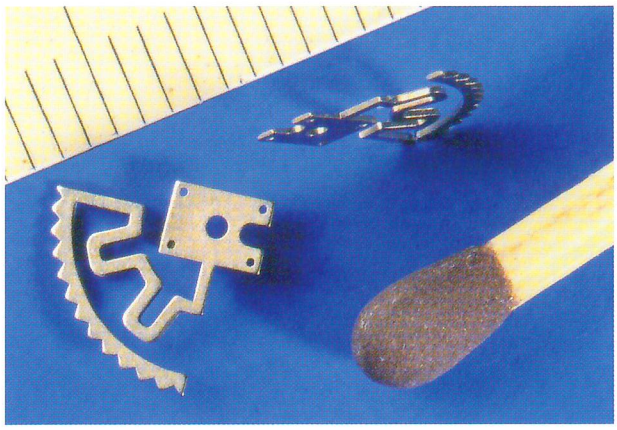
Steiger
Galvanotechnique SA
A company of the Estoppey-Reber Group

Microelectroforming – **UV-LIGA**



A piece made from electroformed nickel by the *UV-LIGA* process, showing the great design liberty allowed. The piece's thickness is about 200 µm.

The *UV-LIGA microelectroforming* technique is pushing back the conventional mechanic limits. This revolutionary processing technique is characterized by a great design liberty, the integration ability of complex mechanical functions in one single processing step and an easy way of parts identification against counterfeit.

Description, possibilities and limits of the processing technique:
The first step of fabrication lays on collimated UV photolithography. As negative SU8 photoresist resin is used unirradiated zones will constitute the molding definition elements for the electroforming process. After the removal of the photoresist mold the newly electroformed parts are directly usable for the focused application or for subsequent finishing steps as grinding.

During projects prototyping phase the costs are particularly low compared with other classical techniques due to the possibility of combining multiple design trials on the same photolithographic mask. During the production phase as well the medium series as the high volume ones can be processed economically.

The characteristic dimensions of the photoresist structure are:
> The maximum achievable thickness is 800 µm in one run. It is indeed possible to superimpose multiple independently structured layers. In that way complex tridimensional parts can be fabricated.
> The achievable aspect ratio during the photolithography step is about 10. Therefore a photoresist thickness of 250 µm allows a structure resolution of 25 µm.
> Millimetres dimension parts have a tolerance of 3 µm as the centimetres ones only 5 µm.
> Sides are nearly vertical forming an angle of 89° to 90° with the base wafer, which is mandatory for gears functionality. Besides this advantage their surface topology is very fine and of much better quality than those obtained by electroerosion.

Electroformed metals
The principal metals being processed are:
> nickel
> nickel-phosphorous (NiP12)
> copper
> pure gold

Ni-Co or Ni-Fe alloys can also be realized for specific needs.

Nickel deposit can be obtained with a wide range of mechanical properties. Its hardness can be tuned from 300 HV to 600 HV. Its ductility varies in this way from 15% to 1% accordingly (%-strain). The physical properties relayed to a hard nickel specially designed for watch industry are given in the table hereafter.

Nickel-phosphorous deposit which contains 12%-weight of phosphorous is amorphous and non-magnetic. It can be hardened up to 1000 HV using a further heat treatment. Its microstructure evolves in this way from an amorphous state to a para-magnetic crystalline one. The physical properties relayed to its raw state are given in the table hereafter.

Copper deposit can be obtained with a wide range of mechanical properties. Focusing electrical engineering or thermal applications, despite its low hardness, pure copper is preferred thanks to its excellent thermal and conductive properties.

Pure gold is electrodeposited for its excellent corrosion resistance toward the major chemical agents and for its good properties of X-Ray radiations absorption. On the other hand its use is not appropriate for mechanically driven parts.

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