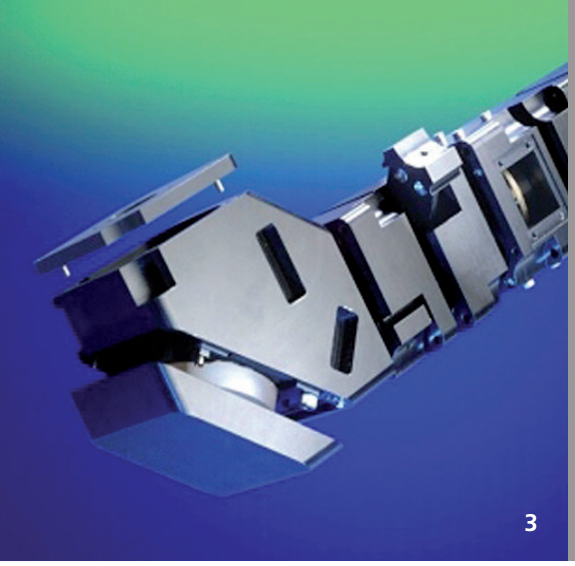

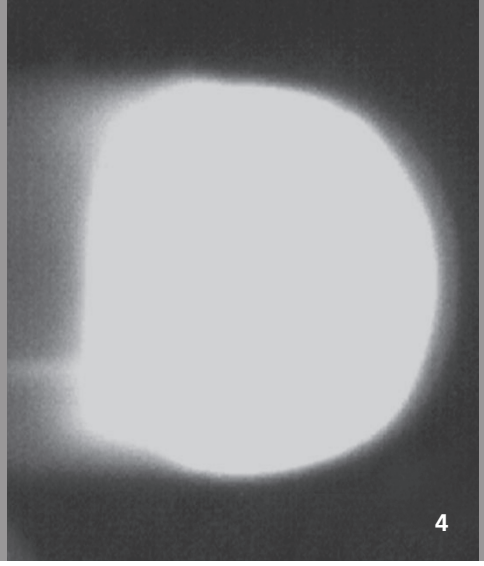

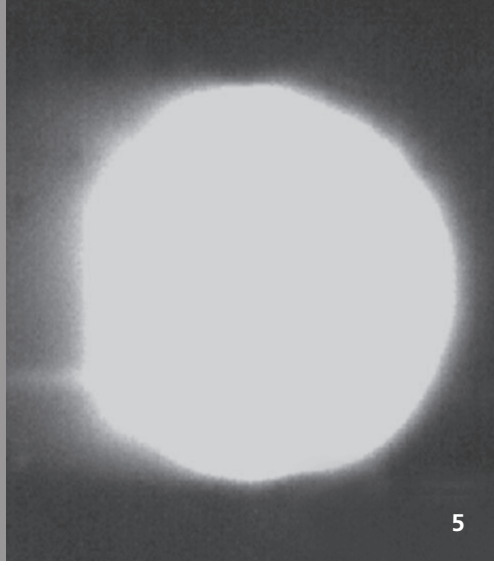

CORRELATION BETWEEN MELT POOL GEOMETRY AND PROCESS PARAMETERS DURING LASER METAL DEPOSITION

Task

The quality of additive manufactured components and coatings by Laser Metal Deposition (LMD) is highly dependent on process stability. For the most part, modern high-performance materials, e.g., of the aerospace and tool industry, can only be manufactured free of defects in a small process window, whereby small deviations already change the process result. In order to minimize variations in the process, those caused e.g. by the part's geometry or continuous heating during the process, by adjusting the process parameters, it is necessary to know how to correlate these deviations to the melt pool geometry.

Method

To observe the melt pool during the process, Fraunhofer ILT has placed a coaxially integrated camera system, operating at a frame rate up to 1000 Hz, in the beam path of the laser. Using it, researchers can systematically analyze the extent to which the essential process parameters – laser power, feed rate and powder mass flow – influence the melt pool geometry. In addition, the institute has also examined the impact by other variables such as the heating of a component, e.g. by heat build-up in the construction of thin-walled structures, upon the melt pool behavior.

Result

By means of correlations determined between process parameters and weld pool geometry, thin-walled structures can be produced with a constant melt pool geometry (see Fig. 4 and 5). For this purpose, process parameters are adjusted in dependence upon the measured melt pool geometry during the process, or, if necessary, even within a single layer.

Applications

The findings help to improve part quality and process reliability in all areas of additive manufacturing and coating of components with LMD. In particular, the processing of materials that place high demands in terms of consistent operating conditions, such as in the aerospace industry and tool making, may thus be significantly improved.

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3 Coaxial process monitoring system.
4 LMD of a thin wall: Melt pool geometry without parameter adjustment.
5 LMD of a thin wall: Melt pool geometry with parameter adaptation.