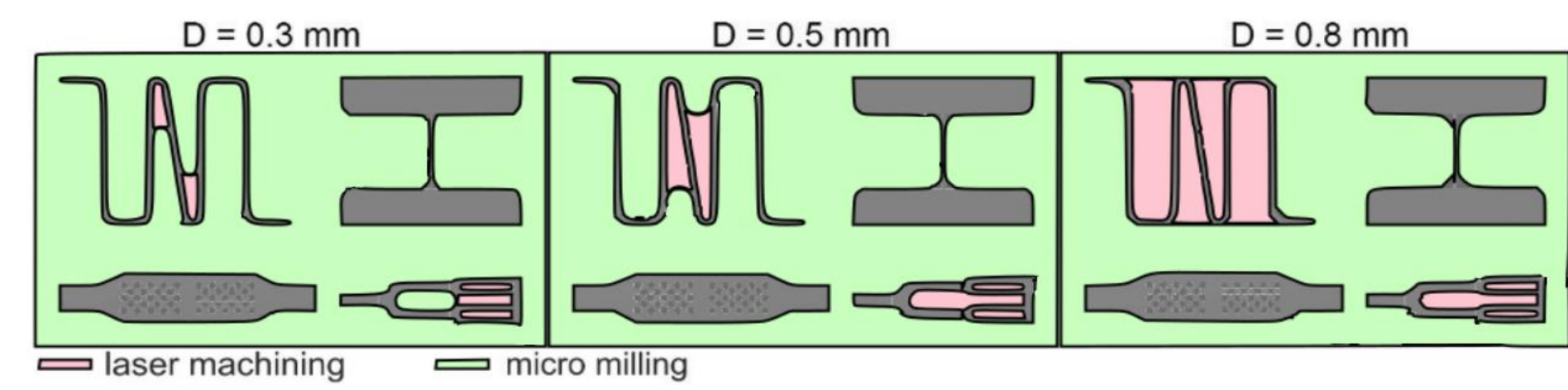




Hybrid machining of Ceramic: Combination sequential milling and laser machining

Introduction

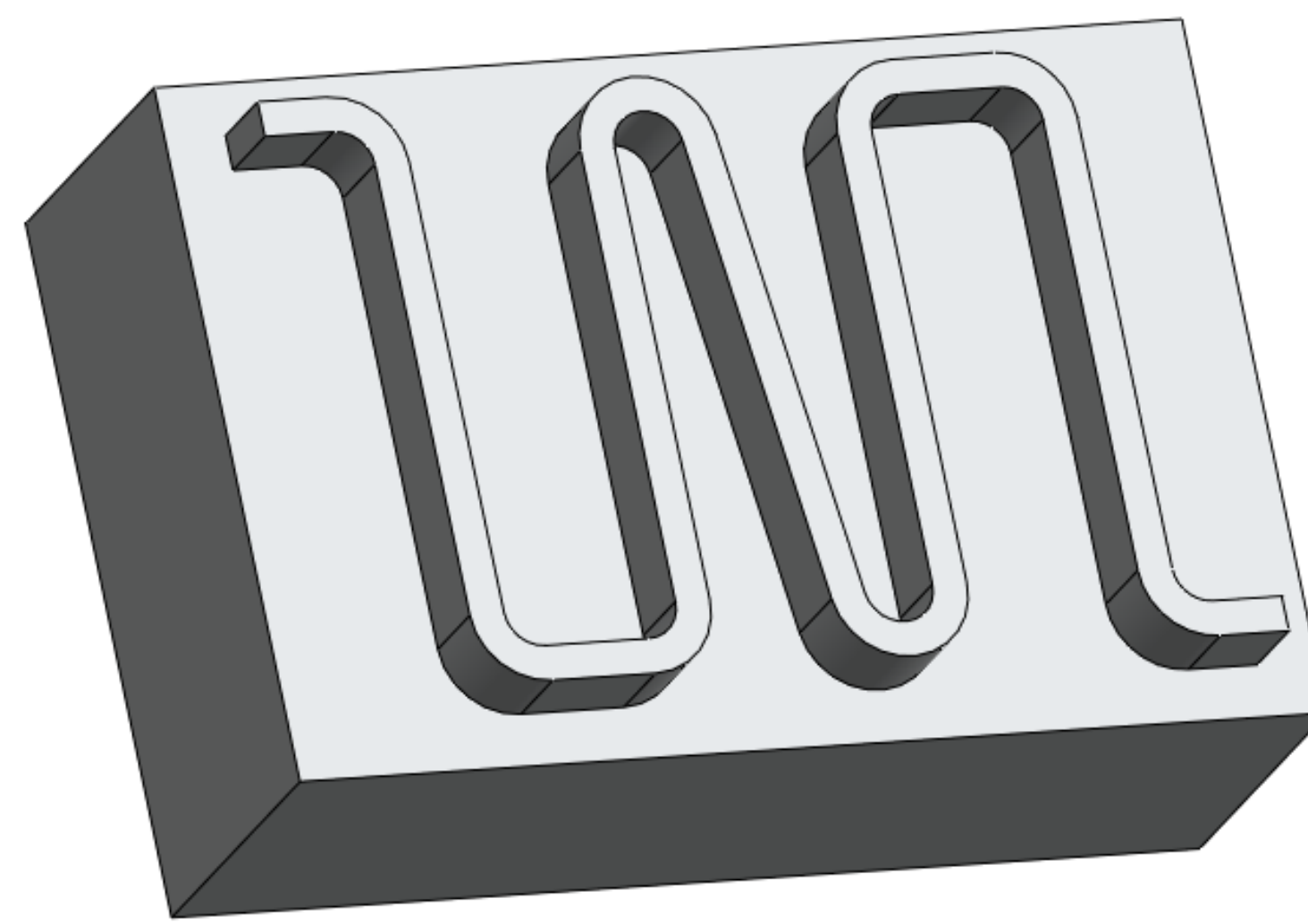
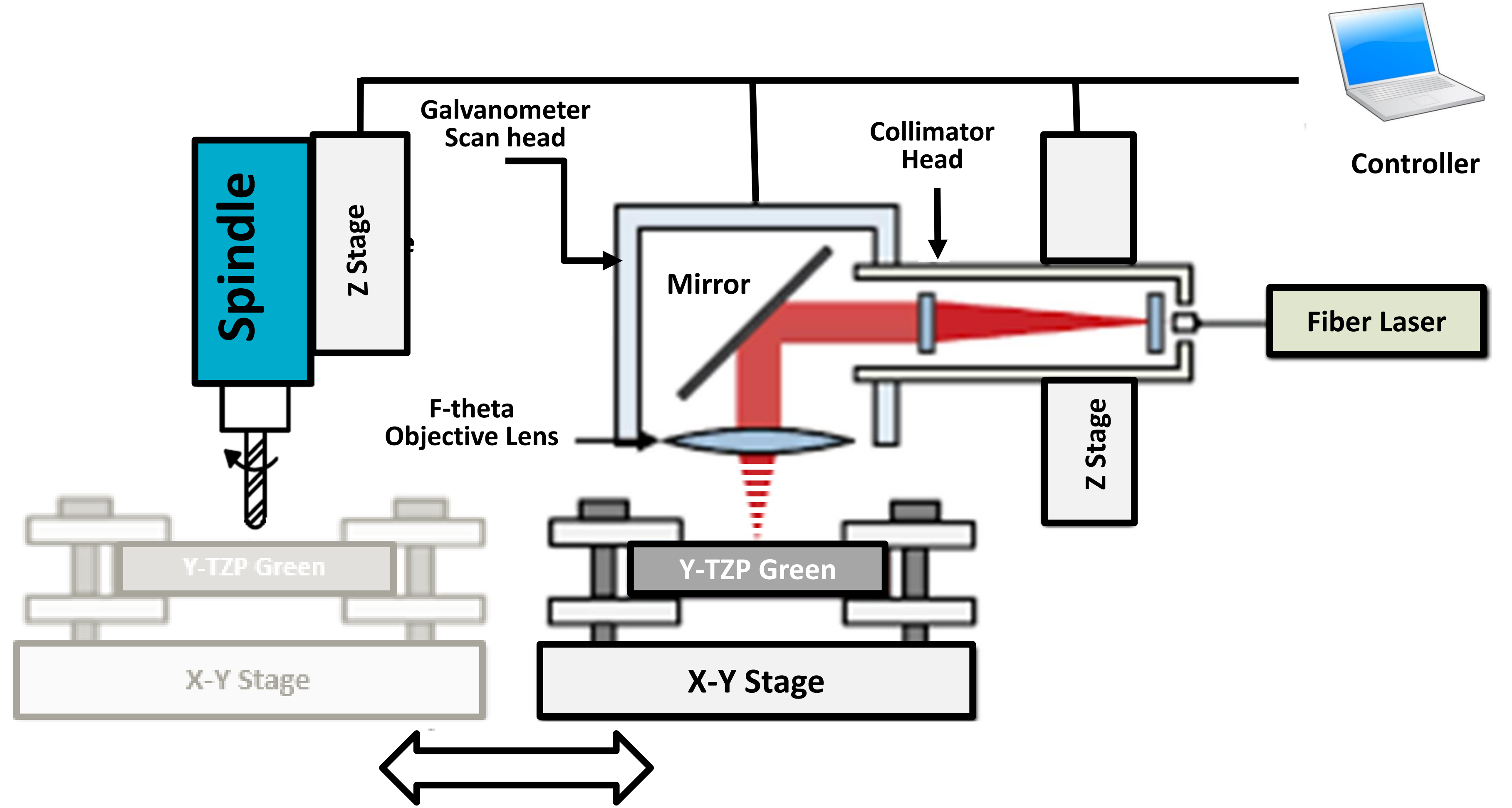
The demand for micro products has increased gradually since last decades in various areas, requiring the development of micro manufacturing processes. Micro manufacturing is characterized by the size of functional features (less than 10 mm), a high precision, a good surface finishing and complex parts in a wide variety of materials. Hybrid Machining Processes (HMPs) were introduced to address the demand to increase production with an enhanced quality for difficult-to-machine materials such as ceramics. The final goal is to determinate an optimal combination with the laser source and one tool geometry.



The first step is to master each process. Indeed, the milling of green body is difficult because of tool contact and the laser machining because of heat transfer. Moreover, the position tool should be to control for HMPs.

Ref: A. Schubert, S. Groß, B. Schulz, and U. Eckert. Sequential combination of micro-milling and laser structuring for manufacturing of complex micro-fluidic structures. Physics Procedia, 12 : 221-229, 2011. Lasers in Manufacturing 2011 – Proceedings of the Sixth International WLT Conference on Lasers in Manufacturing.

Schematic diagram of Hybrid process



Experimental method

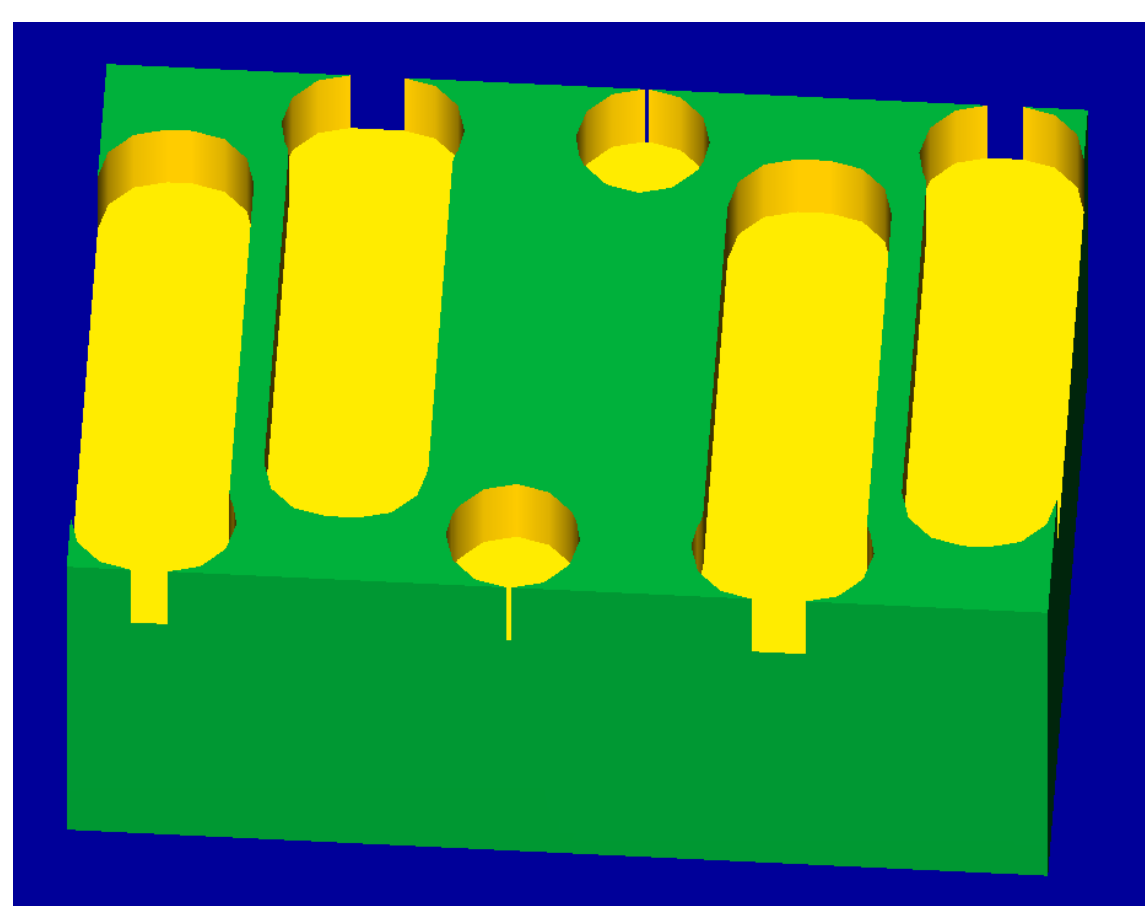
Microfluidic device

Structure height: 500 μm
Wall thickness: 200 μm

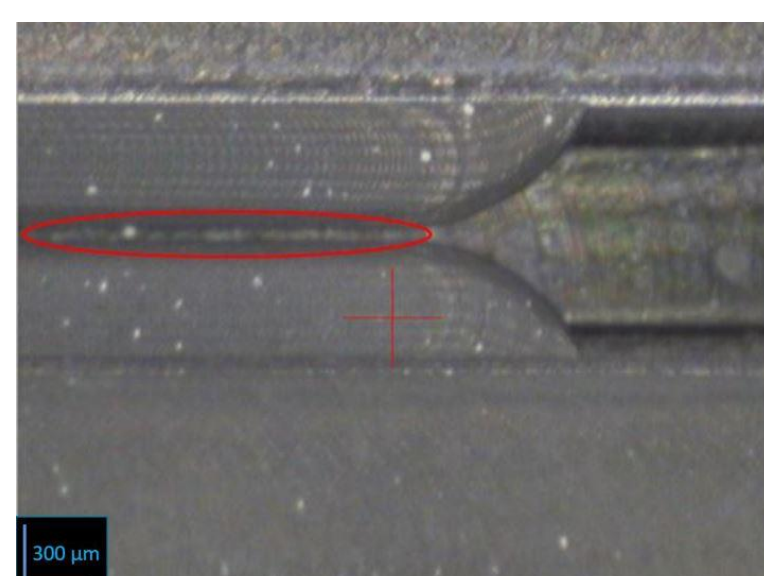
Material

Y-TZP Ceramic
Green body

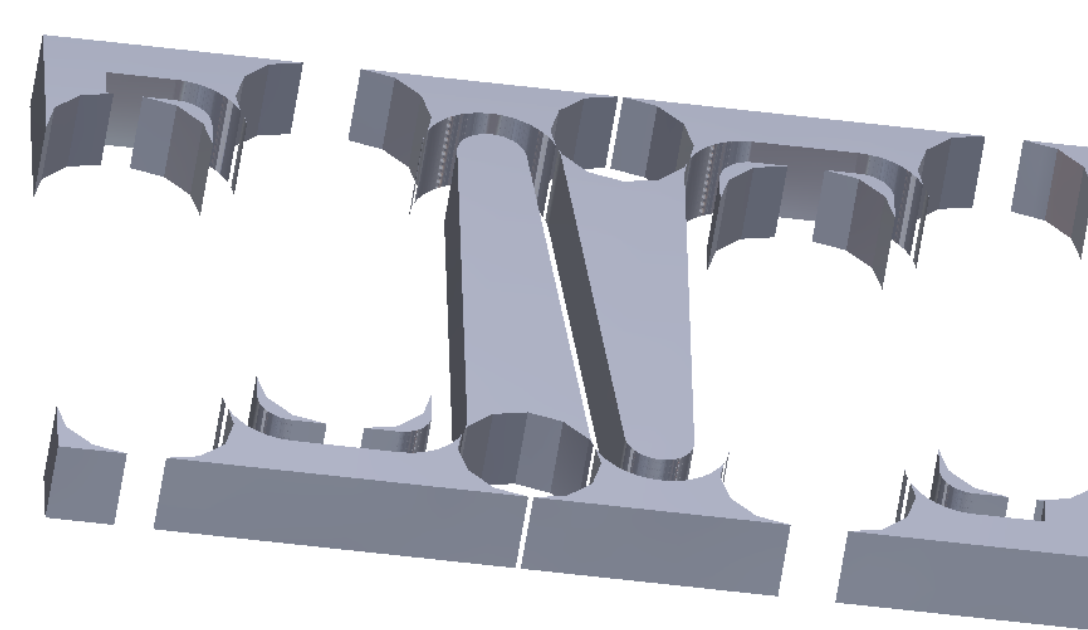
Milling



- Parameters determination
 - Based on coupling tool-material
- Test of thin-walled



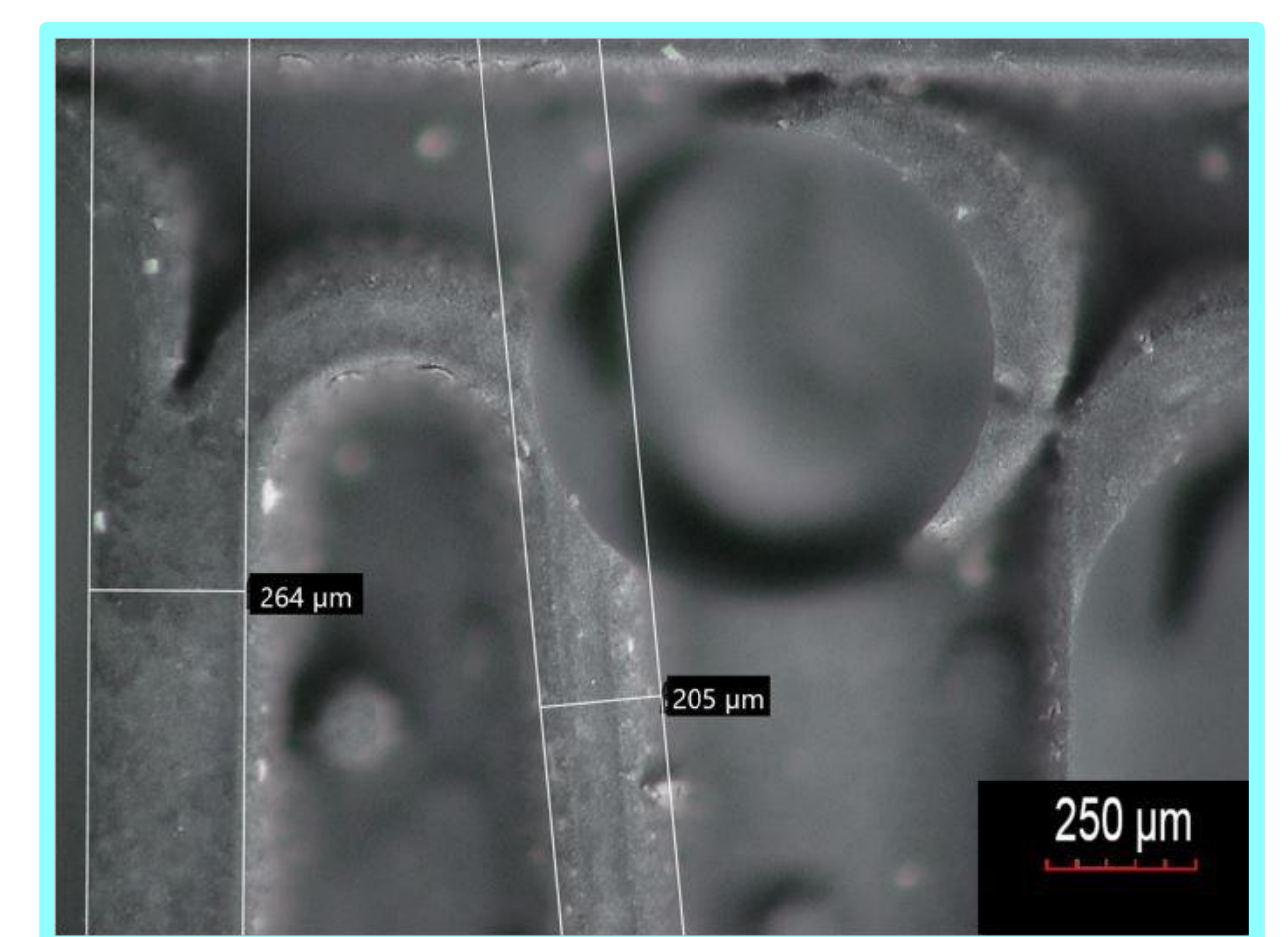
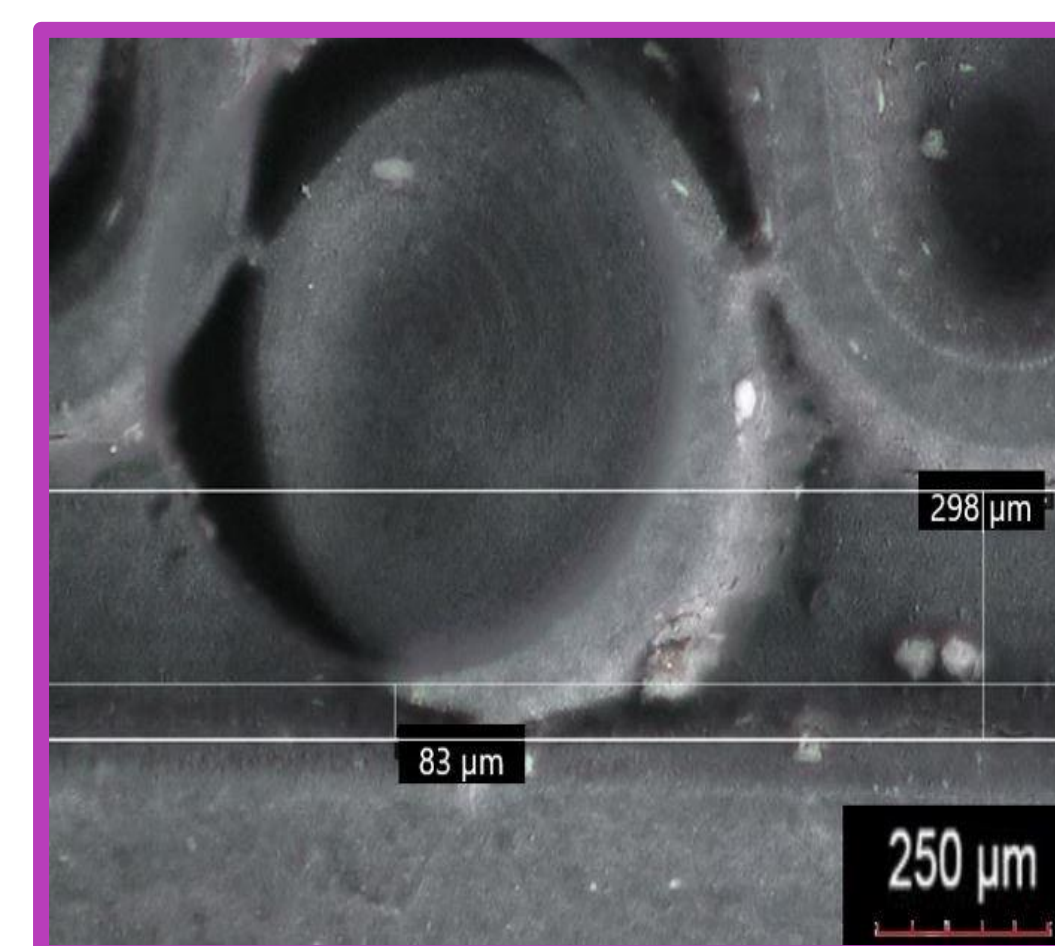
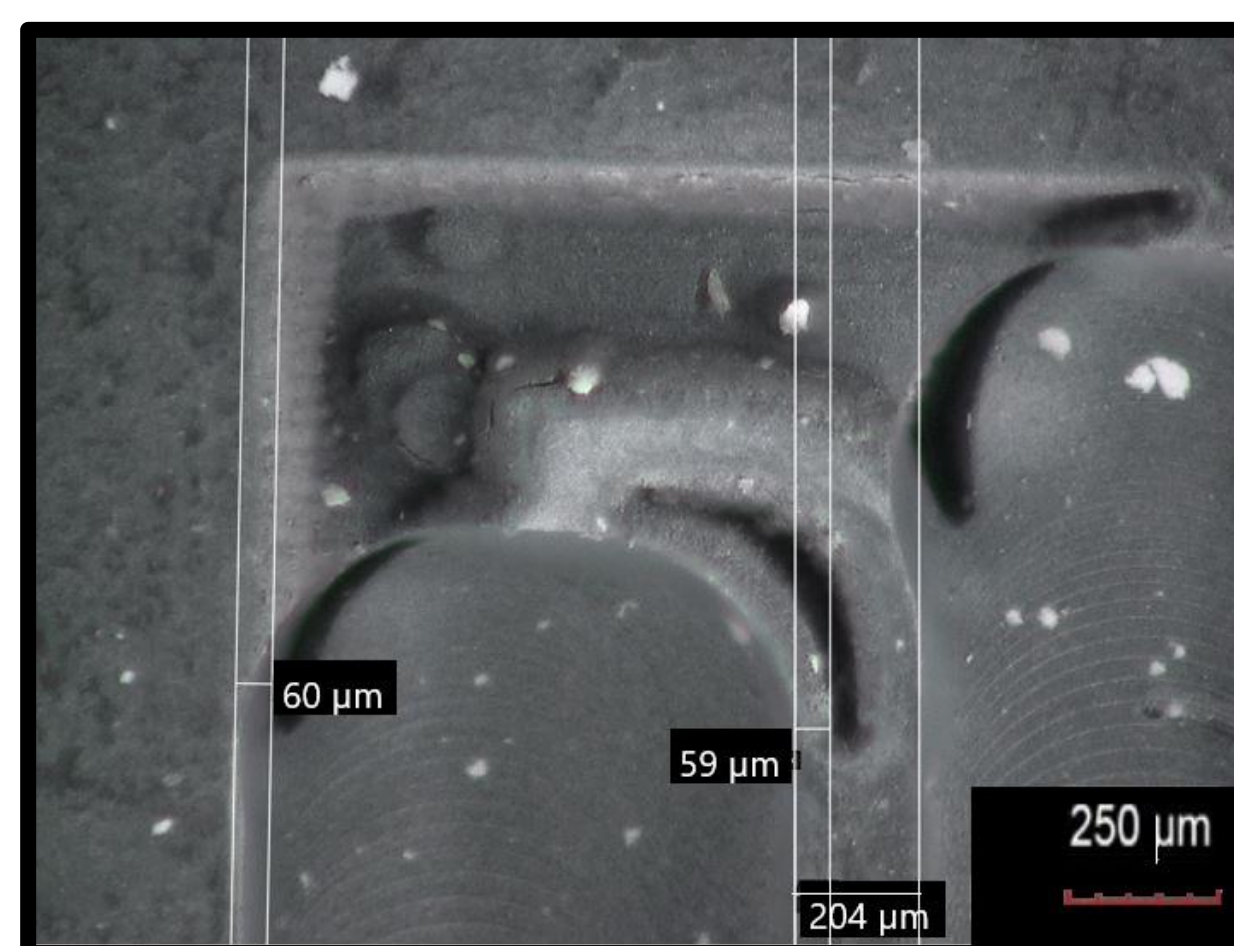
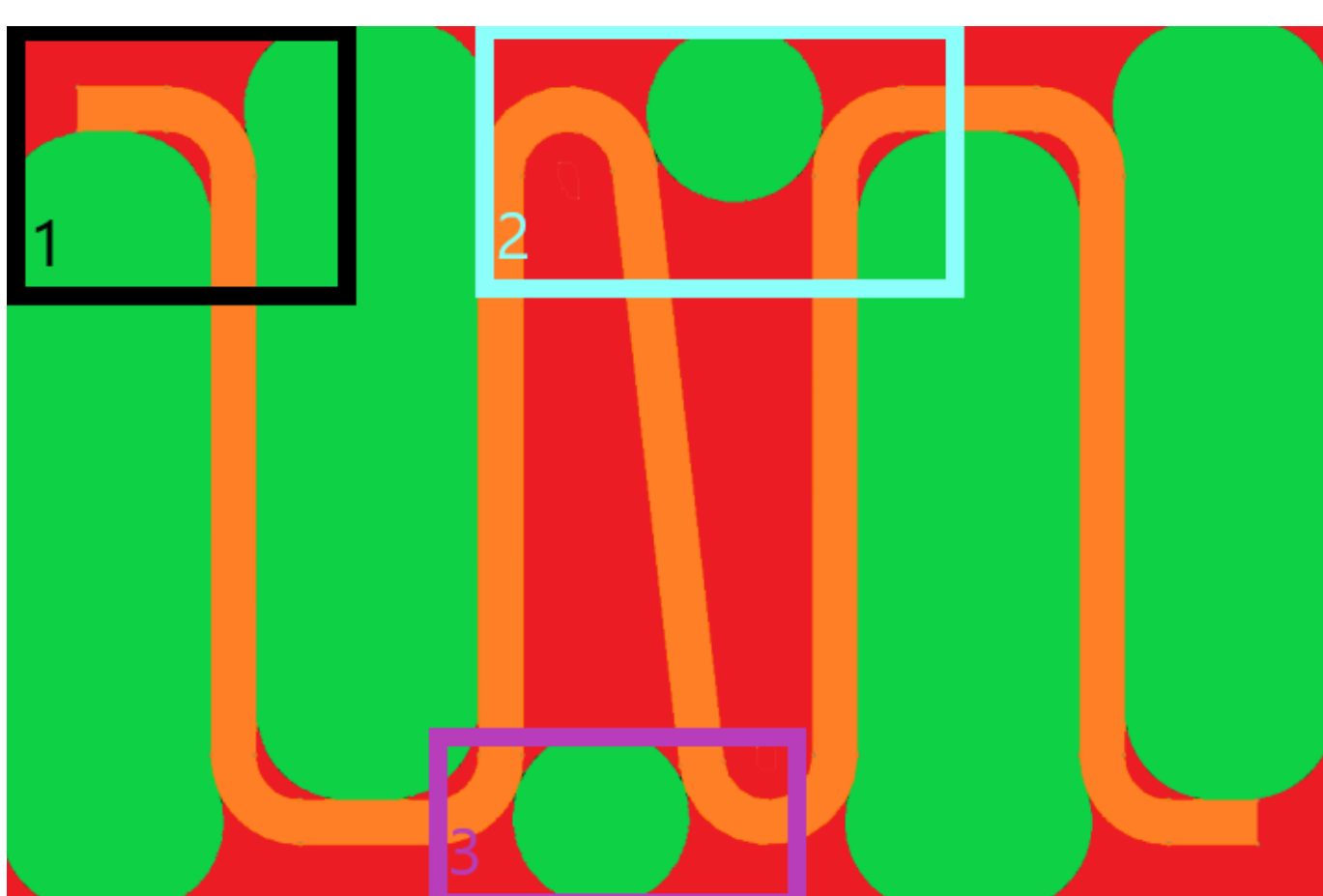
Laser Machining



- Parameters determination
 - Based on experimental design 2⁴
- Test of thin-walled



Combinaition



Acknowledgment

The research was conducted in cooperation with CRIBC member of EMRA and OPTEC laser systems



Conclusion

- Default in the tool position
- Thin-walled in laser << Thin-walled in milling

Pespectives

- Development an other method for milling parameters
- Sequence optimisation