High-power femtosecond lasers for higher throughput and advanced processing

Xavier Wolters, Guillaume Szymczak
Amplitude Laser Group, , 11, avenue de Canteranne, 33600 Pessac, France

Corresponding author: xavier.wolters@amplitude-laser.com

The precision needed nowadays, exceeds the limits of what can be achieved with traditional manufacturing methods, hence the rise of femtosecond laser applications. New industrial solutions that benefit from the advantage of femtosecond lasers, such as the ability to induce absorption in any, even transparent, material while precisely controlling the heat affected zone, are discovered every day. Where precision is key on one hand for industrial applications, throughput is key on the other hand. Higher throughput often goes together with higher power.

When talking about increasing the power of a femtosecond laser, we are either talking about increasing the repetition rate, or the energy. Increasing the repetition rate up to GHz, means that we are falling another ablation regime. Although the heat affected zone is low, there is always some residual heat remaining in the target, while most is ejected. When operating in the kHz regime, the residual heat will mostly dissipate in the time between two consecutive pulses, but in the GHz regime this is not the case. Therefore, the consecutive pulse incidents on a heated surface and due to the heat that remained in the material, the ablation threshold decreases.
When the energy is increased to obtain higher powers, it can be used in a combination with a Spatial Light Modulator. This can be used for parallel processing to increase the throughput of a process.

The ability of a femtosecond pulse to induce absorption in any, even transparent, materials resulted in the development of advanced beam engineering to cut transparent materials. By thermal accumulation, oriented cracks are created to cut at high speed with high quality while preserving the mechanic properties in the bulk.

Looking at recent trends, it is sure that more application will be developed to exploit the potential of high-power femtosecond lasers.