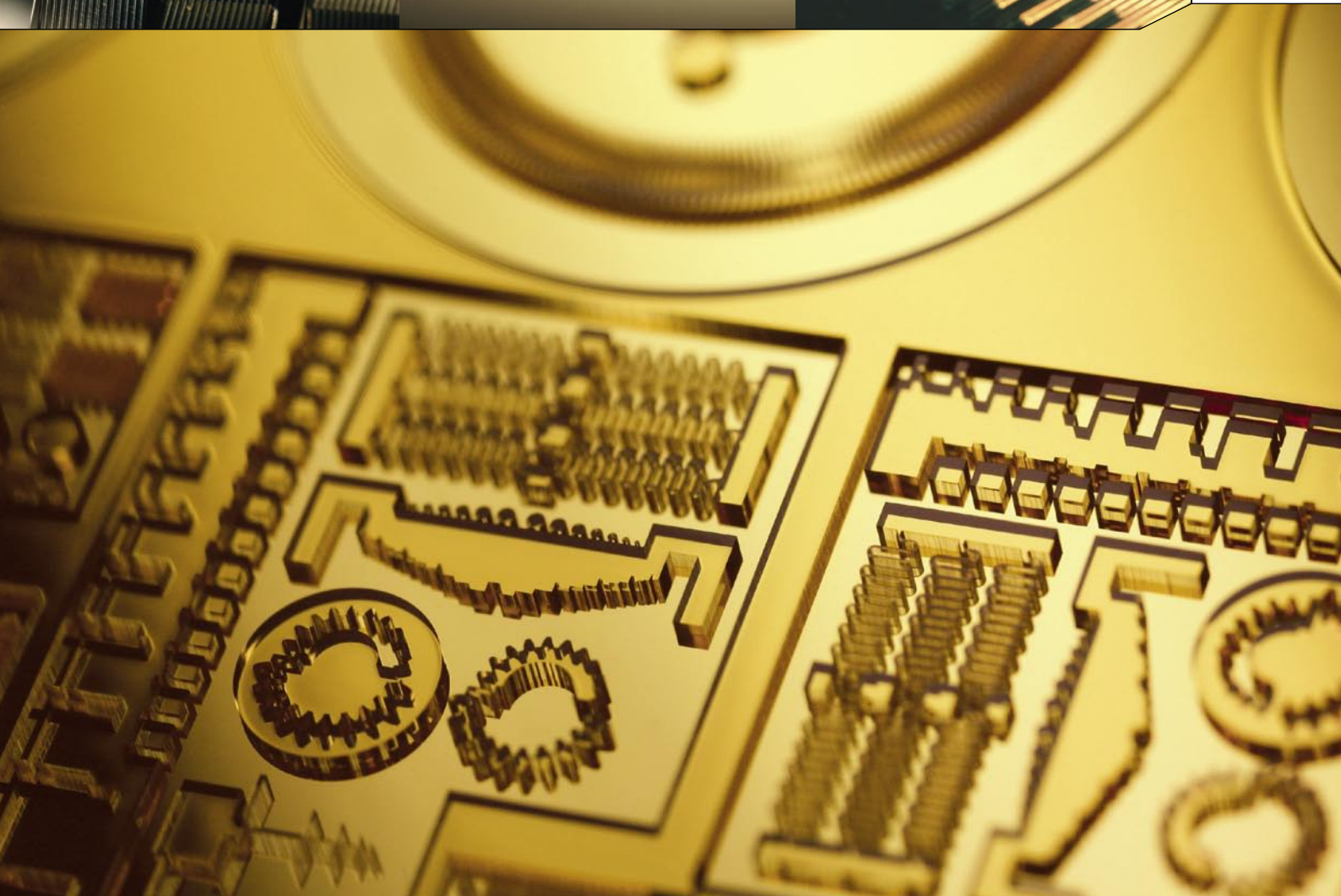




micro resist 
technology

The Next Generation of Micro Parts

Future applications with SU-8



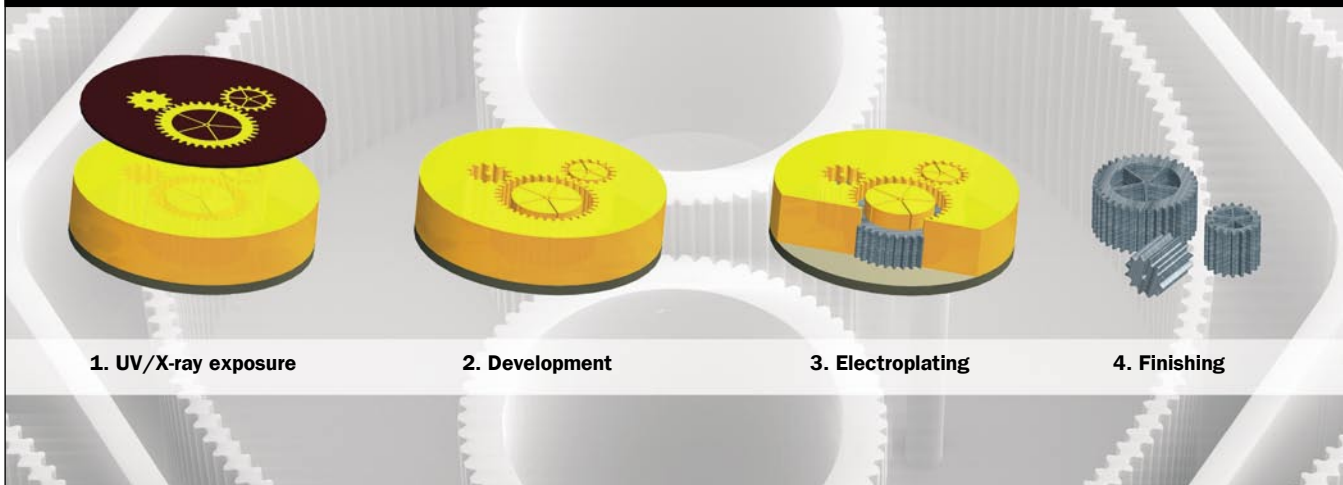
Unique material with outstanding advantages



Transform your original ideas into reality. We are a strong partnership of two areas of expertise in micro technology using DIRECT LIGA (LIGA – German acronym for lithography, electroplating and molding) with SU-8, a photosensitive material with excellent properties and very well suited for the fabrication of micro parts. The patterning of SU-8 with UV and X-ray lithography allows the development and the generation of your innovative micro technical products with minimal dimensions ranging from a few millimeters down to sub micrometers. The advantages of SU-8 are considerable:

- High photosensitivity
- Cost effective fabrication
- Excellent imaging capabilities
- Chemical resistance
- Thermal and mechanical stability
- Good biocompatibility
- Optical transparency

DIRECT LIGA fabrication process



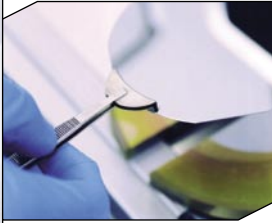
Applications you have dreamed of...

Life science | Medical care | Precision mechanics | Micro optics

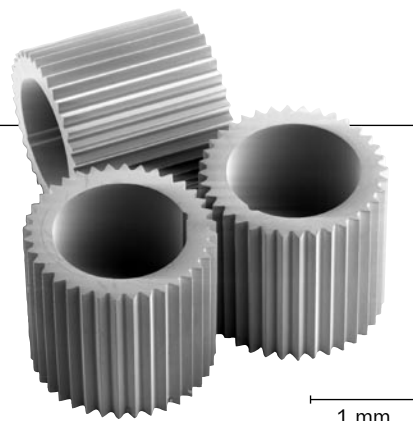
- MEMS (micro electromechanical systems)
- Sensors and actuators
- Micro gears
- Micro fluidics
- Biochips / μ TAS (micro total analytical systems)
- Multichip modules
- Packaging / housing
- Mold inserts

Macro service for micro parts

Your ideas – Our service



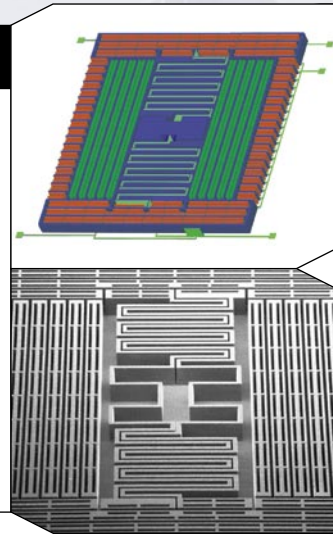
- **Complete fabrication of micro components** using the DIRECT LIGA process
- **Fabrication of various thin film structures**
 - » Gold (Au) » Titanium (Ti) » Chrome (Cr)
 - » Indium Tin Oxide (ITO) » Silicon Nitride (SiN_x)
 - » And others
- **Coating of various substrates** (e.g. silicon, glass, ceramics, foils) with photoresists/polymers
 - » Spin coating (up to 8 inch substrate)
 - » Doctor blading (15 cm x 30 cm)
 - » Preparation of ultra thick resist films (up to 1500 μm)
- **Lithographic patterning**
 - » UV: SU-8 films up to 300 μm (4 / 6 inch substrate)
 - » X-ray: SU-8 films up to 1500 μm (4 inch substrate)
- **Electroplating processes**
 - » Nickel (Ni) » Iron (Fe) » Nickel Iron (NiFe)
 - » Copper (Cu) » Gold (Au)
- **Metrology**
 - » Scanning Electron Microscope (SEM)
 - » Laser Scanning Microscope (LSM)
 - » Multisensor Coordinate Measuring Machine
 - » Interferometer
 - » Profilometer
 - » Ellipsometer
 - » Determination of Young's modulus
 - » Estimation of hardness
 - » Determination of yield stress



Fields of application

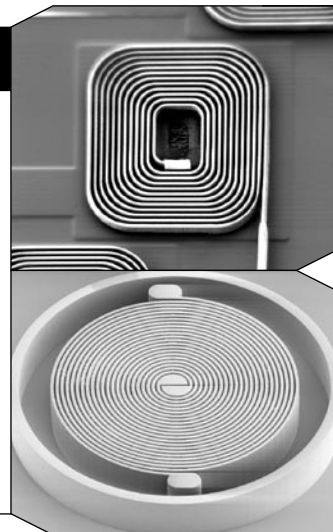
Sensors

To demonstrate the capability of the UV lithographic technology, a capacitive acceleration sensor was developed – starting with the design concept (figure above) up to the electrochemical molding. The required SU-8 resist mold with a thickness of 200 μm (figure below) ready for the electrochemical deposition of the critical sensor parts was produced using an UV mask aligner in contact mode. The minimum feature size is 20 μm .



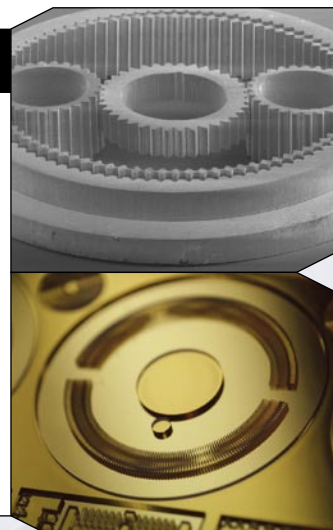
Actuators

The generation of strong magnetic fields with high lateral resolution requires specially designed coils in an electromagnetic actuator array. Only SU-8 offers the realization of high aspect ratios of the conducting lines with UV lithography (figure above: 15 μm height, 4.5 μm line width and spacing). Using SU-8, even extremely thick molds with heights of up to 500 μm can be fabricated with good quality (figure below).

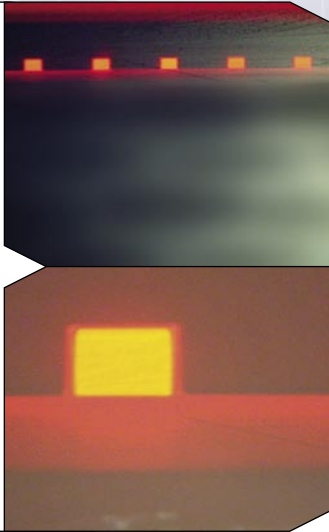


DIRECT LIGA

In collaboration with industrial partners we have fabricated metal components for a zero-backlash micro gear* (figure above) and mixer plates** (figure below) for a fluidic system by use of DIRECT LIGA. SU-8 with its excellent sensitivity and achievable vertical side wall profile is well suited for cost effective and high precision fabrication of micro components by means of X-ray lithography. Its high functionality, minimal swelling and chemical resistance enable the use of SU-8 as an accurate molding form for electroplating.

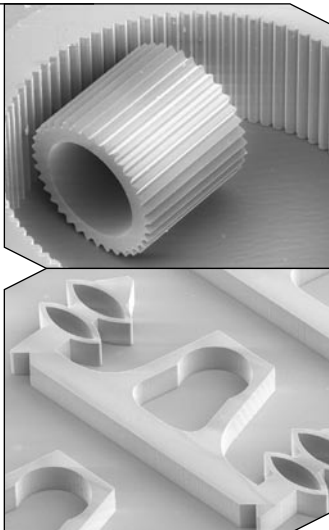


* by courtesy of Micromotion GmbH, Mainz
** by courtesy of Ehrfeld Mikrotechnik BTS GmbH, Wendelsheim



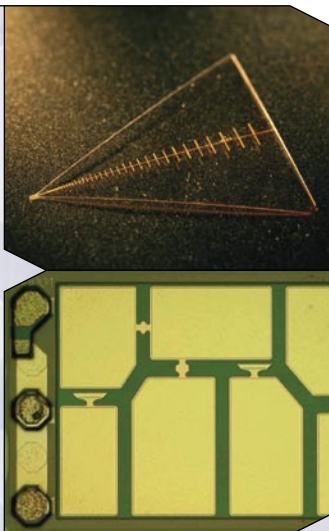
Wave guides

Chemical modification of SU-8 gives rise to produce micro optical wave guides owing to changes in the refractive indices. Such wave guides have high thermal stability and very good adhesion properties to various substrate materials as well as good transparency values in the visible wavelength range. The figures show multimode wave guides with $(50 \times 50) \mu\text{m}^2$ dimension patterned by means of standard UV lithography.



Plastic micro parts

A special advantage of working with SU-8 is the fabrication of micro parts directly in synthetic material. The photoresist itself and the patterning results from UV or X-ray lithography serve as basic material. Working without replication processes high precision micro parts can be fabricated by means of a direct lithographic process including resist set-up, exposure, development, and finally removing the parts from the substrate surface. Plastic lens holders (figure below), to be integrated in micro optical benches, and micro cog wheels (figure above) are examples for such products.



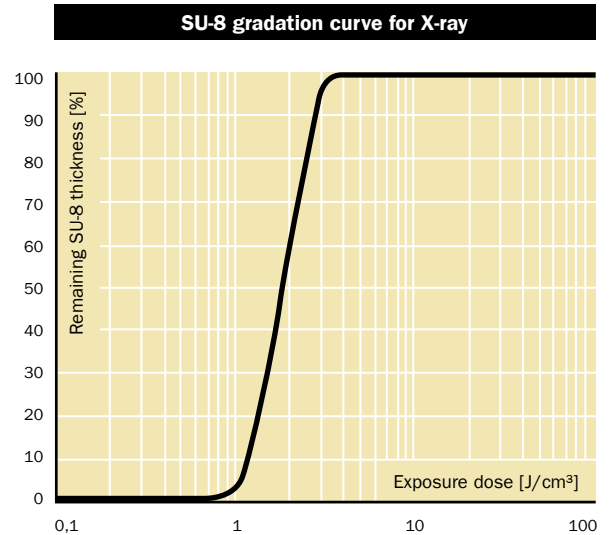
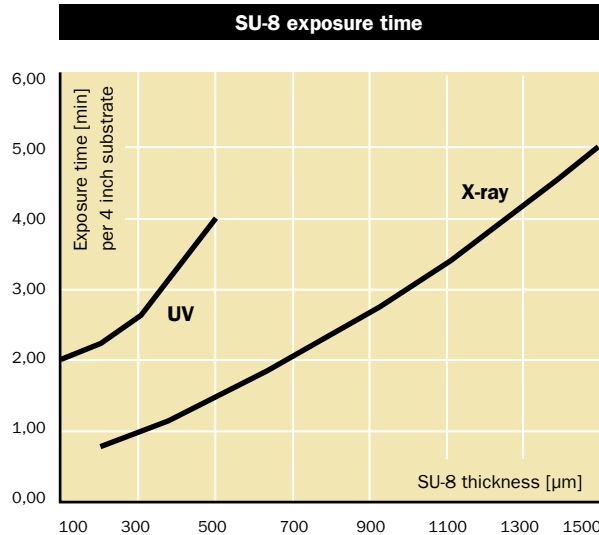
Packaging

The good mechanical strength and chemical resistance of SU-8 allow its application for packaging and housing solutions of electronic and sensor micro components. Consequently, SU-8 has been successfully used for sealing of a micro antenna for the detection of electromagnetic signals (figure above). Chips are covered with $55 \mu\text{m}$ high SU-8 boxes produced by bonding lids on walls both patterned by UV lithography (figure below*). These packaging solutions are realized by means of UV lithography.

* by courtesy of Infineon AG, Munich

Process and material specifications

SU-8 sensitivity



	SU-8	Reference polymer (PMMA)
X-ray		
Threshold dose	< 0,2 J/cm³	< 100 J/cm³
Contrast	1,4	1,2
Exposure dose	12 – 15 J/cm³	3500 – 4000 J/cm³
Maximal aspect ratio (height vs. width)	50	250

Characteristics of SU-8

Characteristics	Value
Young's modulus	4.4 GPa
Poisson's coefficient	0.22
Coefficient of thermal expansion	50 ppm/K
Thermal conductivity	0.22 W/m K
Glass transition temperature	>200 °C
Degradation temperature	~380 °C
Refractive index	1.8 at 100 GHz 1.7 at 1.6 THz
Absorption coefficient	2 /cm at 100 GHz 40 /cm at 1.6 THz
Relative dielectric constant	3 at 10 MHz
Film stress (after post exposure bake)	16 - 19 MPa
Maximal stress (hardbaked at 200 °C)	34 MPa

A strong partnership for industrial service

For several years BESSY GmbH and *micro resist technology* GmbH have successfully cooperated in the field of micro technology. This strong partnership offers you a large pool of know-how in key technologies for the realization of your ideas. Our service includes design studies, development and optimization of your fabrication process and prototyping or production of micro parts and of complete systems. The use of modern technologies based on the DIRECT LIGA process and years of experience build a solid base for finding new ways to fulfil your need.

BESSY GmbH – Anwenderzentrum für Mikrotechnik



The Application Center for Microengineering (AZM) was established at BESSY in 2001. Our activities concentrate on the development and fabrication of micro components by using synchrotron radiation, which is an excellent source for deep X-ray lithography due to high intensity, high penetration, high stability, and low divergence. Synchrotron X-ray radiation allows patterning of ultra thick resist layers (up to 1500 µm) with extremely high resolution in the sub micrometer range.

The AZM labs are equipped with several cleanroom areas, house a complete LIGA process line and provide metrology for characterization of generated micro components. Furthermore, micro processing capabilities for precision machining and fabrication of microstructures are available.

The main goal of the AZM crew is to assist activities of our industrial partners in all phases of establishing a micro fabrication process ranging from initial design to the manufacture process. The AZM supports innovative enterprises as well as interested cooperation partners during their start-up process with new technologies.

micro resist technology GmbH



The *micro resist technology* GmbH, located in Berlin, was founded in 1993 by scientists and engineers with many years of experience in basic research and industrial application in the fields of photochemistry as well as in the development of semiconductor technologies for the production of optoelectronics, electronic devices and storage circuits.

micro resist technology develops and produces specialized resists and polymers applicable in nanoimprint lithography (NIL), micro electronics and micro machining/micro electromechanical systems (MEMS) as well as resists for large area patterning and electroplating processes.

The success of *micro resist technology* is based on continuous product development starting with basic components and the implementation of recent innovations. Experience and close cooperation with scientific partners and customers guarantee stable and successful progress of the company. Our partners can rely on the expertise, the experience and the power of about 35 employees. The quality management system of *micro resist technology* has been certified according to the DIN EN ISO 9001 standard since 1997.

We are looking forward to discuss your specific needs. For further information please contact:

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