1 1 x 8 beam array.
2 MultiFlex system at Fraunhofer ILT.

MultiFlex – Multi-beam processing of non-periodic structures

Laser material processing with ultrashort pulse (USP) lasers is an excellent method for processing almost any material precisely and melt-free. It enables ablation with virtually no thermal influence. This makes USP laser processing attractive for many industrial applications, including toolmaking. A major disadvantage is the long process time compared to ablation using nanosecond laser radiation, for example. A common method of compensating for this disadvantage is processing with several sub-beams, known as multi-beam processing. The classic variant is limited to periodic structures, as the individual sub-beams are used to perform parallel processing with a fixed spatial distance. MultiFlex removes this restriction.

Individually modulated sub-beams for multi-beam processing

To circumvent the process' limitation to periodic structures, each sub-beam is guided by a separate acousto-optical modulator (AOM). With this, the sub-beam pulse can either be deflected precisely into a beam dump or passed through to the scanner, i.e. switched off or on. The individual AOMs are controlled and synchronized with the laser beam source via an FPGA module developed for this purpose. This allows a beam matrix consisting of 8 x 8 sub-beams, for example, to be moved over the workpiece in a similar way to a dot matrix printer, whereby only the sub- beams that are needed for processing at the respective point are switched on. This switching pattern for the AOMs must be calculated beforehand in software developed for this purpose. All sub-components are installed in laser material processing system typical for the industry.

Scaling by means of non-periodic multi-beam processing

The use of MultiFlex technology for non-periodic multi-beam machining with 64 individually modulated sub-beams enables an increase in productivity by a factor of around 30 compared to single-beam machining. The exact factor depends on the geometry to be machined.

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