Transparent Advanced Material

Not many companies are able to offer a product that creates a new trend or an entirely new approach to a problem. Ceramics manufacturer CeramTec is the first European company to develop series-ready transparent ceramics. The material, called PERLUCOR, was officially presented at the Hannover Messe industrial trade fair two years ago and is now used in a variety of applications. PERLUCOR is extremely robust, very stable, and can be used to manufacture complex geometries cost-effectively. This makes it the material of choice for applications in which specialized glass reaches its load capacity or sapphire glass is too expensive.

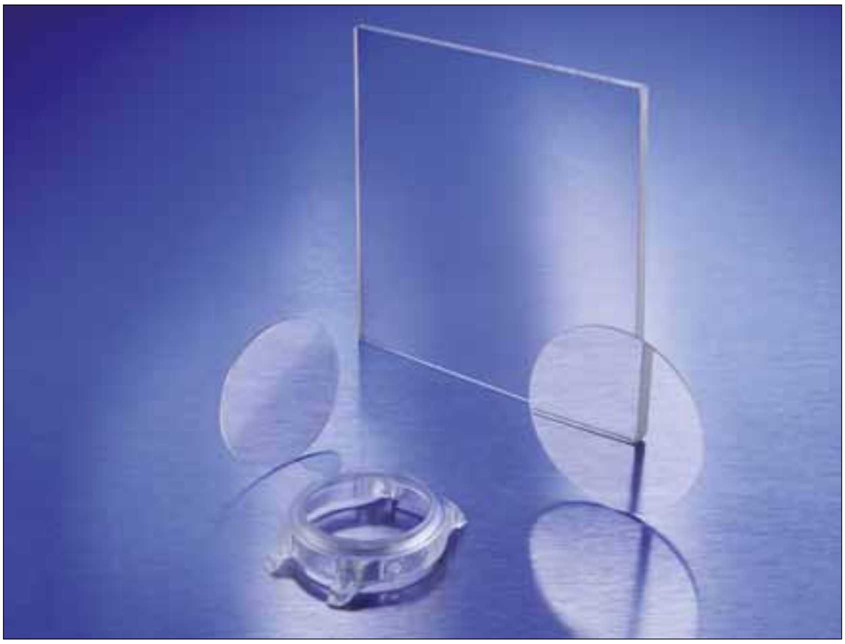

Fig. 1
CeramTec GmbH has succeeded in becoming Europe's first company to manufacture PERLUCOR transparent ceramics on a series-production scale

Background

Intensive research and development work enabled CeramTec specialists to successfully transfer the advantages of ceramics to the world of transparent materials.
The result is a material that offers an affordable alternative to sapphire glass on the one hand and is easier and more cost-effective to process on the other. Beyond this, transparent ceramics boast numerous other properties that make them far superior to conventional and specialized glass. Now that the material has already been used frequently in small-scale applications, transferring it to market segments with a wider range of use is quite conceivable. „The development of PERLUCOR has allowed us to take a decisive step towards the future. Transparent ceramics are helping us venture into completely new dimensions for transparent solutions," explains Dr. Lars Schnetter, Director of Transparent Ceramics at CeramTec-ETEC, a subsidiary of CeramTec.

Keywords
transparent ceramics, scratch-resistance, bioinertness, corrosion resistance

High transparency and tremendous strength

PERLUCOR is a highly pure ceramic material with a number of extraordinary mechanical, chemical, thermal and optical properties. Combined with a high transparency grade of over 80 % – which translates into a relative transparency of over 90 % – this opens up fields of application for PERLUCOR everywhere conventional, specialized and even protective glass does not demonstrate the potential to achieve optimum results.
Developed for a new generation of bullet-proof glass systems for ballistic protection, using PERLUCOR in transparent protection systems helps reduce weights by up to 50 % compared to conventional systems. Based on PERLUCOR's unique property profile, there are also numerous other areas of application for this innovative material,

CeramTec GmbH
73207 Plochingen
Germany

www.PERLUCOR.com

such as in the manufacture of jewellery or in the field of design.

Precise, customized manufacturing

Due to their excellent workability, transparent ceramics easily make it possible to produce even complex two or three-dimensional geometries that readily satisfy requirements in applications that call for extremely tight tolerances in the micrometer range. Transparent ceramics can even be used to manufacture ultra-precise watch cases. This is where one of PERLUCOR's key advantages comes in to play, as certain types of geometries cannot be produced cost-effectively using sapphire glass.

What's more, ceramics are already used successfully in deep-sea dive computers and watches due to their extreme toughness. Depending on the strength, the material can enable deep-sea dive equipment to reach dive depths of several hundred meters. When directly compared to the respectively required strength of conventional glass, PERLUCOR is proven to reach the same dive depths with significantly thinner materials. This aspect of transparent ceramics has an impact on dive computer design, making it possible to manufacture products more compact and elegant. Displays for additional devices and gadgets are also conceivable.

Robust material for harsh environments

Alongside its high transparency, PERLUCOR also offers convincing performance thanks to its tremendous compressive strength, hardness and thermal resistance, which are over three to four times that of glass. This property is what makes the material so scratch-resistant. Thus, transparent ceramics from CeramTec are well suited for use in extreme wear conditions, such as in mechanical, plant or equipment engineering. Blasting cubicles are a specific application example here. PERLUCOR delivers a clear view even when other viewports have long grown dull.

PERLUCOR can be used at temperatures of up to 1400 °C – for example as an inspection window in high-temperature furnaces. Due to its purity, PERLUCOR also exhibits uniquely high chemical resistance and is thus of interest in fields of application with highly concentrated acids and lyes – whether as a plane surface for inspection windows or as a sight glass in tube geometry.

Fig. 2
PERLUCOR transparent ceramics brings new ideas to the design of jewellery

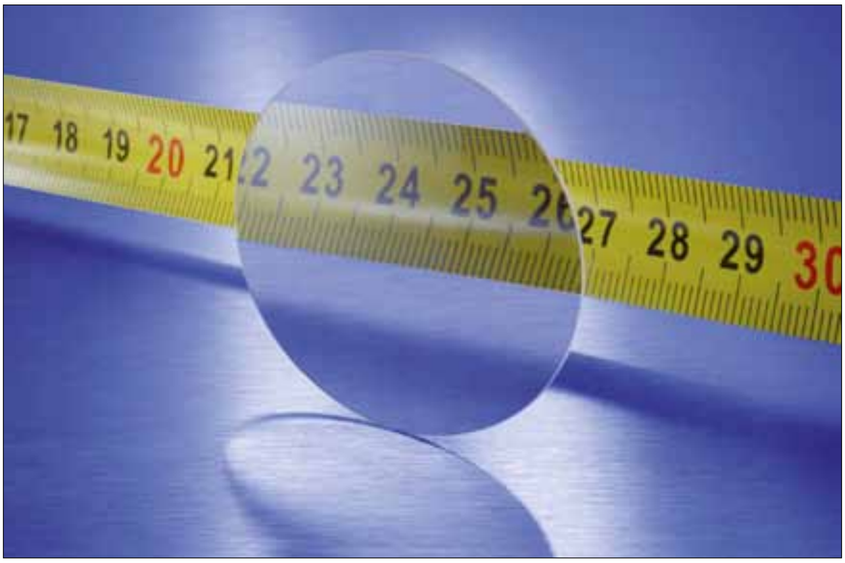

Fig. 3
With the refraction index of 1,72 good magnifying effects are achieved

When it comes to sensor technology, PERLUCOR's properties make it a highly interesting product used in countless optical applications. PERLUCOR also offers distinct advantages in industrial plant or manufacturing process monitoring.

Businesses can successfully protect the cameras used for these purposes with composite materials that feature transparent ceramics. This greatly extends the life of the optical lenses used in these applications.

Even the use of infrared technology poses no problems: the material is very translucent up to the mid-infrared range, opening up an additional area of application in cameras with this technology. Its excellent chemical resistance has helped develop special protection applications for maritime sensors, among other innovative ideas.

Optical applications

With a refraction index of 1,72, PERLUCOR lets even the smallest parts achieve powerful magnifying effects. It would be very difficult to deliver this type of magnification using polymers or glass. This high refraction index makes it possible to miniaturize optical lenses and other optical elements

– while still achieving the same level of magnification.
This makes PERLUCOR a viable alternative for endoscope lenses, for instance. Additional areas of application in which lenses come in direct contact with the human body include body-contacting laser optics. PERLUCOR's bioinertness and chemical resistance play a vital role here.

Large-scale architectural installations
For production engineering reasons, PERLUCOR discs are 90 mm × 90 mm in size when manufactured. PERLUCOR moulds can be combined into multi-tile composites to create larger surfaces. Ceramics and adhesives have the same index of refraction, allowing the joint edges to be joined together using a special adhesive process developed by CeramTec that makes the joints virtually invisible, thereby creating a uniform, transparent surface.
This makes the material an outstanding choice in the field of architecture as well. One possible use could be as a material for what are known as "SkyWalk" projects, such as those seen in the Grand Canyon or the Tower Bridge in London. This technology offers a unique benefit here: when paired with tempered glass, this type of transparent walkway is not only highly scratch-resistant, it also stands up well to shock and impact. When PERLUCOR ceramic is used as the top layer of a glass composite, the glass panels used below this material are protected against impact from rocks or other hard objects. PERLUCOR helps minimize the risk of deliberate or accidental damage often found in public buildings and crossings.
This application example is also of interest for protecting ground lights. The advanced material protects glass covers on ground lights from scratching or dulling over time. The result: lighting installations that retain their visual appeal even after long periods of use yet also significantly enhance lighting conditions. This opens up a broad range of new applications, including vehicle protection.
PERLUCOR could be manufactured to protect headlight lenses in mining and construction vehicles that are used in rough conditions and regularly subjected to abrasion from sand and dust along with impact from rocks.