Efficient Dielectric Material Processing In Femtosecond GHz Burst Mode

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Femtosecond laser sources continue to be integrated into various applications in industrial fields. Due to inherent ultrashort pulse duration, these laser sources provide great precision, minimal induced thermal effects, and high peak intensities ensure the possibility to process almost any materials through non-linear effects. Many materials benefit from femtosecond laser processing, and among them are dielectric materials. These materials possess excellent electrical resistivity, thermal stability, and chemical inertness, making them highly attractive for various applications. However conventional processing methods struggle in processing these materials due to their high hardness and brittleness which in the end limits the achievable quality. As a solution, femtosecond laser sources have proven to be excellent candidates for processing dielectric materials with high precision and quality [1].

In order to adapt the technology to industrial levels, the process efficiency has to be considered and optimized. From the literature, one can observe that there exists an optimal fluence value at which the maximum material volume per energy is removed [2]. However, nowadays we have laser sources that output pulses in hundreds of microjoules in energy, which exceeds the required energy to process the material multiple times. To bring the fluence values down to the optimal value, one can use GHz burst, which is closely packed sub-picosecond pulses varying in number from 2 to 1000 with repetition rate in the GHz range [3]. With this feature, it is possible to split the high-energy single pulse into multiple ones, eventually reaching the optimal fluence and optimizing the micromachining process.

In this study, the industrial-grade femtosecond laser system FemtoLux 30 is utilized in machining dielectric materials. By using the GHz burst option, which stands out by allowing the end user to change the number of pulses in the burst from 2 to 1000, various burst configurations are investigated and their influence on processing efficiency.

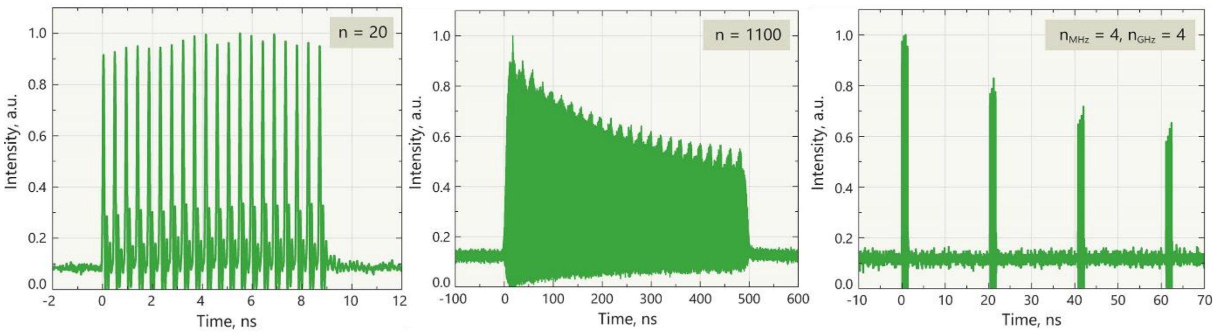

Fig. 1. Different GHz burst configurations: (left) short GHz burst, (middle) long GHz burst, (right) MHz+GHz burst mode

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