The Laser is Gearing up to Become the Universal Tool for Industry 4.0

With the average output power of ultrafast lasers just entering into the multi-kW level, the usage of these lasers is currently leaving the classical micro processing labs and conquering large-scale manufacturing applications. We will soon see more and more laser-based high-precision (micro) material processing performed on large-scale production machines that at a first sight look quite similar to those we are used to apply for the classical macro applications such as cutting and welding. The thought to in fact perform all the known laser processes, from drilling and micro- or nanostructuring all the way to cutting, welding, hardening or additive manufacturing on one and the same machine therefore comes rather naturally. Looking at the modular architecture of the high-power ultrafast lasers, one easily comes to the additional conclusion that such a universal machine could even be realized with one and the same laser source. High-power ultrafast laser systems are all based on a small seed oscillator and one or more amplification stages. At high average powers, these amplifiers (such as e.g. slab preamplifiers and multipass thin-disk power boosters) work equally well for ultrashort-pulses or cw radiation. Hence, by integrating additional or more flexible seed sources, there is no technical reason that would prevent us to set up one single laser system that can switch between cw and pulsed or ultrashort pulsed operation. What this leads to is a universal machine that can perform virtually the complete range of laser-based manufacturing process just by changing the operation parameters. The ideal software-controlled universal tool for industry 4.0.

Of course, there are still quite a few challenges on the way to this promising prospect. But the required solutions are currently being developed step by step which is well documented by the many interesting presentations scheduled for this year's Stuttgart Laser Technology Forum, SLT 2018. The latest developments in ultrafast laser beam sources will be highlighted along with the latest advances in their modulation and in fiber-based beam delivery, optical scanners, systems for massive parallel processing, and high-speed online process diagnostics. In the field of materials processing we will see presentations on fascinating new applications that benefit from the high average powers of modern laser systems. The presented applications range from large-scale surface functionalization with high-power ultrafast lasers, multimaterial processing, and additive manufacturing all the way to defect-free welding at very high feed rates and will also include the discussion of solutions and approaches to face new safety issues such as the exhaust for processing of carbon-fiber reinforced plastics and the X-ray emission generated by processing of metals with powerful ultrafast lasers.

The mission of the SLT is to address laser technologies for materials processing in a fundamentally scientific and yet comprehensible manner with a strong contribution by international and German research institutions and exemplify the scientific conclusions by presentations on corresponding industrial implementations.

I wish you inspiring reading of this issue of Laser Technik Journal!

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