Surface conditioning of copper to improve the continuous wave laser micro welding

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Abstract

Copper is used in almost all electronic components. The contacts are laser welded if a low electrical resistance, a high mechanical and thermal long-term stability is required. For example these requests occur in modern motor vehicles, where the power electronics are installed in the engine room to save weight and cost of electric lines. One of the main problems in laser welding of copper is the low and locally varying absorption of the infrared radiation of established laser systems, which currently limits the stability of laser welding. This limits the efficiency of conventional laser welding, as well as its reliability.

Studies have shown that the irradiation of the copper surface with a green laser (532 nm) adduced a significantly higher absorptivity of infrared laser radiation. Figure 1 shows welding results with and without preconditioning. It can be seen that for preconditioning only a fraction of the energy is required. With the combination of green and IR radiation a 100% weld probability and an energy saving of 20 – 40 % was detected.

This work analyses the surface conditioning of copper, by irradiation of the copper surface with a 532 nm nanosecond laser, to improve the welding quality of the copper with an infrared continuous wave fiber laser source. The irradiation under well-defined conditions produces a durable preconditioning, which improves welding quality when irradiated on the preconditioned area.

This paper is focused on the analysis of the copper surface, after the laser preconditioning. In this presentation, the process conditions and laser parameters for surface conditioning of copper are analysed, to demonstrate the relationship between: the laser parameters and the surface conditions after the irradiation. Furthermore the influence of surface conditioning to the subsequent welding process with continuous wave infrared radiation will be shown.