CASE STUDY

COPPER DEPOSITION TO FABRICATE TINY 3D OBJECTS

ETH zürich

CYTOSURGE®

Problem – Challenge

In most existing 3D microprinting processes, overhanging structures can be achieved only through a workaround: during the printing process, a stencil manufactured beforehand is used as a placeholder under the overhang that is to be printed. The template must be removed once printing is complete.

Solution

ETH Zurich developed an innovative technology with which the FluidFM µ3Dprinter prints metal by electrodeposition in a liquid bath. The technique is based on a force-controlled hollow micropipette and can even print overhangs without support structures. Briefly, a conductive substrate is placed in a liquid bath. The tip of a micropipette, the so-called FluidFM iontip, enters the liquid bath and acts as a print head. A copper sulphate solution flows slowly and steadily through the FluidFM iontip. Using an electrode, a voltage between the liquid bath and the conductive substrate is applied, causing an electrochemical reaction under the iontip aperture. The copper sulphate emerging from the iontip reacts to form solid copper, which is deposited on the conductive substrate as a tiny voxel. A force-feedback enables the automation of the movement of the FluidFM iontip, allowing researchers to print pure metal 3D objects, voxel by voxel, and layer by layer targeting arbitrary geometries.

This printing technique is a further development of the hollow cantilever-based fluidic force microscopy (FluidFM) developed at ETH Zurich several years ago and commercialized by the ETH spin-off Cytosurge AG. The latest development leads to the FluidFM µ3Dprinter, a very high-precision stand-alone solution to print solid metal objects at the micrometer scale. This unique printing technology is capable of being industrially scalable and has the potential to drive additive micromanufacturing well beyond current technological boundaries.