# CASE STUDY

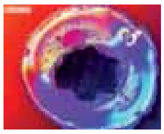
## LIDT AND DEGRADATION INSPECTION TECHNIQUE FOR INDUSTRIAL APPLICATIONS

### *Problem – Challenge*

*The Alpine Rhine Valley between Liechtenstein and Switzerland has a long tradition in the manufacture and use of optical coatings and coating technology. In order to support the regional industry in this area, a CTI (Innosuisse) project was started in 2014 at the NTB Interstate University of Applied Sciences of Technology, Buchs. In this 3-year project, a consortium of eleven industry partners and four research partners extended a commercially acquired LIDT (Laser Induced Damage Threshold) measuring system to enable the state-of-the-art investigation of the damage behaviour of optical components. For applications where the lifetime of the component is critical, laser damage investigations must be conducted in an environment similar to the operating conditions. Another goal was therefore to extend the test bench to allow degradation testing of the optical components under controlled environmental conditions. .*

### *Solution*

*Processes for efficient and transparent measurements with a high degree of automation and fast changeover time when switching between different wavelengths have been developed. In addition, a measurement service with fast turnaround time has successfully been established to support the industry with short development cycles. The developed degradation chamber allows tests to be conducted under a variety of different temperature, gas environment and humidity conditions. This allows the development of optical components tailored to the conditions to which they are exposed in laser applications. By providing a world-first set of degradation testing tools combined with extensive measurement services to determine the LIDT of optical components, the competitiveness of Swiss manufacturers of optical components and lasers is enhanced through rapid, targeted and qualified support in qualifying and optimizing coatings and coating processes. The project also gave the consortium of industry partners the opportunity to network and exchange ideas. In addition, highly qualified employees for the optical industry in Switzerland are trained locally and access to the international laser damage community is made possible, thus ensuring innovation development and transfer in the optical industry. The system is already in use in several Innosuisse projects. The project has enabled RhySearch, which has now become an Innosuisse recognized research institute, to initiate several follow-up activities and establish a measurement laboratory for high quality optical components.*



# CASE STUDY

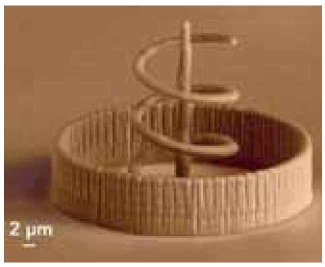
## COPPER DEPOSITION TO FABRICATE TINY 3D OBJECTS

### *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.*

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