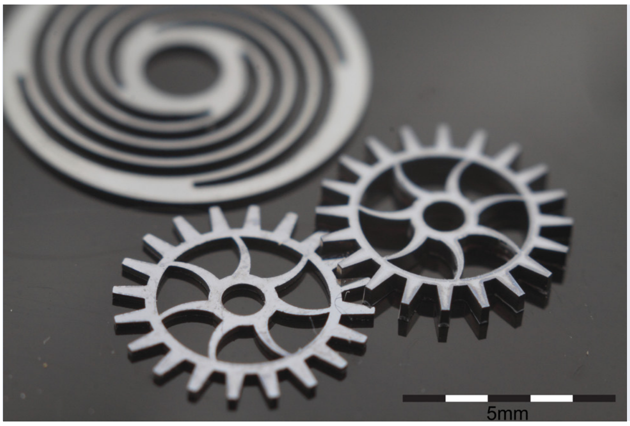
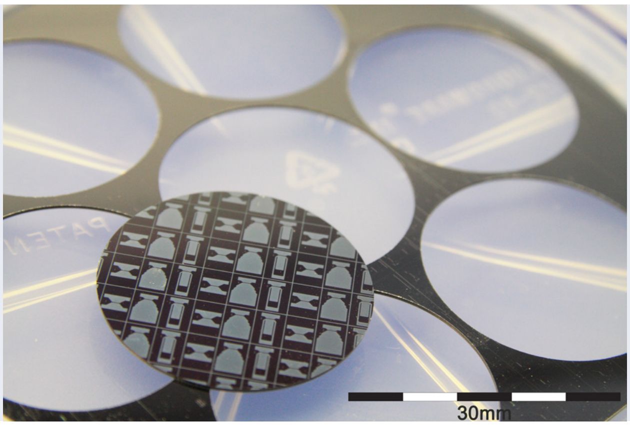
LASER MICROMACHINING OF SILICON FOR MEMS / NEMS APPLICATIONS





Contact

Fraunhofer ENAS
Fraunhofer Institute for Electronic Nano Systems
Technologie-Campus 3
09126 Chemnitz
Germany

Contact person
Prof. Dr. Thomas Otto
Phone: +49 371 45001-231
E-mail: thomas.otto@enas.fraunhofer.de

Tom Enderlein
Phone: +49 371 45001-248
E-mail: tom.enderlein@enas.fraunhofer.de

Figures: Silicon micro gears and springs (left); Dicing of round silicon substrates out of a 4`` wafer (right).

Photo acknowledgments: Fraunhofer ENAS

1. Motivation

In several applications in MEMS/NEMS manufacturing, processes for dicing, through holes, or cavity generation such as sawing, 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, is difficult to use for thin substrates, needs cooling fluids, which can destroy the function of non encapsulated devices and is only applicable for straight contours. The fabrication of micro parts 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 but is favorable in manufacturing due to the batch type process. With ultrashort pulse laser micromachining it is possible to create any 2.5D structures in silicon with high quality, no heat affection of surrounding material and it is not limited to certain substrate shapes.

2. Processes

- Dicing
- Through holes
- Slits
- Cavities

3. Results and Applications

It is demonstrated that silicon can be cut or drilled in high quality with sharp, smooth edges and no debris and even the generation of cavities is possible. Realization of micro gears and spring (Fig. 1), cutting of fragile wafers of thicknesses less than 200 µm in either monocrystalline or polycrystalline silicon (Fig. 2) and opening of fabricated devices without destroying the fragile MEMS/NEMS-structure (Fig. 3). Key features: Cutting, Dicing, Drilling of thin silicon substrates with thicknesses of up to 500 µm, cavity generation, feature size depending on thickness down to 20 µm, selective ablation.

Fraunhofer ENAS
ZfM Zentrum für Mikrotechnologien
TECHNISCHE UNIVERSITÄT CHEMNITZ