High-rate ultrashort pulse laser processing for advanced micro fabrication

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High-rate laser machining using multi-hundred Watts ultrashort pulse lasers in combination with ultrafast laser beam movements will be introduced as key technology for advanced micro fabrication. In fact, polygon-mirror based laser beam scanning at unprecedented speeds of hundreds meters per second and above is the core feature to bring high-average power lasers from the laboratory to industrial production. In particular, this is valuable for power scaling in micro machining as the processing rate scales-up with both pulse repetition frequency and average laser powers. Another advantage of ultrafast laser beam moving is that detrimental machining effects, such as high thermal loads and subsequent material melting as well as laser beam shielding by plasma/particle interactions, can easily be avoided even for MHz-repetitive laser pulses. In this way, high-rate machining can overcome the current limitations of highly-repetitive ultrashort pulses when applied at comparably slow moving speeds, thus facilitating the high processing quality of ultrashort pulses along with high removal efficiency for high-throughput and high-precision micro fabrication.

In this talk on High-rate laser micro machining, the first part deals with how the laser parameters influence efficiency, throughput and quality in material processing. This will be complemented by a brief overview about the advantages and limitations of different strategies for efficient high-throughput laser processing. Following, the key components of the High-rate laser machining technology as established at the *Laserinstitut Hochschule Mittweida* will be presented, namely multi-hundreds Watt ultrashort pulse lasers in combination with polygon-mirror based biaxial raster-scan systems and (external) laser beam switching for exact synchronization of laser emission and ultrafast laser beam movement. In the second part of this talk, the results obtained in flexible High-rate machining will be discussed thus to demonstrate the high potential of this advanced laser micro machining technology for innovative industrial applications.