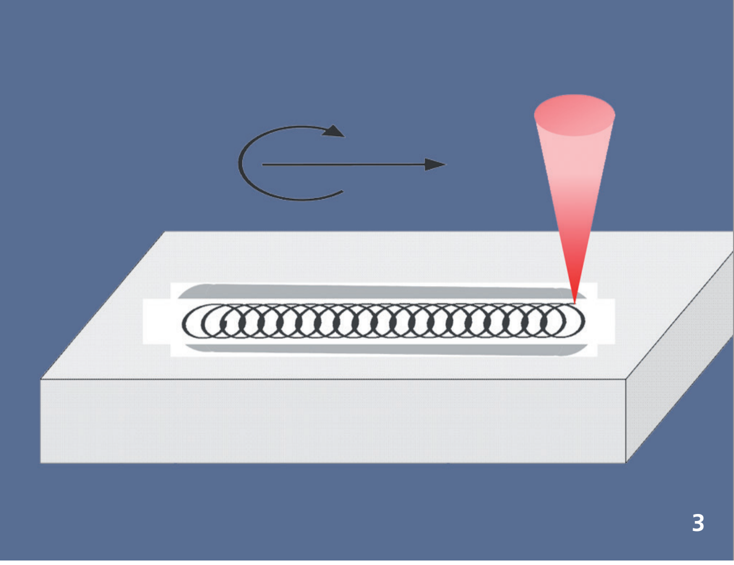

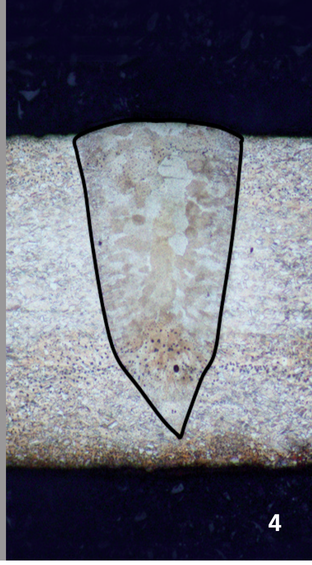

SEAM FORMING BY LOCAL POWER MODULATION DURING MICROWELDING

Task

Thanks to its high electrical conductivity, copper is one of the most important materials in microelectronics and in the electrification of automobiles. When copper materials are welded with laser radiation, there are particular challenges: a high thermal conductivity and a low degree of absorption of the laser radiation in the near infrared wavelength range. Through the use of fiber lasers with high beam quality, focus diameters of several 10 microns can be generated, thus enabling energy to be selectively applied to the material. However, smaller focal diameters cause a small connection area of the weld, which can be compensated for by the use of spatial power modulation.

Method

For spatial power modulation, the feed movement is superimposed by an additional oscillation, which significantly extends the structural framework in laser welding. In addition to the parameters laser power, beam diameter and feed speed, the spatial power modulation generates additional parameters that can be used to check melt pool and to form seams and structure selectively.

Result

The dominant form of the laser beam movement was identified through an observation of the melt pool dynamics during welding with spatial power modulation, which decisively influences seam shaping. Since the laser beam oscillates, regions of higher thermal energy will again be traversed so that, in contrast to conventional welding, a larger volume of material is melted, meaning the efficiency increases.

Applications

This laser welding technology in the fine and micro range can be applied, for example, in power electronics and battery technology. The improvements made to enhance the reproducibility and the targeted seam shaping can be transferred to other fields of application such as in medical technology.

The work was funded by the German Research Foundation (DFG) within the Collaborative Research Centre 1120.

Contacts

M.Sc. André Häusler
Telephone +49 241 8906-640
andre.haeusler@llt.rwth-aachen.de

Dr. Arnold Gillner
Telephone +49 241 8906-148
arnold.gillner@ilt.fraunhofer.de

3 Path of the laser beam at a spatial power modulation.

4 + 5 Cross sections of copper alloys with and without spatial power modulation.