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Collaborative Project (STREP)

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D6.1 – Definition of application requirements and needed laser properties for the 2 benchmark processes

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Dissemination Level		
PU	Public	**X**
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	


D6.1: Definition of application requirements and needed laser properties for the 2 benchmark processes

Nature: Report

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1 Introduction

One of the most important task of the Razipol project is to demonstrate laser applications using beams with radial and/or azimuthal polarization. To show the high potential range of processing applications, the project will focus on two main demonstration applications. The first application based on a fast scanner in combination with a 500 W average power laser to realize complex structures on large surfaces. The second application will show trepanning holes drilling with a 200 W average power laser and a trepanning optic. This report includes the definition of the applications, materials, geometries and the definition of laser properties for the two different laser versions.

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2 Definition applications, materials, geometries

The first benchmark application is structuring wafers (Fig1-2). Structuring with laser is an alternative instead of micro-lithography (photolithography/lift off) and etching processes. The target wafer sizes for the application are 6-8 inches and the material will be Pt, Au and SiN. The minimum targeted structure size will be 1µm at a surface ablation rate of 20 cm^2 per minute.

Fig1: left SiN-coated Pt surface; centre only selectively ablated SiN, right additional Pt cut

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Fig2: Microstructured PT interconnects

The second application is drilling of spinneret holes with high aspect ratio and tight tolerances. Spinneret hole drilling is focussing on real 2D process development without the necessity of solving side effects (3D handling, prevention of back wall strikes) but is extremely challenging on quality requirements. The application is directly focusing on hole quality in dependence on laser properties. One main target of the application is to realize high repeatability and low average deviation of the radius (target 1%). For our demonstrators we chose following parameters:

- 100 – 200 holes per nozzle
- entrance diameter < 50 µm
- exit diameter < 50 µm
- surface roughness of hole < 0.3 µm
- hole depth 1,5 mm for demonstration
- Tapering -10°/10°
- material of the nozzle: 1.4301 and 1.5910

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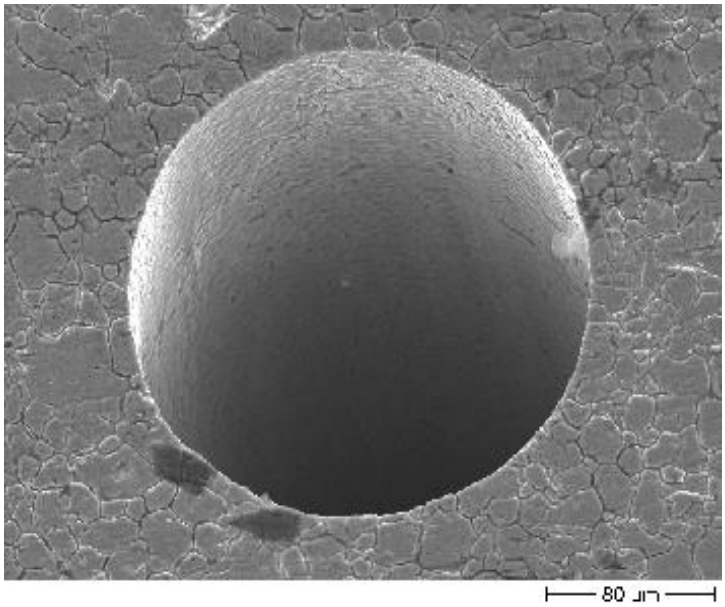

Fig3: laser drilled hole

The results of the process development can be adapted to other challenging hole drilling applications like injection nozzles, air bearings and throttles.

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3 Definition of laser properties

For the application structuring wafers the MOPA system with 500 W average power should have pulse energies from 12.5-25µJ per pulse with pulse duration of approx. 1ps. The repetition rate should be in a range of 10-40 MHz.

The key laser properties for the MOPA System averaging 200 W are as follows:

- MOPA with 200 W average power
- pulse energies (0.2-1 mJ; target for applications should be 1 mJ)
- pulse duration ≤ 10 ps
- repetition rates (0.2-1 MHz; target should be 200 KHz)
- pointing stability ≤ 1 µm
- M^2 = 2-2.2
- ramping possibility
- Mechanical drift based on variations of environment temperature (short/long use (8h)) max. 10 µm

The laser properties given above are recommendations based on the known application requirements. Aberrations, especially beam quality and pointing stability will affect the achievable quality of the benchmark applications or the size of the process window. Pulse energy and repetition rate will influence the processing time.
Temperature stability has an important influence on industrial relevance. High temperature stability of the laser system can reduce the costs for industrialisation and increase the acceptance of such systems for industrial applications.

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4 Outlook

The next step will be process development using 50 W laser systems for benchmark application 1 and 2.
Therefore Class 4 Laser Professionals AG (C4L) and Schweisstechnische Lehr und Versuchsanstalt SLV Mecklenburg-Vorpommern (SLV M-V), partners of the project, started with initial trials. SLV M-V made some tests for the application structuring wafers on nano-coated circuit boards for LoC devices. They have completed the following steps:

- Literature review
- Procurement Pt-coated glass wafer
- Determination of wavelength-specific ablation thresholds on Pt / SiN
- Analysis of the maximum scanning speed for proper contours with no pulse-on-demand
- Effective ablation parameters for surface removal of large areas as well as detailed contours
- Selective layer removal multilayer nanofilms
- High-speed photographs of the patterning processes

C4L has completed the following steps:

- Literature review
- Purchasing axis, bread board, optical parts
- machine setup 1 (C4L) – FGSW Stuttgart rotary optics with JDSU/ TBWP Duetto IR
- machine setup 2 (University of Applied Sciences and Arts Northwestern Switzerland) ILT Aachen rotary optics with JDSU/ TBWP Duetto IR
- Alignment

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