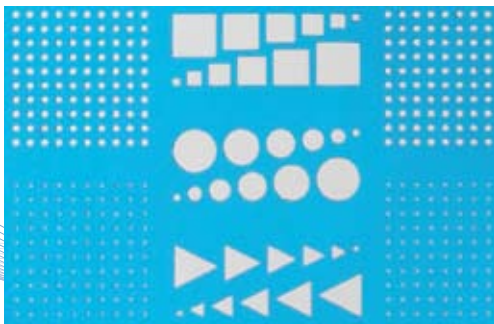
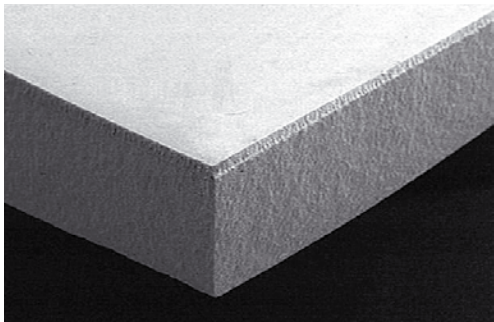
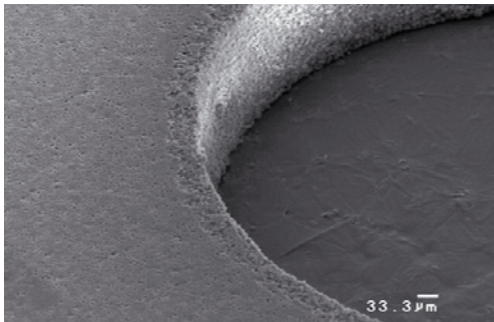


Application Report  
LPKF MicroLine UV Laser Systems  
Micromachining of Ceramic Materials



## Micromachining of ceramics

Micro-processing of ceramics using lasers is becoming increasingly important. Because of their superb electrical, mechanical and thermal properties, ceramics are being increasingly used in the manufacture of circuit boards and electronic components. The laser processing carried out with LPKF equipment involves the cutting, drilling and engraving of green ceramics, as well as cutting, drilling, scribing, engraving and marking of sintered ceramics. The following ceramic materials can be processed:

- Silicon nitride ( $\text{Si}_3\text{N}_4$ )
- Aluminium oxide ( $\text{Al}_2\text{O}_3$ )
- Aluminium nitride (AlN)
- Zirconium oxide  $\text{ZrO}_2$
- LTCC (low temperature cofired ceramic)
- Ceramic composites

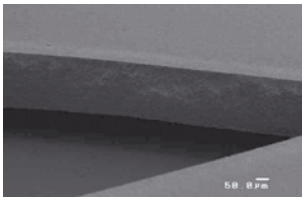
Laser processing makes it possible to create complex geometries, and guarantees maximum dimension integrity, edge quality and throughput.

## Laser marking and engraving

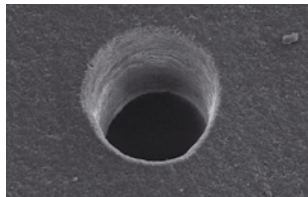
Laser marking is used to create alphanumeric figures, bar codes, data matrix codes and company logos. Laser engraving involves cutting deep tracks in the ceramic material using both shallow ablation as well as ablation to a defined depth in the material.

## Laser cutting and drilling

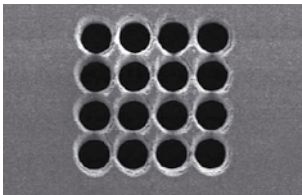
In laser cutting, a top to bottom cut is created, e.g. as an opening, a contour cut or a hole. Laser drilling is used to create ultra-fine holes, e.g.  $<75 \mu\text{m}$  in LTCC with a high aspect ratio. The special benefits of this type of processing are ultra-fine structures with very high quality edges.



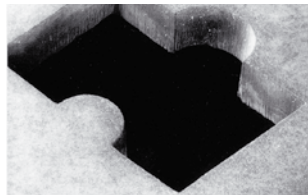
Cutting edge of a laser cut in 254  $\mu\text{m}$  thick unsintered Green Tape®



Guide hole for probe card,  $\varnothing 80 \mu\text{m}$ , roundness  $\leq 2 \mu\text{m}$



50  $\mu\text{m}$  through holes in sintered Green Tape® with a thickness of 254  $\mu\text{m}$



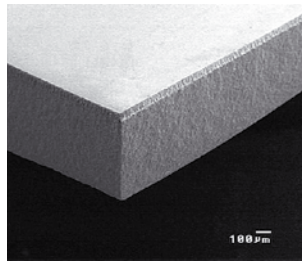
Opening in a 630  $\mu\text{m}$  thick sintered ceramic substrate

## Advantages of laser micromachining with MicroLine UV

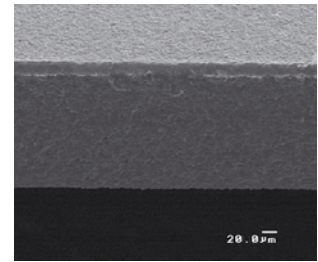
- High edge gradients
- Low edge roughness
- No micro-fracturing
- Drill holes down to 75  $\mu\text{m}$  with aspect ratios possible
- Low thermal influence due to optimized UV-processing
- Contact-free material processing prevents material distortion
- High precision and position accuracy of cut edges through automatic registration
- High process speeds

## Laser scribing

Laser scribing initially involves introducing a 20 to 50  $\mu\text{m}$  thick groove in the ceramic material. The material along this groove is then broken. Laser scribing makes it possible to cleanly separate segments with a high level of quality and accuracy. Unlike mechanical processing, this method leaves no micro-fractures in the material. And because only a minor amount of material is ablated, very high scribing speeds of up to 100 mm/s are possible (depending on the material) without generating the micro-fractures typical of mechanical processing.



1 mm thick AlN scribed and broken



Scribed and broken 1 mm thick  $\text{Al}_2\text{O}_3$ -substrate

## LPKF MicroLine UV Systems

- Frequency-tripled Nd:YAG-laser operating at 355 nm wavelength for the production of ultra-fine structures
- Substrate dimensions up to 18" x 24"
- Scanner system for highest structuring speeds
- Telecentric optics for vertical edges
- High-precision, highly dynamic x-y table
- Automatic substrate handling
- Automatic alignment: camera-based vision system for fiducial identification and online scaling
- Automatic system calibration
- Input data formats: Gerber, HP-GL™, Excellon, DXF, etc.
- Debris extraction during processing

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