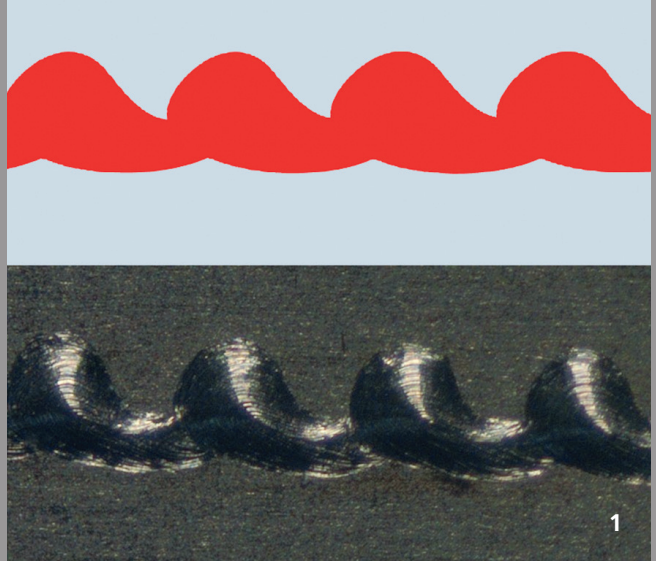
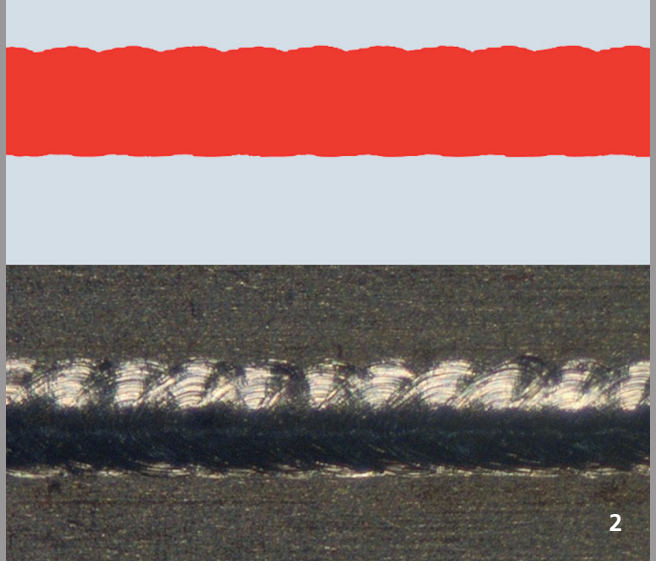


1



2

SIMULATION OF WELD FORM FOR WELDING WITH LOCAL POWER MODULATION

Task

Fiber lasers with high beam quality and small focal diameters generally allow high process speeds. Their small interaction zone, however, leads to connection cross-sections that do not guarantee sufficient seam strength. In order to control the connection cross-section, a circular oscillation is superimposed on the linear feed movement. The shape of the weld seam is examined for different oscillation parameters, such as frequency and amplitude, using the example of the steel X5CrNi18-10.

Method

The weld bead is determined by calculating the temperature field with the software »Comsol Multiphysics®«. As a result, the area of the component surface is recorded whose temperature has exceeded the melting point at least once during the simulation. The results are compared with top-view photographs of seams from blind welding tests.

Simulated and experimental seam bead at:

1 ... 200 Hz.

2 ... 600 Hz.

Result

The welding tests have been carried out with the following parameters: laser power 100 W, focus diameter 30 µm, feed 100 mm/s, amplitude 100 µm, frequency 200 and 600 Hz. Figure 1 shows the simulated and experimental seam bead for 200 Hz, Figure 2 for 600 Hz. The feed direction is from left to right, the oscillation moves counterclockwise. Basically, the calculated bead shape corresponds to the measured shape. With a sufficiently large frequency, homogeneous seam widths, or a uniform connection cross-section, can be achieved. This way a tool has been made available for the dimensioning of electrical contacts and which can be used to observe connection cross-sections in dependence on the material characteristics and the laser parameters when the component is designed.

Applications

Micro welding with laser radiation is commonly used in the automotive industry. Here, in particular, this application is interesting for the current-carrying capacity for electric contacts in power electronics or batteries as is its mechanical strength for the production of micro-mechanical components such as filters or sensors.

Contacts

Dr. Mirko Aden
Telephone +49 241 8906-469
mirko.aden@ilt.fraunhofer.de

Dr. Alexander Olowinsky
Telephone +49 241 8906-491
alexander.olowinsky@ilt.fraunhofer.de

Fraunhofer Institute for Laser Technology ILT, www.ilt.fraunhofer.de
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