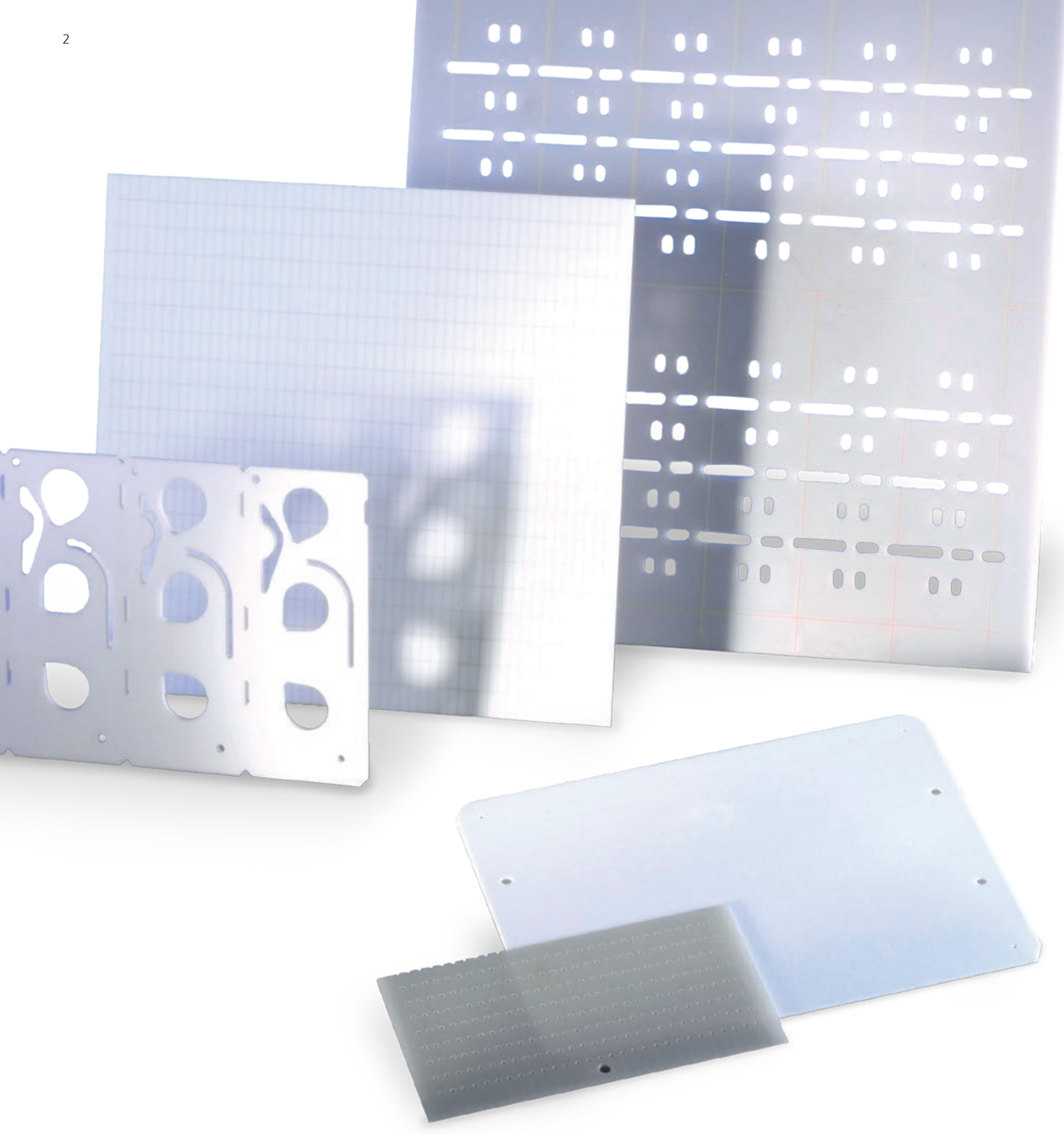
CeramTec

E L E C T R O N I C S

Infopaper

Laser processing of ceramic substrates

C E R A M I C E X P E R T S

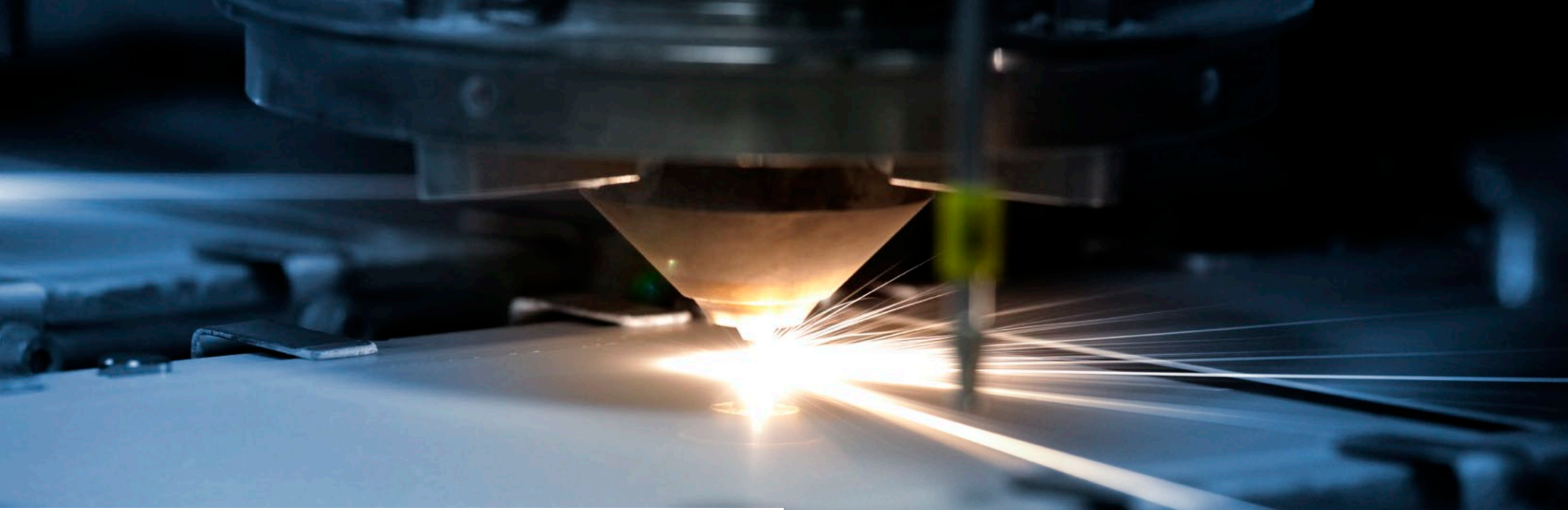


Technical Ceramics in laser quality

One trend in the electronics industry is still unbroken - the miniaturization of electrical circuits and components with higher power density at the same time. This results from the requirements of products such as wearables, smartphones, smart TVs, or e-mobility and renewable energies. Due to the ever more extensive automation of the production of such components, this trend places significantly higher quality demands on the basic products, such as those made available to the electronics market by CeramTec.

The market for electrical components such as chip resistors or circuit boards has long since developed into a mass market. Just like the automatic assembly of circuit boards. Ever shorter product life cycles also influence production.
All these influences place a whole bundle of requirements on the flexibility of the manufacture of the components as well as the quality of the individual components.

In many applications, technical ceramics are used as a substrate for, for example, chip resistors, printed circuit boards or insulating parts. The material properties of technical ceramics, as offered by CeramTec in great variety, have proven and established themselves over many years of use in the international market. Through continuous production innovations, CeramTec was able to provide the electronics market with basic components as they result from the requirements of miniaturization and automation. Manufacturing expertise makes a significant contribution by CeramTec: it provides the electronics industry with basic components with the highest levels of precision, structure size and quality, according to customer requirements, in quantities of one up to mass production.



Laser processing of ceramic Substrates

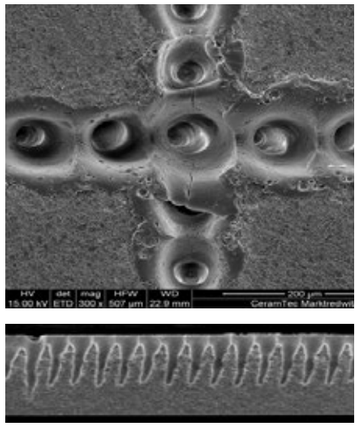
The lasering of ceramic substrates is a well-established technology for processing. Depending on the application, blind holes, vias, various recesses, fine patterns or break lines are worked into the substrate. If deep cavities are required, these are also introduced using appropriate laser processes. For a long time, the lasering of ceramic substrates was reserved for CO2 lasers. The reason for this lies in the absorption behaviour of high-energy light of the ceramic Substrates. The CO2 laser works with a wavelength of 10.6 µm and is not absorbed by the ceramic material. This sets the required material removal in motion through heating, melting and evaporation. In addition to the advantages of relatively precise processing, economical processing speed and good repeatability, there are some problematic influences on the subsequent processing of the lasered substrates.
The Gaussian beam profile of the CO2 laser has a major influence. The edge areas of the Gaussian beam profile ensure a partial melting of the edges due to the relatively long pulse durations and change the ceramic material and lead to glazing. Vias can partially or completely clog. The pronounced Gaussian curve of the laser beam leads to a strongly funnel-shaped hole formation and wide laser tracks. Melt-off residues can also settle on the ceramic surface. The contour sizes that can be generated are sometimes not fine enough in the course of miniaturization. This has a negative effect on the design of blind holes, as they are used to create break lines.
All of this can lead to problems in the highly automated processing of basic ceramic products. Contamination due to breaking off of the glass layers at the break edges when chips are separated, wear and tear of the transporter and gripper due to sharp and partially glazed break edges, clogged and therefore uncoverable vias, to name just a few examples. This technology also offers almost no economic starting points in terms of structure size and finish quality. The search for an alternative laser method is therefore essential.

Lasern up to date

Offering the customer optimal product quality tailored to the application is one of the top priorities at CeramTec. Following this credo, when the product quality requires it, CeramTec uses the up-to-date laser process with fibre lasers. This relatively young and yet mature use of fibre lasers has many advantages that make it possible to provide the required quality to CeramTec customers.

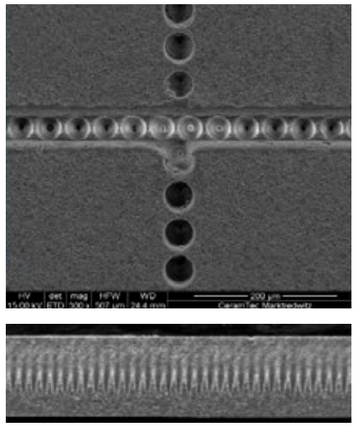
Fibber lasers differ from CO_2 lasers in focus size, beam quality and wavelength. The beam focus is significantly smaller, and the beam quality is significantly higher. As a result, the laser beam has a high beam intensity in focus. This leads to reliable machining with a high degree of precision. At the same time, the heat affected zones (HAZ) are significantly smaller. The melting of edge zones is thus significantly reduced, as is glazing. The beam is reliably directed with high resolution and results in a constant spot size on the ceramic surface. As a result, very small structures with significantly sharper contours can be created. In the case of blind holes, for example, the cones can be reduced by more than 50%, and the laser track width is also narrowed by over 50%.

Co_2-Laser



Laser width height: < 15 µm
Laser track width: < 120 µm

Fibre-Laser

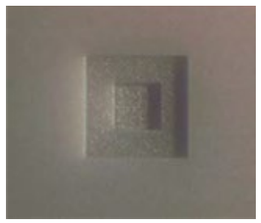


Laser width height: < 5 µm
Laser track width: < 50 µm

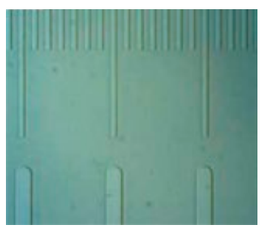
The contamination of the substrate surface with melted ceramic particles is practically negligible, as the high beam quality means that virtually no energy-rich particles are generated that can splash onto the substrate surface. Vias are open and not completely or partially clogged by melting.

3D Lasering

If cavities are to be lasered in any shape, then CeramTec's production is also geared towards this. From simple basic geometric shapes such as triangles to more complex polygons to complex polygon shapes can be introduced into the substrate as a 3D cavity. The great advantage of this is that there is no vitrification of the edge layers during removal and the edge material therefore consists of 100% ceramic substrate. This offers quality advantages and increases the process-reliable further processing of the basic component. The laser process is ideal when it comes to producing prototypes with complex 3D structures. In series production, it shows its advantages when thin wall thicknesses are required. For example, wall thicknesses of 120µm were produced on behalf of the customer. The criteria of evenness and parallelism as well as sharpness of the edge contours were reliably met. With the laser process, channel widths of up to 50µm can be safely generated in the ceramic substrate. The finest cavities can thus be created and there is room for CeramTec production facility to also manufacture complex components.



Cavity lasers



Structure lasers

Powerful laser techniques

The use of these laser technologies in the production of lasered substrates enables CeramTec to react quickly and flexibly to customer requests. Prototypes are provided quickly, changes to existing products can be implemented just as quickly. Required qualities are provided from one piece to mass production. For this CeramTec production is attuned with over 100 laser heads worldwide. The manufacturing know-how and the quality of the ceramic materials and substrates from CeramTec make us a partner to the electronics industry. We deliver the basic components that are required for existing products or new, innovative applications quickly and flexibly.

What can we do for you?

Material overview CeramTec substrates

Material	Typical Ra Value	Content
Rubalit® 708 S	< 0.6 µm	96%, Al_2O_3
Rubalit® 708 HP	< 0.6 µm	96%, Al_2O_3
Rubalit® 710	< 0.1 µm	99,6%, Al_2O_3
Alunit®	< 0.6 µm	Y-stabilized
Zirkonoxid®	< 0.6 µm	Y-stabilized

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