Application Report
Micromachining of ceramic materials: Cutting, drilling, scribing, engraving and marking of green and sintered ceramics
Micro-machining 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 (Si₃N₄)
- Aluminium oxide (Al₂O₃)
- Aluminium nitride (AlN)
- Zirconium oxide (ZrO₂)
- 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 µm in LTCC with a high aspect ratio. The special benefits of this type of processing are ultra-fine structures with very high quality edges.

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Laser Micronics – your service partner

Benefit from the possibilities opened up by Laser Micronics: we produce small runs at attractive conditions for your applications. Our system engineers are happy to answer all questions regarding your specific application.

Advantages of laser micro-machining

- High edge gradients
- Low edge roughness
- No micro fracturing
- Drill holes down to 75 µm with aspect ratios possible
- Low thermal influence due to optimised 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 µm 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.

Our systems: LPKF MicroLine Drill and Multifunction Laser

- Nd:YAG-lasers operating at 1064 or 355 nm wavelength for the production of ultra-fine structures
- Substrate dimensions up to 640 x 560 mm
- MicroLine Drill with scanner system for highest structuring speeds and telecentric optics for vertical cut edges
- High-precision, high dynamic x-y table with an accuracy of +/- 1 µm in the Multifunction Laser
- 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
- Debris extract during processing