The Perfect Material for Industry, Architecture, Design and Technology – Transparent and Extremely Robust: Perlucor

CeramTec's Perlucor opens new doors in areas where special and industrial glass types reach their limits: thanks to its extraordinary resistance to chemical and thermal influences and mechanical stress, this transparent technical ceramic lends itself excellently to the harshest applications.

Fig. 1
The commemorative coin "Zeme"

Its extraordinary properties are what make the high-purity ceramic material Perlucor a game changing material with near universal application potential. As first European manufacturer, CeramTec is in the position to put this revolutionary ceramic into mass production. The material is a mechanically, chemically, thermally, and optically perfected solution for transparent applications in extreme conditions. The transparent ceramic is resistant against highly concentrated acids and lyes. With a relative transparency of more than 90 %, Perlucor is an attractive alternative to glass when the latter reaches its limits in specific applications.

Keywords
transparent ceramics, wear resistance, corrosion resistance

It is distinguished by its pronounced strength and wear resistance. The material exhibits three to four times the hardness and strength of conventional glass. Its hardness on the Mohs scale is on 9 – surpassed only by diamond or ruby. This makes it particularly resistant to mechanical stress and scratches. For instance, this property prevents Perlucor panes from clouding or corroding. The technical ceramic also has three times the thermal resistance, enabling it to be used in temperatures of up to 1600 °C. The high refractive index of 1,72 makes it possible to miniaturize optical lenses and elements.

Bank of Latvia takes advantage of Perlucor

Perlucor represents the blending of high-quality, innovative design and robust everyday functionality. With it, manufacturers and designers of watches, glasses, jewellery, coins, and other everyday objects and luxury items can draw on a more ambitious range of design possibilities. As a recent example the Bank of Latvia made use of the versatile properties of the transparent technical ceramic for its collector coin "The Earth." The design, created by Latvian architect and designer Mārcis Kalniņš, unites the transparent ceramic with silver for the first time in a valuable 5-Euro coin. In the unique design, Perlucor takes the form of a transparent disc, symbolizing the universe, in which the earth is visibly suspended.

Interesting material for architects

Aesthetics and functionality go hand in hand in architecture, too. The products and materials used in this field must meet many requirements. Transparent surfaces such as glass stairs, walk-on windows, skylights, and glass flooring are subject to high mechanical stress but should still be long lasting and reliable in function.

The same is true for inground lights for outdoor use: the glazing quickly becomes scratched when subject to daily use. Light intensity and aesthetics suffer as a result. With a transparent Perlucor cover, the glass surfaces are protected against the likes of snow, ice, road salt, sand, or gravel. It has also proven itself in extreme temperatures

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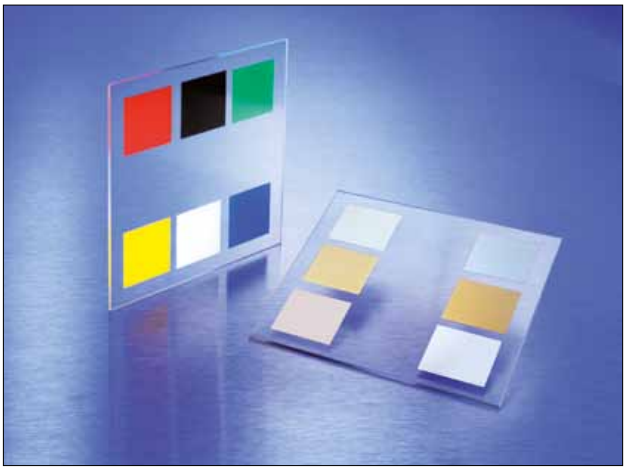

Fig. 2
Colouring of Perlucor opens new applications for design

Fig. 3
The refractive index of 1,72 enables optical lenses, also for miniaturisation

Fig. 4
Monitoring of processes thanks to Perlucor laminated viewing windows

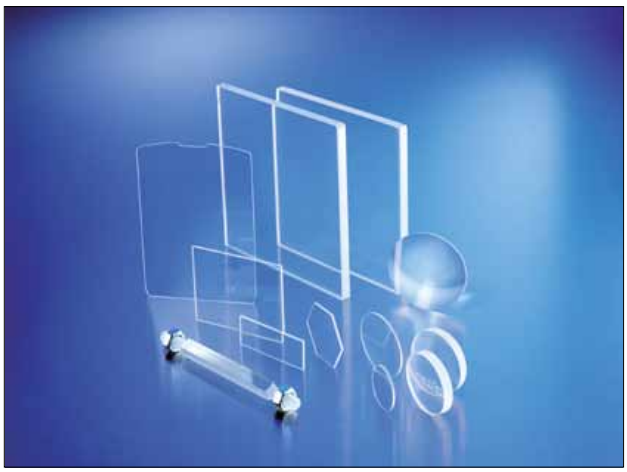

Fig. 5
Various shapes of transparent ceramics

in winter or in direct sunlight. Perlucor's high robustness and scratch resistance means that the transparency of the glass underneath can be assured on a long term basis. The material is predestined for use in high traffic areas such as pedestrian zones. Perlucor is, for instance, used by the manufacturer SLV in its DASAR PREMIUM light series.

Industrial applications

Its outstanding properties also make Perlucor a ideal material for numerous applications in mechanical, plant, and equipment engineering. The transparent ceramic lends itself well to all applications where production processes need monitoring – such as machining, sand blasting, or chemical engineering processes. It is installed on the inside of a machine's viewing window in the same way as a laminate. Perlucor is predestined for these applications on account of its extraordinary hardness: silica, metal chips, and other materials that are involved cannot scratch or destroy the transparent ceramic.

Users also benefit from the material's extremely smooth surface. What's more, unlike glass it is inert. That means it does not react with potential reactants, or if so then minimally. When compared with conventional windows, the clouding or corrosion of the pane as a result of chemicals or mechanical stress is significantly slowed down or outright stopped. The material's high strength also is beneficial here.

In collaboration with CeramTec, the manufacturer Hema has developed a safety glass with a Perlucor layer. They are laminated with the transparent ceramic on the side that faces the process. The SWIW Panel, as it is known, is the perfect solution for abrasive applications.

Extremely flat with a thickness of only around 3,5 mm, it is extremely durable and can also be built into machine doors. The VISIPORT Spin Window is suitable for all applications which require the monitoring of processes involving liquids. The window spins with up to 3000 rpm. The resulting centrifugal forces together with the scratch resistant ceramic prevent liquids from accumulating on the window. The window remains clear.

This process works in more or less the same way with conventional glass; however, because the glass will become scratched, materials do tend to stick to it sooner or

Fig. 6
Conductors can be metallized on Perlucor and assembled with electronic components

Fig. 7
Even complex geometries like watch cases are feasible

later due to the rougher surface. Also, this in turn induces further chemical reactions and the glass becomes clouded. Perlucor on the other hand prevents the adherence of chemical components. Perlucor layers are at least 550 µm thick depending on the level of stress they are intended to withstand. VISIPORT is suitable for applications in up to 100 °C. Depending on use, the service life of the window is extended ten- to twenty-fold. Complexity costs resulting from replacing the pane go down accordingly. Retrofitting existing windows with the Perlucor-glass substrate composite can be carried out easily.

Quick and easy scanning

Use of identification systems such as barcode scanners, document scanners, or fingerprint scanners is increasingly on the rise. They allow for a prompt and uncomplicated check-in at airports, register goods at the point of sale, or grant entry to buildings. It is therefore imperative that scanned data is collected quickly and with absolutely no errors. In highly frequented areas, in particular, the glass covers of scanners must cope with a high level of mechanical stress.

This isn't just because of damage caused by packaging of goods: the paper of scanned documents contains the abrasive substance titanium dioxide, among other things. Perlucor offers scanners lasting protection against chemicals by virtue of its scratch and wear resistance.

The scanning specialist Desko is already making use of these advantages, which also can be translated to the production of display screens, for instance in electronic devices such as smartphones and in other touchscreen devices.

Transparent ceramic for underwater applications

The material is also used in diving watches and has already proven itself. Its value in this field is based on its high scratch resistance. Diving computers fitted with Perlucor meet even the most stringent requirements of the military sector with regard to the factor of safety. The term factor of safety refers to the structural capacity of a system beyond the expected loads or actual load.

A further benefit: the design of the computer can afford to be thinner because a comparatively thin Perlucor cover is adequate in protecting the device. To achieve a level of resistance approaching that of Perlucor with conventional glass alone would require a considerably larger amount.

It is therefore no surprise that manufacturers of diving watches, such as Heinrichs Weikamo, use the transparent ceramic as a sales argument: thanks to Perlucor, the displays are particularly robust and resistant to pressure and can be read without difficulty both in direct sunlight and in the dark.

Protecting life and limb

In the defense industry, the transparent ceramic demonstrates yet another important advantage. Compared with conventional bullet-proof glass systems, Perlucor can result in weight and volume savings of up to 30–60 %. The material's extraordinary hardness is particularly useful in applications requiring ballistic protection and protection against explosions.