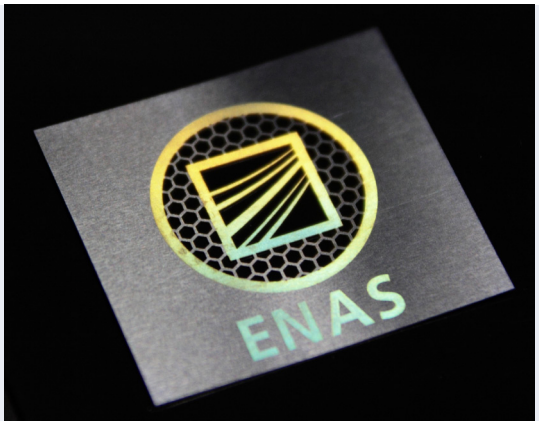
ULTRASHORT PULSE LASER MICROMACHINING



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1. Motivation

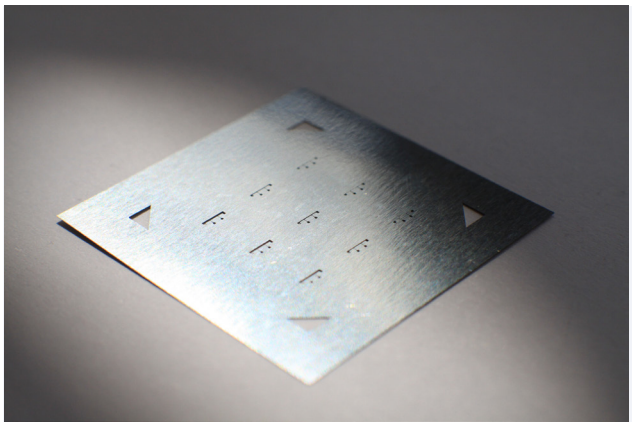
In research and development fast changing design steps of parts are very common, thus short turn-around times are needed. Laser micromachining is a powerful tool to process a wide range of materials and due to direct writing and processing of computer generated files new designs can be rapidly implemented. Especially picosecond pulse laser machining is capable of delivering high precision with outstanding quality (small heat affected zone, no burr, …) at the same time for structuring a wide range of materials. It is thereby cost effective due to low initial costs (no masks are needed) and offers short processing times.

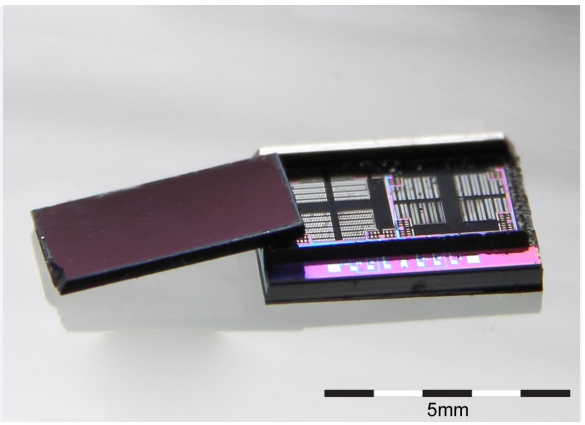
2. Equipment

At Fraunhofer ENAS a laser workstation (Fig. 1) with an implemented picosecond laser with four different wavelengths (1064 nm, 532 nm, 355 nm, 266 nm) and a 1908 nm continuous wave fiber laser, can not only be used as a prototyping tool, i.e. structuring and bonding of microfluidic parts, but can also be integrated in complex processing chains for example in MEMS/NEMS applications. Due to the wide range of variable parameters like wavelength, power, pulse frequency, mark speed, focus-Spot-diameter etc., new processes can be developed and existing processes can be adapted to meet the customers need.

3. Main advantages

- No mask – fast design changes – cost effective prototyping
- Small heat affected zone
- No melt
- No cracks
- Sharp edges
- No limitations in substrate material and outlines (max size 400x400 mm²)





4. Overview

Application areas	Materials	Processing
Microfluidics	Polymers	Cutting
MEMS/NEMS	Glass	Drilling
Dicing	Metals	Bulk material ablation (also selectiv)
Ceramic based applications	Semiconductors	(Color) marking
Counterfeit protection	Ceramics	Scribing
...	Compounds	Welding
		Surface treatment

10 W Picosecond Laser (structuring/welding)

20 W CW-Laser (welding)

Figures:
page 1: Laser micromachining workstation (left); Laser micromachined stainless steel (right)

page 2: Laser cut deposition mask 30x30 mm in a 100 µm Molybdenum sheet with structures down to 25 µm (left); Opened chips for quality control (right).

Photo acknowledgments: Fraunhofer ENAS
All information contained in this datasheet is preliminary and subject to change. Furthermore, the described systems, materials and processes are not commercial products.