GEMÜ®

VALVES, MEASUREMENT AND CONTROL SYSTEMS

Fabrication of metallic microcomponents by electroforming

The complex geometry of microcomponents, which for example are used in a clock movement in the form of gears or escape wheels, can no longer be obtained without burring using standard mechanical

processes. New processes, such as the Direct LIGA Process, allow the fabrication of such microcomponents, in which the microstructures are defined lithographically and deposited by electroplating.

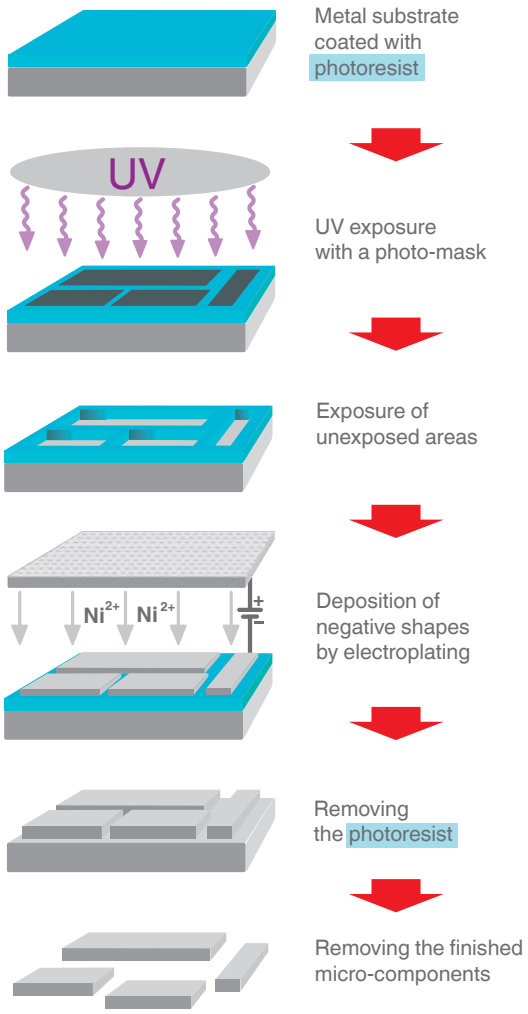
The Direct LIGA Process

The LIGA process comprises three subprocesses: lithography, electroplating and shaping.

***Lithography** involves transferring the 2-dimensional design of the component to a metal substrate coated with photoresist using a high-resolution photomask. This substrate is applied to a silicon wafer. Lithographic transfer of shapes to the resist is achieved by shadow projection and by exposure using UV light or X-rays. The unexposed areas are later exposed to allow deposition by electroplating into the negative structures, which can be up to several millimetres thick.*

*The second stage of the process is the **deposition by electroplating** of the negative shapes using a nickel-iron electrolyte. The metal dissolved in the bath deposits onto the conductive surface under electrical current.*
Various layer thicknesses can be electroplated depending on process duration and electrical current. The rate of deposition can vary between 25 µm/h and 1 mm/h.
The gears (wheels) are then fabricated by chemically and mechanically removing them from the photoresist and wafer. Depending on the size of the components, up to 1000 gears can be fabricated per wafer in a batch process.

*In a third process stage the resultant metallic shapes can also be used as moulds for the production of plastic microcomponents by injection moulding. If this **shaping process** is not performed and the metallic components are used directly, this is referred to as the "Direct LIGA Process".*



The system design

A buffer tank containing electrolyte heated to a temperature of approx. 80 °C is located in the supply area (fig. 1) below the working tank (fig. 2). The temperature is monitored by using a GEMÜ 3220 temperature transducer. Water is added in order to compensate for evaporation losses. A GEMÜ 910 level sensor provides protection against overheating and against dry operation of the pump.

The electrolytic solution is injected, from below and through an upstream filter, into the working tanks containing the pre-treated wafers by a GEMÜ 610 diaphragm valve made of PP. Due to the high temperatures involved, diaphragm valves made of PVDF are the first choice. PP is used for the temperature range below 70 °C.

Customer benefits

With its comprehensive range of products, GEMÜ supplies not only pneumatic and manually operated diaphragm valves (GEMÜ 610, 617) and plastic ball valves (GEMÜ 717) in a variety of materials, but also sensor devices such as level transmitters (GEMÜ 910), flow transmitters (GEMÜ 3020) and temperature transducers (GEMÜ 3220).

GEMÜ 610

GEMÜ 617

GEMÜ 717

GEMÜ 910

GEMÜ 3020

GEMÜ 3220

Source: MOT GmbH

Rear view of the system

Source: MOT GmbH

Front view of the system

Source: MOT GmbH

Section of supply area

Source: MOT GmbH

Section of supply area

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