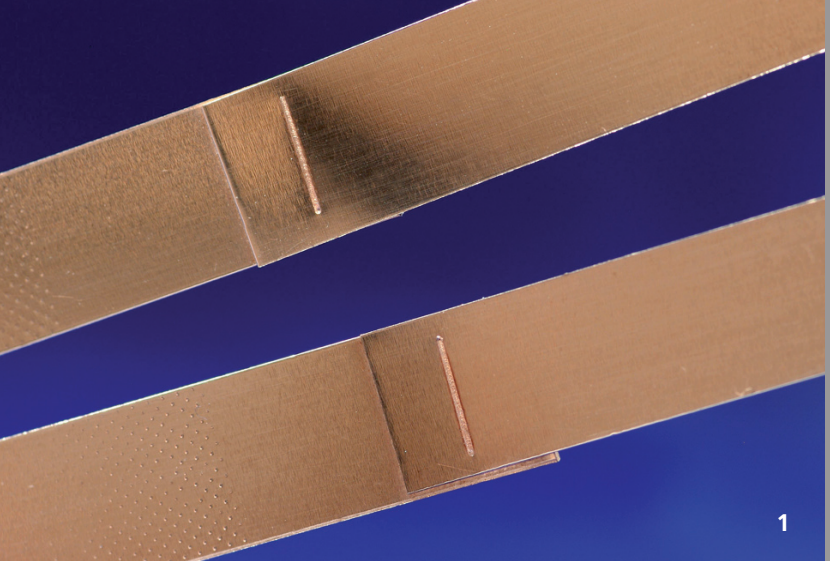

MICRO WELDING OF COPPER COMPONENTS USING POWER MODULATION

Task

Copper is still the most important material for conductors and the setup of electrical and electronic systems. However, high thermal conductivity and low absorption of copper (alloys) in the near infrared are challenges for welding and, in particular, for the laser welding process. It is difficult to control the weld depth in copper material due to laser power spiking, which results in a local increase of the penetration depth. In addition, during the welding process of copper, instabilities are often observed, such as melt pool ejections.

Method

Within the BMBF-funded CuBriLas project, several approaches are being investigated, all of which aim at producing an improved weld quality and achieving constant weld depth. In addition to the parameters of beam diameter, laser power and feed rate, further process parameters have been generated by using temporal and spatial power modulation. This technique makes it possible to better control melt pool and reduce weld defects. For the temporal power modulation, a sinusoidal wave is imposed on the laser output power, which is adjusted in frequency and amplitude. When using spatial power modulation, researchers at the Fraunhofer ILT have superimposed a circularly oscillating movement onto the feed movement and, therefore, can vary oscillation frequency and amplitude.

1 Overlap joint (CuSn6).

2 Cross-section of a modulated weld seam.

Result

By using temporal power modulation in the range of several hundred Hertz, the team has achieved an almost constant welding depth when welding Bronze CuSn8 sheets (0.2 mm thickness) in overlap joint. The spatial power modulation can also be used to stabilize the weld. This is especially helpful regarding the bridging of a gap and the enlargement of the cross-section in an overlap joint configuration.

Applications

The use of laser welding is currently being discussed in the power electronics and battery technology sectors. The improved possibilities of depth control for the melt pool – in order to avoid full penetration and thus damage to the substrate or thin batteries – is the key reason for using laser welding in these areas.

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