



- A** Damage identification
- B** Subtractive pre-processing
- C** Additive repair process EHLA
- D** Subtractive post-processing
- E** Quality control
- F** Reinstallation

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SUPPORTING THE CIRCULAR ECONOMY THROUGH A HYBRID PROCESS CHAIN

Task

As the demand for increasingly scarce raw materials grows, importing countries become economically dependent up on them, causing a significant environmental footprint due to the CO₂ emissions generated in the manufacturing process.

Components subject to high levels of wear and corrosion often fail due to local surface damage. Exchanging defective components requires resource-intensive part replacement, while recycling discarded metallic components involves energy-intensive smelting processes. Despite saving resources or energy compared to primary production, these two methods still pollute the environment significantly.

Method

It is much more sustainable to repair a component by locally processing the damaged areas and reconditioning the component itself. To accomplish this, Fraunhofer ILT has developed an automated hybrid process chain – Here, the damaged areas on the component are removed by a machining process and converted into a defined groove geometry, which is then filled additively by Extreme High-Speed Laser Material Deposition (EHLA). The post-processing of the repair area then restores the requirement profile, and the component is put back into operation.

1 Principle of the hybrid process chain.

2 Repair of a component in the hybrid process chain.

Results

By developing and qualifying an automated hybrid process chain for the repair of metallic precision components, Fraunhofer ILT can significantly increase resource and energy efficiency in the circular economy and reduce the burden on the environment. The repair reduces the need for raw materials and the dependence on suppliers, thus making companies more competitive.

Applications

The hybrid process chain can be used for the repair of rotationally symmetrical metal components. In addition to blank components, coated components with similar or dissimilar materials can also be repaired. Particularly large resource and energy savings can be expected when large-volume components need to be repaired.

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