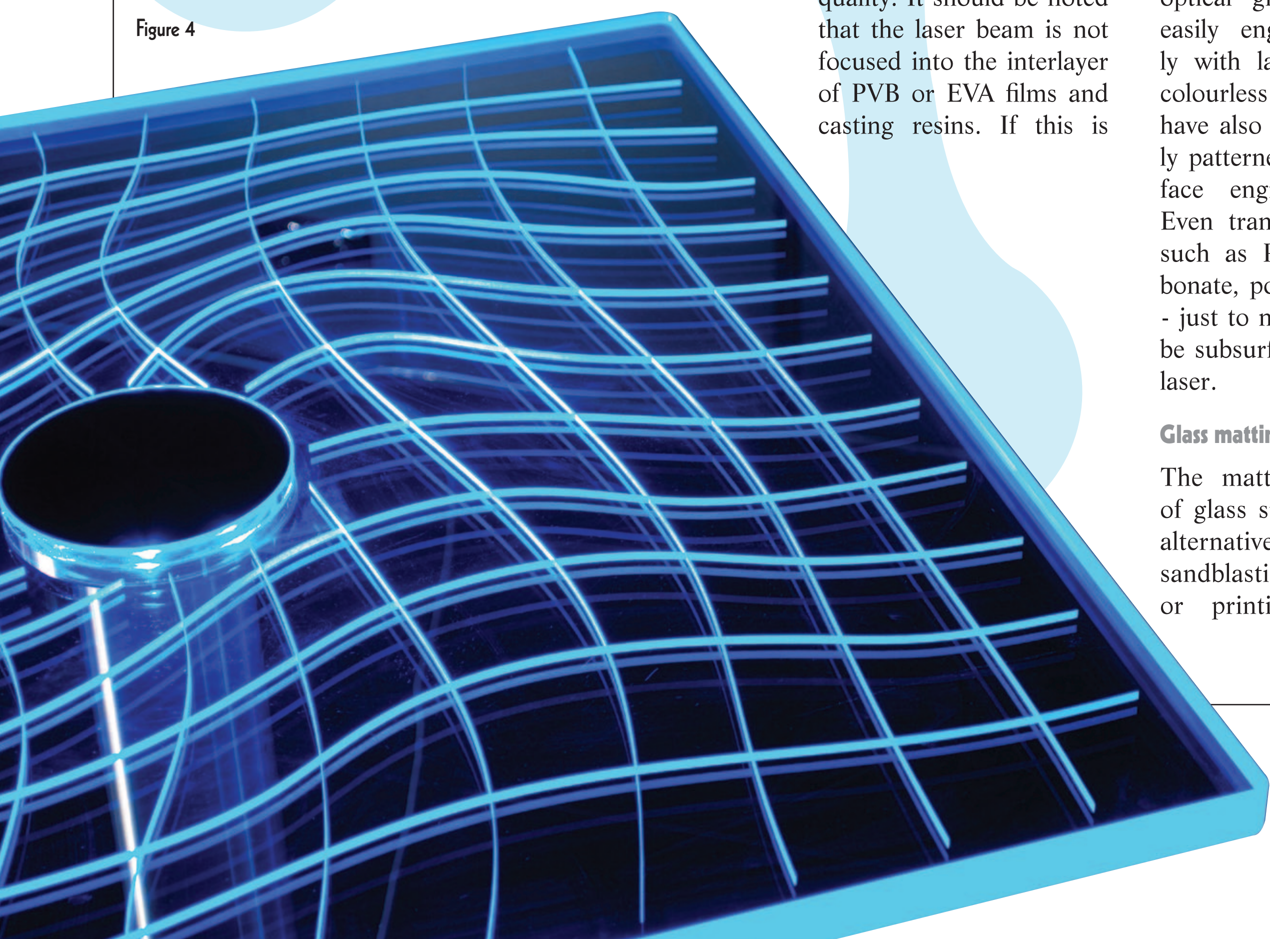
APPLICATIONS OF LASER TECHNOLOGY

Subsurface engraving

Glass subsurface engraving is still a niche, but also a sensational characteristic of the laser processing of glass (Figure 4). This is partly due to the fascinating possibilities of 2 - and 3-dimensional design of glass inside and the opportunity of combining photographic images with nuanced shades of grey. Secondly, it is also due to the fact that the glass surface remains untouched, even during laser processing. Visible structures are created inside the glass only. Every single laser pulse generates a dot in the glass of 100 micron in size, which is visible as a small slowdown for the eye. Using many points, any kind of 2- and 3-dimensional designs can be created inside the glass. It should be noted that, in general, a distance of about 1 millimetre is observed from the glass surface so that the stability of the glass is not impaired. A prerequisite for the subsurface engraving of glass is that the surface through which the laser beam enters the material is of good optical quality. For that reason, frosted or textured glass surfaces are not used. If the glass is frosted or textured on one side only, of course one can still work from the clear glass or smooth side. TSG or HSG - i.e. thermally toughened glass or glass that is to be further processed into tempered or heat-strengthened glass - unfortunately cannot be reliably provided with engraving internally. The microstructures generated by the laser - as experience shows - can, even if the TSG or HSG should initially appear stable, lead to sudden spontaneous breakage of the glass many months later. Where increased safety and stability requirements are required, such as for glass doors, curtain wall panels or shower enclosures, an alternative laminated float glass, also in combination with toughened glass, can be used (always check the local restrictions). Normal or low-iron float glass (e.g. optiwhite® or starfire®), even if it is part of laminated glass can be engraved inside using the laser with no problems. At the author’s premises multi-pane laminated glass was engraved on the subsurface to thicknesses of more than 50 millimetres. Even through thicknesses of 200 millimetres by 10 each 19 millimetres thick laminated optiwhite® panes, internal engravings were realized with astonishingly good quality. It should be noted that the laser beam is not focused into the interlayer of PVB or EVA films and casting resins. If this is done, blisters and slightly discoloration may occur, caused by the material burning. This means that multi-plate laminated glass cannot be easily structured throughout its entire thickness with the laser - despite the structure and the thickness of each glass and foil layers being fully considered. To engrave the glass surface of a glass composite of laminates, a distance of approximately 1 millimetre should be maintained at the inner glass surfaces bordering the organic interlayers, in order to ensure stability of the glass. Single glass panes, which are already provided with subsurface engraving, can easily be processed to laminated glass.

Many other types of glass, such as borosilicate glass or crystal, quartz glass and optical glass are usually easily engraved internally with lasers. Dark and colourless glass ceramic have also been successfully patterned using subsurface engraving systems. Even transparent plastics, such as PMMA, polycarbonate, polyamide or PET - just to name a few - can be subsurface engraved by laser.

Figure 4



Glass matting/frosting

The matting or frosting of glass surfaces is a real alternative to traditional sandblasting and etching or printing techniques.

The matting produced by laser is characterized by a reduced sensitivity to dirt compared to conventional matted surfaces. However, an additional frosted glass surface can also be provided by laser, with an impregnation or even colour painted. Since the surface structure produced by the laser is visually different to sandblasted or etched surfaces, patterns can also be generated by laser to previously sandblasted, frosted or etched glass surfaces, which clearly stand out in contrast (Figure 5).

Using laser technology, the finest graphical structures, such as lines and points, can be produced, which are not very expensive to produce using conventional techniques. The generation of grayscale of course is no problem using a laser. Thus, photographs and graphics can easily afford laser without loss of quality on the glass. Surface matting can be generated with the laser on all common types of glass. Toughened or heat-strengthened glass or glass which is to be further processed into tempered or heat-strengthened glass, can also be processed with the specially developed laser process. Self-coated glass can be processed using laser. Glass coatings, such as mirrors or layers, chrome or ceramic layers and organic layers of colour are easily perforated by laser or eroded, and the underlying glass surface is frosted at the same time. The laser is less suitable for the fabrication of large or full area matting. Here, the classic matting process by sandblasting is more advantageous due to reduced process times. But wherever it comes to the application of decors, detailed graphics and pictures, the laser has its advantages. Thanks to cerilas laser technology, the otherwise costly and labour-intensive manual process steps are replaced and the decor is lasered directly from the computer onto the glass. The refilling of ink, cleaning of screens and print heads or the treatment and disposal of used abrasive is omitted. The future is light - a tool that will never dull.

Anti-slip glass walkways

A real innovation is the anti-slip structuring of glass surfaces by the laser beam. In a fine grid, which can only be seen with the naked eye at close range, small depressions are made on the glass surface. Each laser pulse generates precise, small depressions in the glass surface to help prevent slipping on wet glass. This patented method has been used under the name Laser Grip for many years

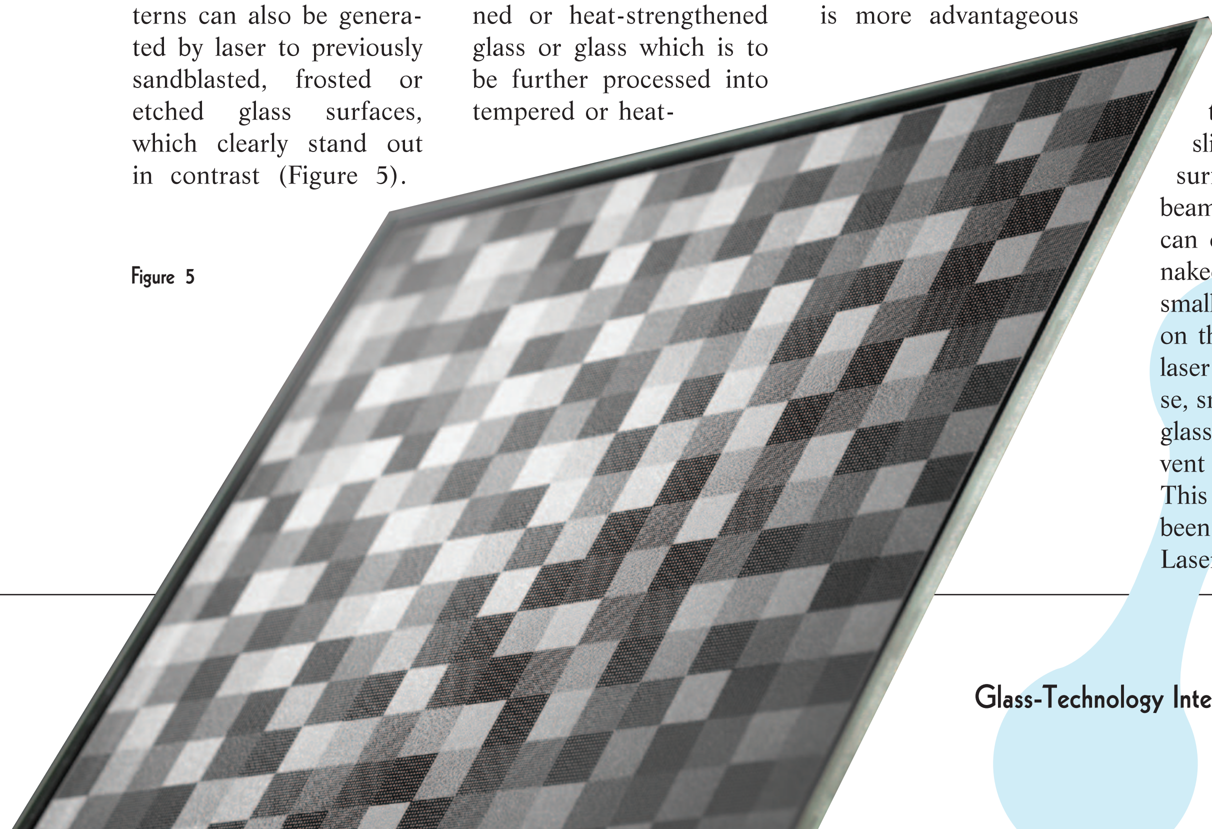


Figure 5

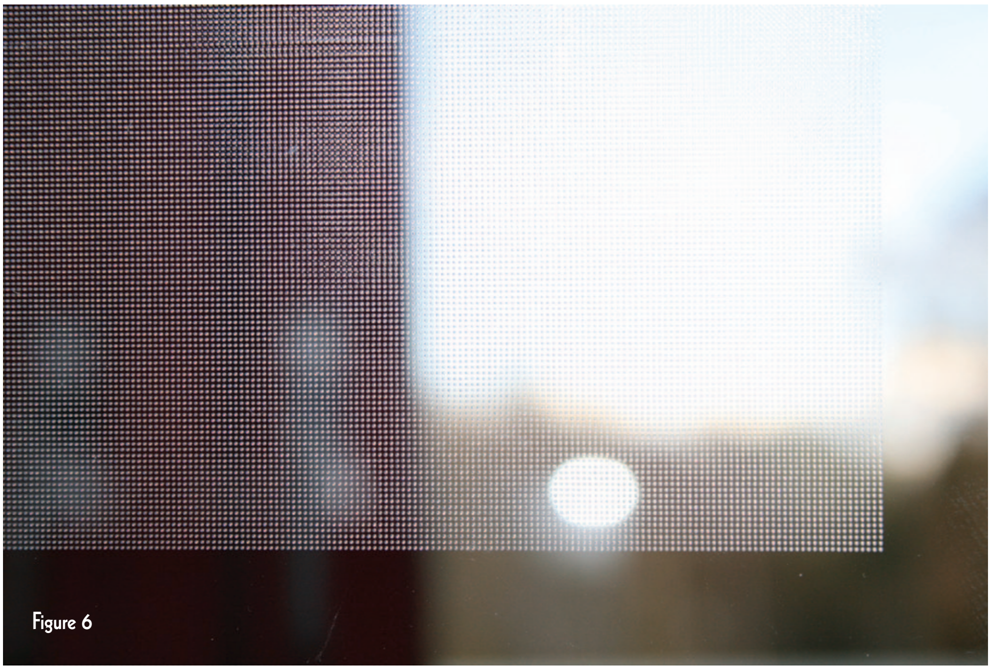


Figure 6

Figure 7

on polished stone surfaces and is now also available for glass. The Materials Testing Laboratory Wismar has certified the generated laser machines with Cerion anti-slip glass surfaces with the values of R9 and R10.

Laser Grip is characterized by high transparency and durability. Nothing is applied to the glass surface, as is the case with the conventional screen printing method. Often, printed structures disappear after only a few months, due to wear, and cleaning printed slip surfaces is also complex. With Laser Grip, 90 per cent of the glass surface remains untouched and its anti-slipping effect is created by the negative pressure of the small wells in the glass, which are subject to practically no wear. Different designs can also be applied. (Figure 6)

Laser lamellae as sun and vision protection

Laser engraving processes can not only create extremely decorative designs in the glass, but also structures that meet technical functions. For example, laser generated parallel lamellae in the glass act like a blind (Figure 7).

Direct sunlight can be significantly reduced and softened. The direct light is scattered at the lamellae or in large part reflected and thus transformed into pleasant, soft light, which illuminates the space in its depth. With the laser lamella itself, the blind effect can be integrated unobtrusively into the window glass or in a curtain wall double façade. The usually visible and often disturbing sun protection systems in buildings are susceptible to wind and incur costs for cleaning and maintenance. Inside the IG Units, integrated lamella systems affect the U-value of the window in a negative way. All this is not applicable when using the laser lamella. Thanks to Cerion's laser techno-

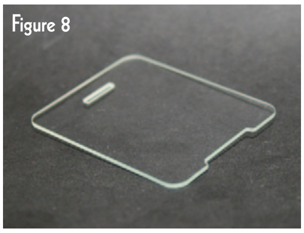


Figure 8

logy, these new types of sun and vision protection can be unobtrusively integrated into the building envelope. Maintenance-free, future-oriented and covering aesthetically highest demands.

Drilling, cutting and milling by laser

Every conceivable form can be cut in glass with a laser machine using a patented process - without contact and without the otherwise necessary coolant (Figure 8). The kerf is only 100 microns wide and extremely accurate. It does not matter whether the glass is only 0.5 millimetres or 100 millimetres thick. Holes from 0.2 to 100 millimetres and greater can be created without problems. From razor-thin glass to glass blocks more than 100 millimetres thick, you can drill and cut all thicknesses with the laser. Moreover, the laser process does not transmit force to the glass and the heat released is insignificant.
It is practical, a cold cutting process, which only leaves a small amount of glass dust due to the laser-induced atomisation, which is extracted at the machining point.

Another application is a pressure relief hole in the centre pane of a triple IG Unit, thus to enable same air/gas pressure of the two chambers to compensate breakage at high wind load peaks.

Glass marking

The marking of glass becomes an increasingly important role in our industry.
Product tracking, anti-counterfeiting and brand awareness are the main drivers here.
Laser technology can indicate both by engraving the glass subsurface as well as on the surface. Letters, numbers, logos and machine readable codes are transmitted through the laser beam in seconds onto or into the glass (Figure 9).
The laser-generated marking cannot be removed, is resistant to abrasion and unobtrusive. Both laser marking and scanner technology can either be integrated directly into a production line, at a cutting table or be used as a mobile system of production for use right there where you need it.
Wherever clear visibility is required, black marks can also be transmitted on the glass surface by laser. These are characterized by high mechanical and chemical resistance.
Whether barcodes, Data Matrix or QR codes, alphanumeric characters, serial numbers or TSG

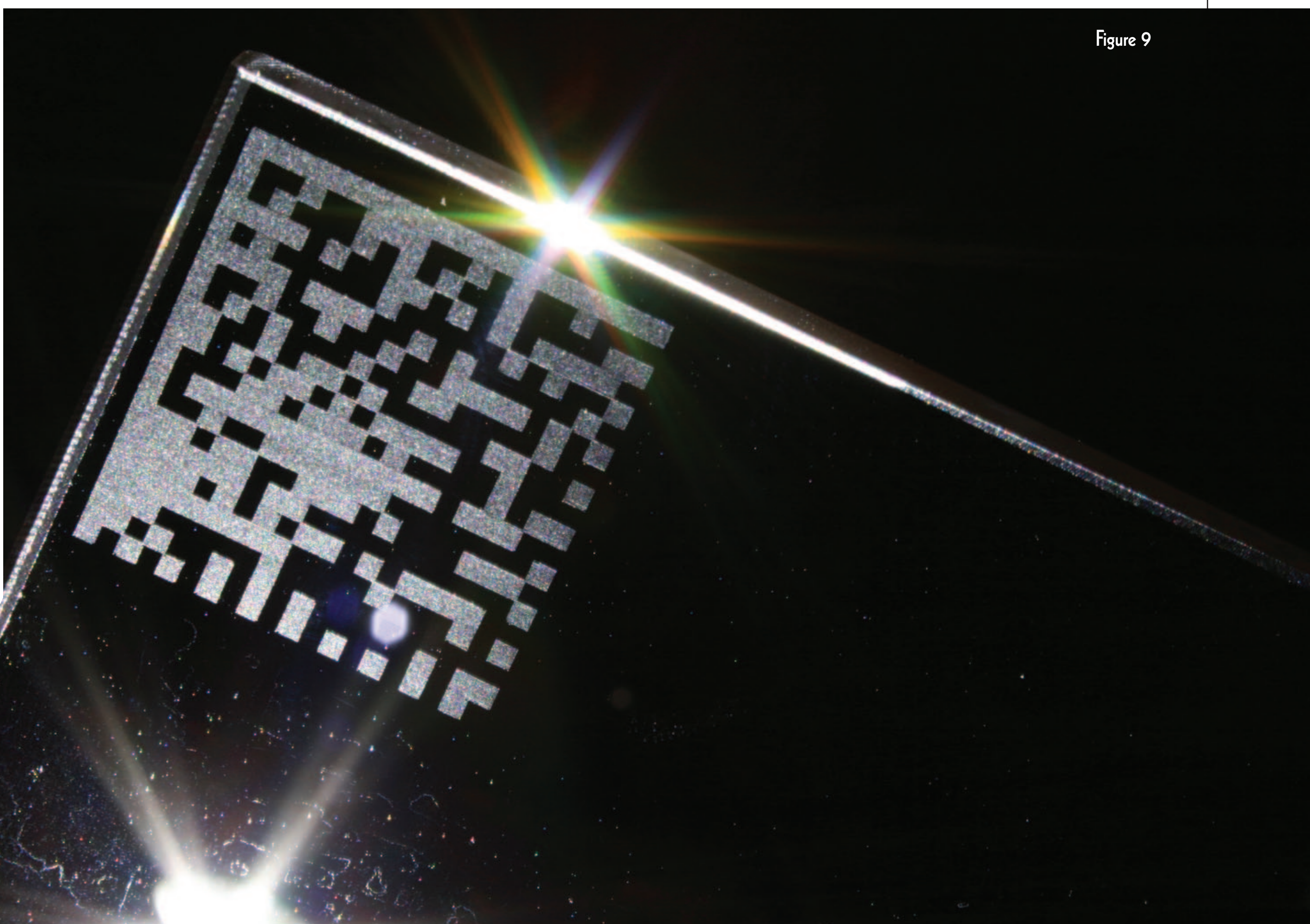


Figure 9

Figure 10

Figure 11

stamp - with laser marking technology products can be flexibly and securely marked to the highest quality.

Removal of or patterning coatings

The laser procedures developed also allow for the removal of and patterning glass coatings. Depending on the type of coating and the desired quality of the exposed glass surface, various laser procedures can be selected (Figure 10 Lacobel® & 11 Mirror).
To have a mirror with decorative design or technical structure on an ITO layer, laser technology provides the highest process control and many opportunities.

Combination of diverse techniques on one machine

Particularly interesting is the combination of different processing techniques on the same machine. A common requirement is not only to structure coated glass but to also drill holes. Both processes can be combined on one machine system and, thereby, make processing more efficient. Material handling is reduced to a minimum. Internal engraving and surface matting are also available on the same installation.

LED LIGHTING

A special reason for laser engraving is the appropriate lighting for installation in buildings. The rapid development of LED bulbs in function and size helps to achieve more and better lighting effects. Interaction of both techniques leads to impressive results.

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