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LASER MATERIAL PROCESSING AT THE SPEED OF SOUND

Task

Current developments of ultra-fast lasers have reached new records regarding average laser power and pulse rate. To produce high-quality processing results, the individual laser pulses have to be separated from each other, which prevents the material from overheating and the individual pulses from interacting with each other. At pulse frequencies in the multi-MHz range, the scanning speed of galvanometric scanners is, however, no longer sufficient since scanning speeds of more than 100 m/s are required. Using this high scanning speed, researchers at the Fraunhofer ILT have been able to utilize high power and high repletion rate ultrafast lasers, thereby achieving high process efficiencies.

Method

To make a high scan rate possible in the range of > 100 m/s and to structure with ultra-fast lasers, the Fraunhofer ILT has developed a processing system with a polygon scanner rotating at extremely high speeds and fast laser beam modulation.The polygon mirror of a polygon scanner rotates at a high, constant speed, thus increasing the maximum scanning speed considerably. This allows a low pulse overlap for optimum processing results and the utilization of the full laser power.An incident laser beam hitting the polygon mirror is deflected along a line. This line is shifted by moving the working piece on a linear axis to allow two-dimensional processing. The laser beam modulation occurs synchronized to the laser pulse and the position of the polygon and the axis.

Result

The Fraunhofer ILT has developed a polygon scanner system for 2.5 dimensional machining. Scan speeds of up to 360 m/s can be achieved, whereby even pulses with a diameter of 20 µm at pulse rates of 18 MHz remain separated. The processing area is restricted to 100 x 200 mm^2 by the focusing lens and the travel range of the axis.

Applications

Areas of application include the large-scale structuring or laser treatment of different materials with high power ultrashort pulse lasers. In addition to current applications of the system with these lasers, high-speed processes with cw lasers, such as the quasi-simultaneous soldering of solar cells or dicing of semiconductor wafers are also possible.

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1 Projection of one processing layer.

2 Polygonal processing optics.

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