Tunable GHz and MHz femtosecond burst for various material processing

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Femtosecond lasers are versatile tools that enable unique material processing capabilities. Recently a new type of technology was created that allows splitting the singular femtosecond pulse into a train of pulses separated either at several hundred picoseconds or tens of nanoseconds. In other words, laser can operate in burst regime in MHz or/and GHz frequency domains. Due to the short time separation between adjacent femtosecond pulses, the light-matter interactions mechanisms are different as compared to a conventional femtosecond laser therefore this regime opens new frontiers for material micromachining. To demonstrate burst-in-burst capabilities, the femtosecond laser CARBIDE (Light Conversion, Lithuania) was used which can output up to 80 W of average power, at a maximum pulse energy of 800 µJ, operating at a repetition rate of up to 1 MHz. The burst-train envelope is configurable (from declining to quasi-flat to inclining) which allows finding the optimal material processing parameters [1].

It is known, that using the burst modes it is possible to improve the material ablation rate per unit of energy as compared to a conventional femtosecond laser setup. [1]. Moreover, the thermal input into the material while it is being micromachined can be controlled by adjusting the parameters of burst. This is particularly interesting for surface smoothing and polishing applications. In addition, the burst mode is useful for drilling of brittle materials, cutting, deep engraving [2], selective ablation, transparent materials volume modification, high contrast marking or fabricating functional surfaces.

[1] S. Butkus, D.Paipulas, M.Barkauskas, K.Neimontas and V.Sirutkaitis " Comparison of GHz, MHz and kHz Femtosecond Burst Mode Micromachining of Invar Foils" Proceedings of LPM2017 - the 18th International Symposium on Laser Precision Microfabrication
[2] A.Žemaitis, P.Gečys, M.Barkauskas, G.Račiukaitis and M.Gedvilas, "Highly-efficient laser ablation of copper by bursts of ultrashort tuneable (fs-ps) pulses", Scientific Reports, volume 9, Article number: 12280 (2019).