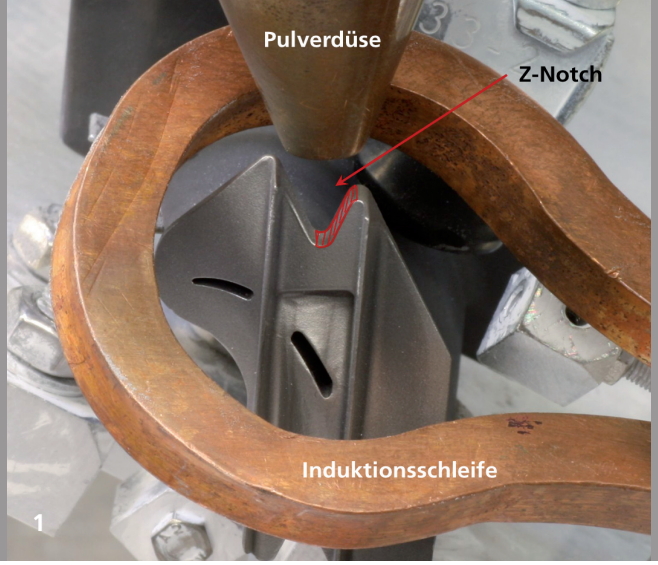

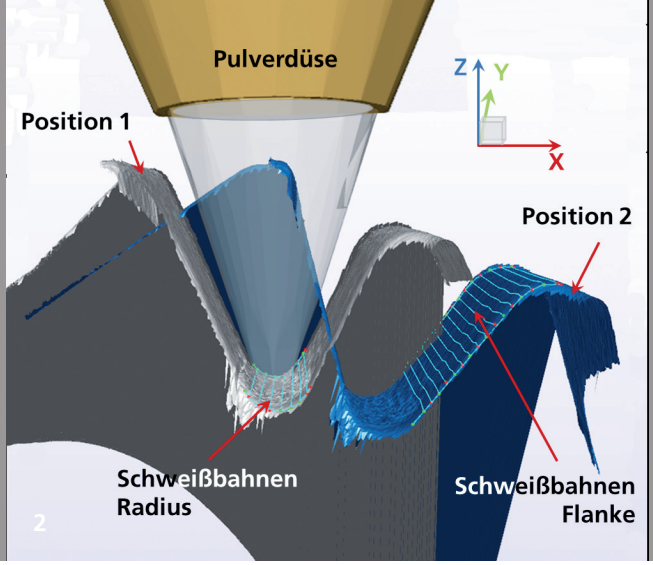

Subject to alterations in specifications and other technical information. 06/2013.

LASER MATERIAL DEPOSITION ON COMPLEX GEOMETRIES OF TURBINE BLADES

Task

Wear protection coatings shall be deposited on Z notches of turbine blades in the bottom radius and on one flank using laser material deposition (Fig. 1 area marked in red). The turbine blades are manufactured from a crack-susceptible nickel-based superalloy containing γ'. It must be ensured, that cracks are prevented from forming during laser material deposition. A cobalt-based alloy with a hardness of ≥ 650 HV will be deposited as a wear protection coating. The angle of aperture of the area to be deposited is approx. 50 °, accessibility is largely restricted, thus posing challenges for laser material deposition and programming.

Method

In order to prevent cracks in the blades, a buffer layer made of Inconel 625 is initially deposited using laser material deposition. Process parameters that reduce energy input into the blades are used for the buffer layer as well as for the wear protection coating made of the cobalt-based alloy. The cobalt-based alloy cannot be deposited at room temperature to the required thickness without cracks forming, so the Z notch is preheated locally using induction (Fig. 1). To produce the tool paths, the relevant area of the Z notch is optically scanned and the resulting point cloud is converted into an stl model. In-house CAM software is used to produce tool paths on the stl model, and to create the CNC programs. Owing to the small angle of aperture of the Z notch, the turbine blades have to be turned once the coating is deposited on the radius area (Fig. 2) in order to deposit on the flank; this factor is taken into account during the creation of the CNC programs.

Result

Crack-free wear protection coatings with high hardness can be deposited on the radius and the flank of Z notches using laser material deposition.

Applications

This process is particularly suited to working with components made out of crack-susceptible materials and/or with freeform surfaces, such as repairing turbomachinery components or tools, molds and dies.

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1 Test setup (left) for deposition position 1 with powder nozzle and induction loop, the area to be deposited is hatched in red.

2 Programming (right) for two deposition positions using in-house CAM software.

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