Femtosecond bursts advancing ablation efficiency and quality of metals

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The successful utilisation of ultrashort pulse lasers in industrial applications, like milling and structuring, is mostly limited by processing throughput. Therefore, there is a high interest in process optimisation techniques pursuing higher ablation efficiency [1,2]. Lasers capable of working in pulse sequence regime, so-called, burst mode are of high interest in this topic [3]. The idea of this work was to investigate two temporal ablation optimisation methods: pulse repetition rate and burst length. These methods are of great interest due to their ability to simultaneously optimise ablation rate (volume per time) and ablation efficiency (volume per energy) with constant focused beam spot size. Ultrashort pulse laser (FemtoLux 30, Ekspla) with a widely tunable repetition rate from 200 kHz to 4 MHz and intra-burst repetition rate of 50 MHz was utilized for ablation of common metals: aluminium, stainless steel and copper. In addition to rapid and efficient material removal (Figure 1), the optimisation resulted in increased ablation quality measured as a surface roughness S_a. Therefore, the most important characteristics of the ablation process were enhanced.

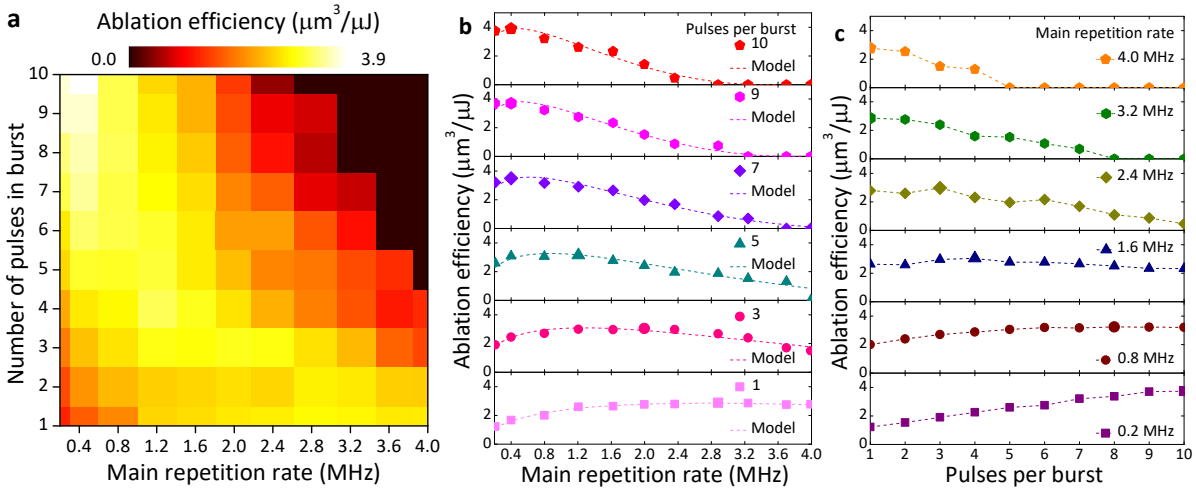

Figure 1. Laser ablation efficiency of stainless steel dependenceon burst length and pulse repetition rate: (a) - color map; (b) and (c) - line profiles.

References:

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