MULTIFLEX

ULTRASHORT PULSED LASER PROCESSING AT 1 KILOWATT USING A FLEXIBLE MULTI BEAM APPROACH

Grant No 825201

Project Summary

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PHOTONICS PUBLIC PRIVATE PARTNERSHIP

Project Summary

Challenge

Ultrafast lasers can do something very unique: They ablate material of almost any kind without thermal load of the adjacent material. Their cuts are smooth and melt-free, even on a micron scale. This makes ultrafast lasers very interesting for many industry branches such as tool making, where hard materials must be processed very precisely. Unfortunately, such precise processes take time. Too much time for an efficient use of this technology for many industrial applications. The MultiFlex project will overcome this obstacle and pave the way for a widespread, cost-effective application of ultrafast lasers in industrial manufacturing.

In the MultiFlex project, a consortium of six partners from industry and research is doing the next step in the development of the ultrafast laser process technology to make materials processing with ultrafast lasers up to a hundred times faster.

Approach

The basic idea behind MultiFlex is to setup a high power “USP laser-dot-matrix-printer”, which consists of a newly developed high power ultrashort pulsed laser with an output power of more than 1 kilowatt and a flexible multi beam optics concept.

In MultiFlex a highly stable high power laser with average power of more than 1 kilowatt and a pulse duration below 1 ps will be developed as pulse durations in the femtosecond range enable higher process efficiency, better quality and broader process windows. Special emphasis will be given to flexibility in pulse shaping, power stability as well as pulse modulation capability at high pulse energies.

The optical system converts the single laser beam into a pattern of more than 60 beamlets, where each single beamlet can be turned on and off separately. The resulting pattern can be directed onto the workpiece with a fast scanner. By enabling the flexible switching of the separated single beams and a control system for compensating field distortions, arbitrary surface structures can be generated with highest precision and throughput. The complex system will be accomplished by an industry grade control unit.

The “USP laser-dot-matrix-printer” developed within MultiFlex will be evaluated on several demonstrator parts as well as in two industrial use cases provided by associated industrial partners.

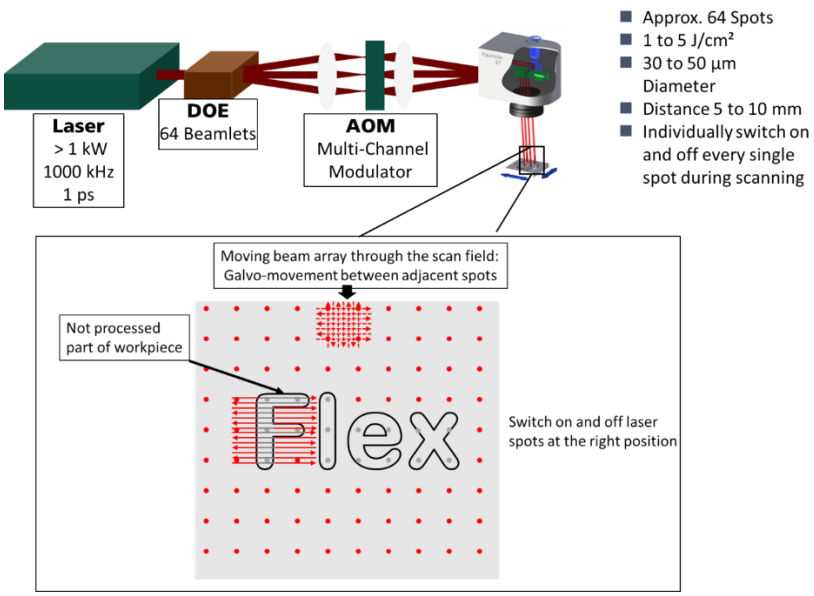

Figure 1: Principle of the "Laser Matrix Printer"

The key tasks carried out in the MultiFlex project are:

- **Ultrafast laser** with more than **1 kW** average power, **burst** capability and **free triggering.**
- **Multi-Beam-Optics,** capable of controlling every single beamlet using a **multi channel AOM.**
- **FPGA-based** control system to control every single beamlet and **correcting field distortions** with highest precision.
- **Demonstrator machine** to **integrate** all developed components and validate the developed technologies.
- Integrating a **data acquisition** and processing system to **monitor** optical system and process.
- **Validating** the developed solution within **industrial use cases** given by associated industrial partners.

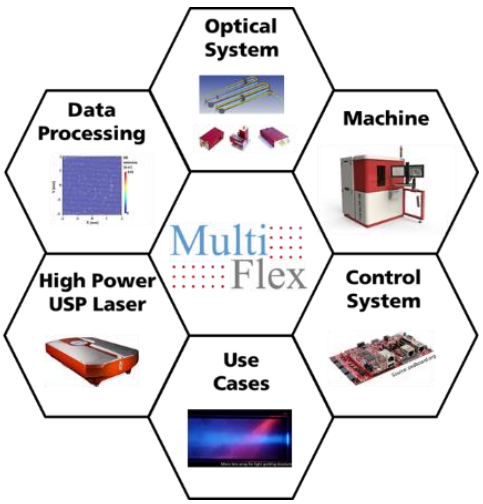

Figure 2: Task within the MultiFlex project.

Impact

Ultrafast laser processing and especially surface structuring has numerous potential fields of application. The focus of MultiFlex is in the field of structuring of tool and molds, but the planned developments can be used for several other ultrafast laser applications as well. The development of this project help to strengthening industrial manufacturing based on ultrashort pulse lasers and to extend its field of applications.

MultiFlex will deliver an enabling technology for the European industry in the field of mass production of functional and design surfaces in several fields, e.g. Automotive, Lighting, Consumer and Luxury Goods, Lightweight Construction and Filter Systems.

The MultiFlex project aims for a completely new dimension in ultrafast laser processing. By efficiently using twenty times higher laser power compared to conventional processes, a 20 times faster control system, an up to 100 times higher productivity will be reached.
With the developed technology opening up a new dimension of multi-beam processing, large area applications get feasible.

This helps to bring the advantages of ultrafast laser processing to a broader application and helps to replace environmental problematic technologies like chemical etching.

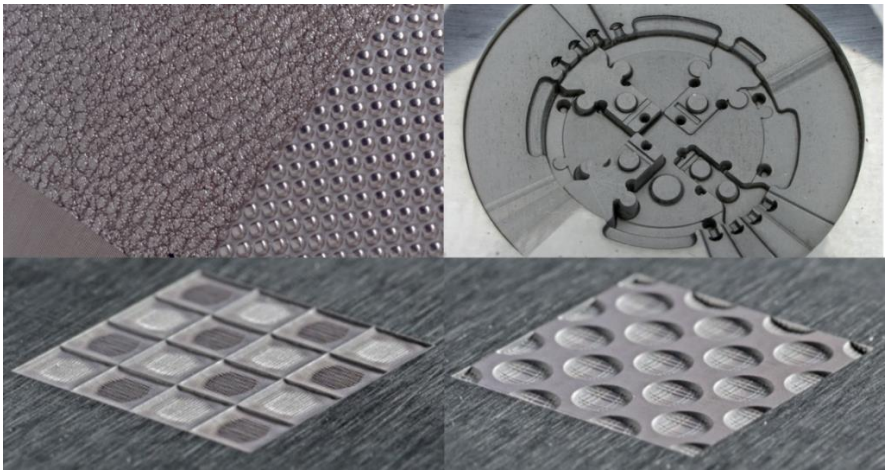

Figure 3: Ultrafast laser fabricated surface structures.

Consortium

The consortium consists of the research institutes Fraunhofer ILT and the RWTH Aachen University from Germany as well as Amplitude Systèmes, LASEA France and AA Opto-Electronic from France and LASEA, Belgium, as industrial research and development partners.

The Laser source development is the key working point of laser manufacturer Amplitude Systèmes. The flexible multi-beam optics will be developed by LASEA France in cooperation with RWTH Aachen University for the optical design. The key element in the optical setup will be the modulator for switiching on and off the single beams in a multi beam array that will be delevoped and fabricated by AA Optoelectronics. All components will be integrated in a machine tool by LASEA. Fraunhofer ILT

and LASEA work together on the control system for the whole system. The project is coordinated by Fraunhofer ILT.

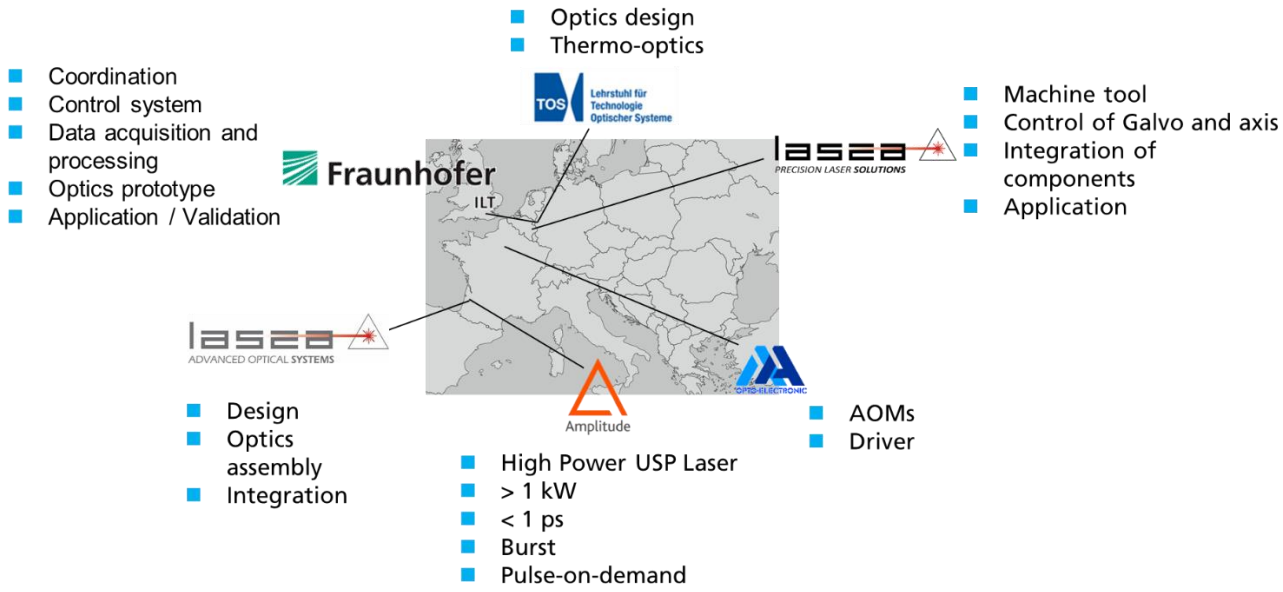

Figure 4: Consortium of the MultiFlex project.

Logo

Figure 5: Logo of the MultiFlex project