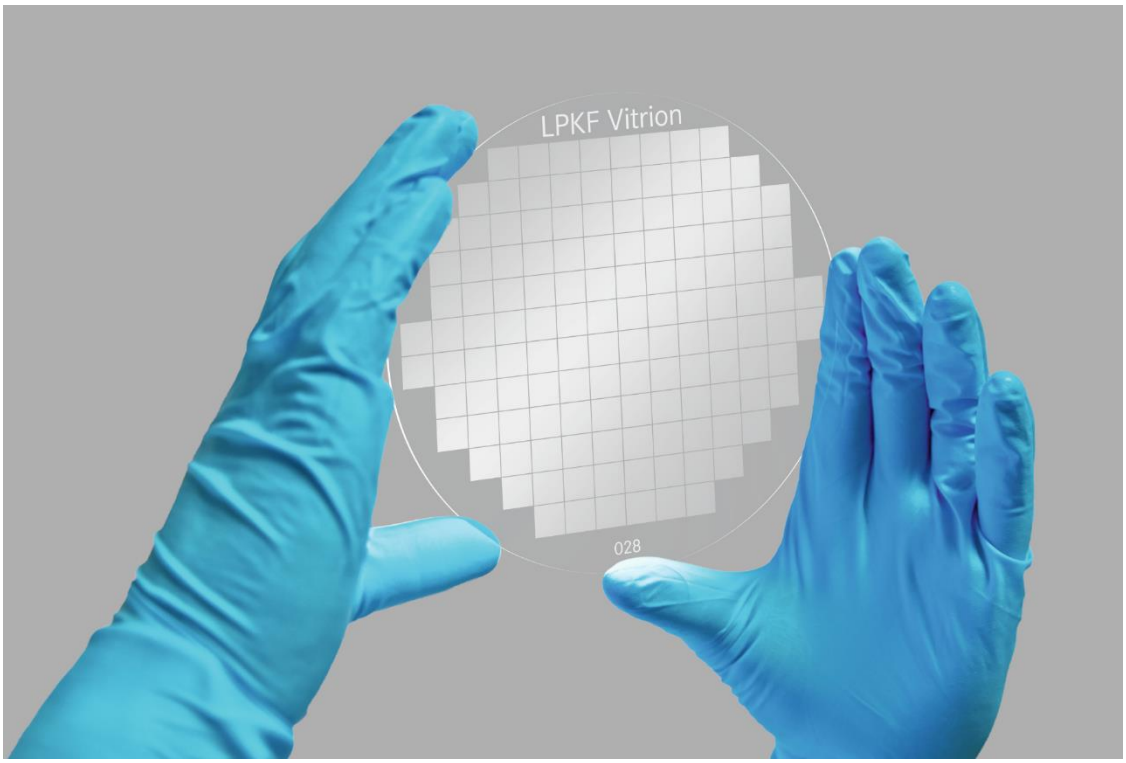
Micro-Machining of Thin Glass for Innovative Applications

Vitrion



LPKF
Laser & Electronics

Unique, Innovative Technology

LPKF's many years of experience in laser technology and its strong investment in innovation have led to the development of a new revolutionary glass micro-processing technology: Laser Induced Deep Etching (LIDE®). This patented technology makes it possible to machine highly precise micro-holes or cuts through the entire thickness of the glass or down to a specific depth – by use of a single laser pulse.

LIDE's maskless and direct-writing laser process creates slight alterations in the structure of any type of thin glass substrates, which allow it to be anisotropically etched in the subsequent batch wet-etching process, leading to the formation of high-quality and high-aspect-ratio features in glass. LIDE not only enables the creation of essentially any type of defect-free features in glass with unmatched precision, but it also does so with very high throughput and unrivaled cost-effectiveness. This LPKF technology is truly unique, and it can be used for applications in any area that does or would benefit from using thin glass.

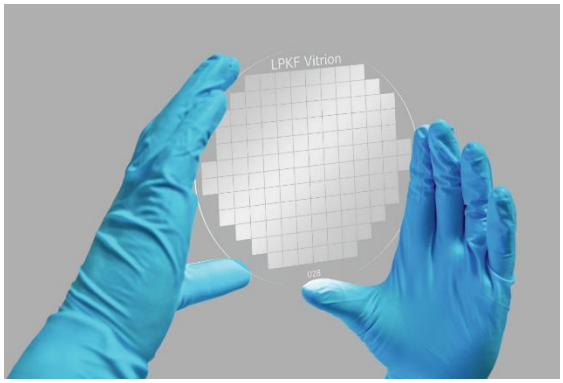


Fig. 1: Millions of through glass vias (TGV) can be created in a glass wafer, completely defect-free, at unrivaled speed.

Background: the ambivalent reputation of glass

Glass is arguably one of the most interesting materials used in products and processes in various industries due to its:

- high chemical inertness, making it ideal for use in life science applications;
- high thermal stability and tunable coefficient of thermal expansion (CTE), which allows it to operate at a high temperature while ensuring full compatibility with other materials such as silicon for the semiconductor industry, for example;
- high electrical resistivity and excellent radio-frequency properties, making it a prime material for use in high-frequency communication applications such as 5G and beyond;
- well-known optical properties for use in display applications, from TV's to mobile phones.

While the amazing characteristics of glass are not new, its processability issues using traditional technologies such as laser drilling or wet etching have - until now - significantly limited its use. Thin glass and its machining have often involved complex and expensive technologies that typically create micro-cracks and internal stresses which are known to result in the loss of certain properties, quality, production yield and reliability during use. Such issues have led to glass's reputation as a material with poor mechanical properties that is hard to machine, has significant yield losses and is therefore, expensive.

LIDE brings new life to glass

Thanks to LPKF's patented glass machining technology, Laser Induced Deep Etching (LIDE), glass can now be regarded as a potential material for a multitude of industries and applications, without a premium price tag attached to it.

Fig. 2: A Vitrion system with two automated feeding stations

LIDE consists of two process steps: firstly, a fast direct-write laser illuminates the digitally-defined areas to create any shape desired. During this step, no glass material is removed – the laser simply induces gentle and very localized modifications to the glass in preparation for the second process step. Secondly, the whole glass substrate is wet-etched in a batch process, and the areas modified by the laser during the first process step are etched anisotropically at a rate hundreds of times faster than the non-modified glass. This two-step process not only allows LIDE to create highly precise, high aspect-ratio features, it does so in a completely defect-free manner and with very high yield and throughput. Therefore, LIDE solves all the traditional issues with glass micromachining while adding new dimensions of freedom to what is possible in glass production. LIDE can create several thousands of blind vias – i.e. with a limited depth – or through glass vias (TGV) per second with incredibly high precision and accuracy. By taking advantage of this ability, LIDE can be used to quickly create cutting lines, openings and cavities in glass with any shape and depth desired. Since its patterning process is performed through laser direct writing, it does not require lithography or masking pre-processes or any associated technologies, thereby reducing complexity, and allowing the patterning of various features with different dimensions within the same process step and substrate. **Such freedom of design and cost-effectiveness makes LIDE a key enabling technology for current and future glass applications in essentially any industry, from semiconductors to life sciences.**

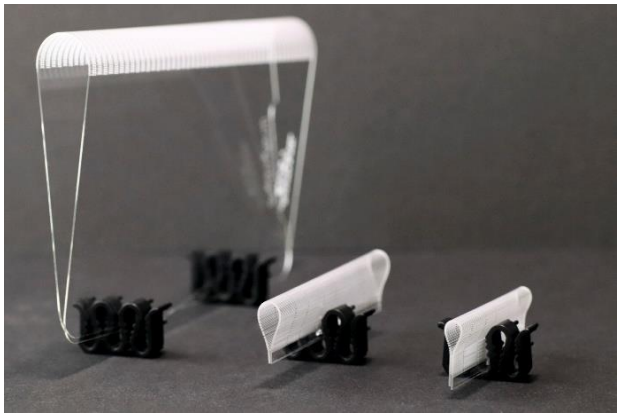


Fig. 3: LIDE-processed glass can be folded – even when as thick as 0,5 mm – and used for many applications, e.g. foldable back plane for glass displays

LPKF's glass machining service: Vitrion

The amazing capabilities of LIDE are offered by LPKF as a foundry service under the brand name Vitrion. Vitrion's commitment is to provide specialized glass machining solutions to clients in any industry. We are ready to support projects all the way from initial conception and prototyping to large volume production.

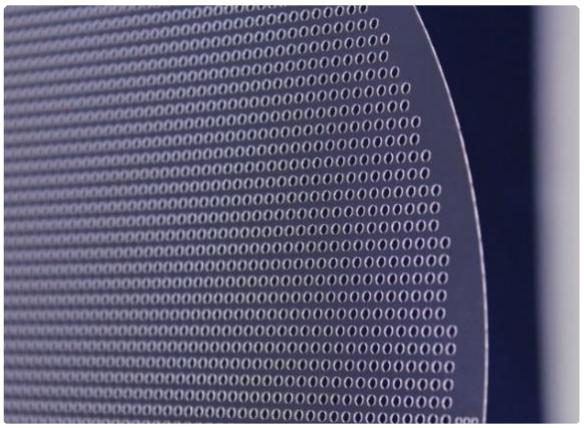


Fig. 4: Glass wafer with large openings for spacer wafer applications

LIDE can process either glass wafers or panels, up to 20" (510 mm) in diameter or 20 " x 20" (510 x 510 mm²) respectively. Nor is LIDE limited to special glass types: it can process practically any transparent, silicate-based glass substrates, such as borosilicate glass, fused silica, and many others.

Some of the applications of LIDE-processed glass include:

- Glass interposers
- Wafer-level heterogeneous integration wafers
- Glass spacer wafers
- Display cover glass
- Foldable display backplane glass
- Microfluidics
- High-density microwell plates
- High-yield glass dicing

Vitrion is currently able to handle any request up to medium volume production and is significantly expanding its capacity through the building of a brand-new ISO 6 cleanroom in Garbsen, Northern Germany, with the start of operations scheduled for Q1/2021.

Fig. 5: The completion of the cleanroom building is expected shortly in Q4 2020

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