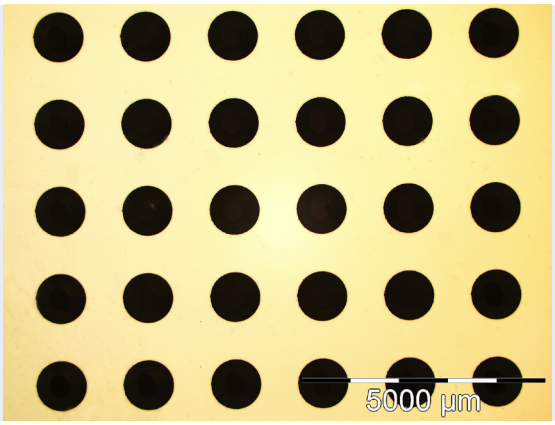
LASER MICROMACHINING OF GLASS FOR MEMS / NEMS APPLICATIONS



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Figures: 1 mm holes in 1 mm thick glass (left); Glass area-ablation 500 µm deep and micro channel 250 µm wide and 100 µm deep (right)
Photo acknowledgments: Fraunhofer ENAS

1. Motivation

In several applications in MEMS/NEMS manufacturing of glass, processes for dicing, through holes, or cavity generation such as sawing, sandblasting, etching are either not economical, not applicable or just do not deliver the specified quality and resolution. Sawing, for example, exhibits no constant cut quality due to degradation of the saw blade, causes chipping, mechanical stress and cracks. Furthermore it is difficult to use for thin substrates, needs cooling fluids and is only applicable for straight contours. The fabrication of cavities or through holes using etching is a time consuming process and expensive in the development stage of a project due to the need of cost intensive masks. Sandblasting is a fast process, but also needs masks, leads to damaged edges and is difficult to apply for thin substrates. With ultrashort pulse laser micromachining it is possible to create any 2.5D structure in glass with high quality, sharp edges with no cracks, without the limitation to certain substrate shapes and without the need of any masks.

2. Typical Processes

- Cutting
- Through holes with variable aspect ratios (e.g. fluidic contacts, …)
- Channels
- Cavities
- Engraving (e.g. logos, …)
- In-situ barcode writing in thin metal layers

3. Results and Applications

It is demonstrated that glass can be cut or drilled in high quality with sharp, smooth edges and no debris (Fig. 1) and without damaging of other adjacent materials like chromium (bright area on the left of the small image). Furthermore, the generation of large area cavities is as possible as structuring of small micro channels as shown in Fig. 2. Company logos or generated barcodes can be engraved directly into the glass surface, below the surface or in a prior deposited metal layer without any damaging of the glass. All these processes are done without any tool change in one single process and under clean room conditions.