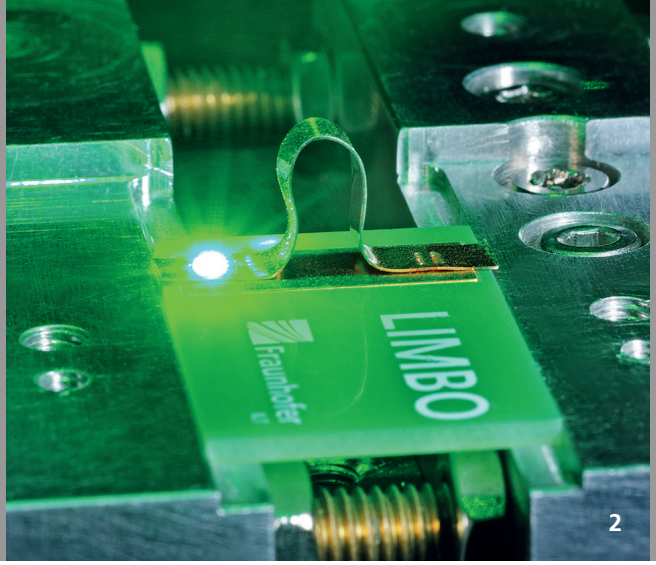

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LASER BEAM MICRO-WELDING WITH BEAM SOURCES IN THE VISIBLE WAVELENGTH RANGE

Task

As vehicles and everyday objects are increasingly becoming electrified, materials with high electrical and thermal conductivity, such as copper and aluminum, need to be contacted efficiently. The laser beam sources currently used by the industry typically operate at a wavelength of $\lambda \approx 1$ µm, which has low absorption, especially in copper-based alloys, thus leading to an unsteady energy input into the welding process.

Method

Beam sources at a wavelength in the visible spectrum can be used to achieve higher absorption, e.g. in copper alloys, to achieve a more constant energy input during welding processes and to reduce irregularities due to fluctuations in the coupling degree in the weld seam.

The radiation sources used for this purpose usually work with electromagnetic waves at a wavelength of 515/532 nm (green) or 450 nm (blue); they are either based on frequency doubling of conventional solid state lasers in the near infrared wavelength range or use direct diode lasers.

Results

In particular, Fraunhofer ILT has investigated how such high feed rates can be reached, while taking the changed focusing conditions into consideration since the beam is generated differently for blue and green beam sources. Furthermore, the institute has looked at the achievable welding depth in relation to the laser power and placed it in connection with the achievable coupling degrees. Furthermore, Fraunhofer ILT has investigated how spatter, pores, etc. – quantified by the seam surface roughness – influence the seam quality when different process regimes are used.

Applications

These new laser beam sources in the visible wavelength range can be applied especially where the metals joined have bonds showing irregularities in the seam shape due to their absorption-related properties. These include, in particular, the fields of power electronics, electromobility and microelectronics.

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2 Thin-film contacts by means of green laser beam sources.
3 Laser beam welding of battery modules with blue laser radiation.