New Trends in Laser Technology – Laser Systems and their Applications

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In material procession there is an ongoing need for higher output power of lasers systems leading to higher processing speed and therefore higher production rate. In YAG laser development the upscaling was limited by thermal lensing inside the active medium. With new concepts of disk lasers and fiber lasers these limitations have been overcome and optical pumping was vastly improved by recent developments of diode lasers. The latter have been improved in three ways, higher output power, longer lifetime and higher beam quality. With these improvements even material processing like welding is possible with direct diode lasers, which have the advantage of the highest wall plug efficiency of all laser systems. As an example a welding process of electric arc combined with a diode laser leads to a robust process with extended process parameters, see Figure 1, in terms of welding speed and arc stability [1]. High brilliance lasers with output power of 10 KW and beyond are needed in deep penetration welding like pipeline construction or in mass production applications like automotive industry for upscaling of throughput. Here the new lasers are often combined with remote welding systems, which drastically reduce the time for positioning the laser spot due to galvo scanners with maximum spot velocities of 600 m/min [2]. Similarly in micro machining the short pulse and ultra short pulse lasers have been pushed to higher peak power and average output power resulting in cost efficient production of functional surfaces, ceramic sensors, solar cells, and semiconductors. In the processing of silicon, the thermal damage of the crystalline structure must be avoided, if no post processing is tolerable. Here the reduction of pulse length results in higher ablation rates and lower heat input into the lattice. As a result for many new solar cell concepts laser drilling and scribing is a key technology for improved cell efficiency [3]. Among the various activities at LZH, examples of new production technologies are selected to represent the potential of laser material processing, which leads to its continuous growth in manufacturing.
Keywords: laser processing, disk laser, fiber laser.

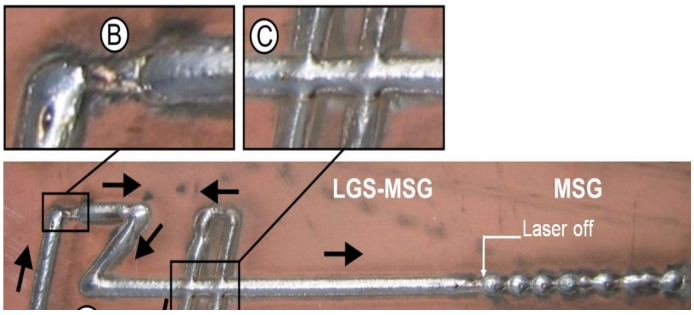

Figure 1: In laser assisted arc welding very regular seams can be generated even with sharp edges (A), jumps (B) and overlapping areas (C) in the geometry. For comparison the laser is switched off resulting in an unregular seam.

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