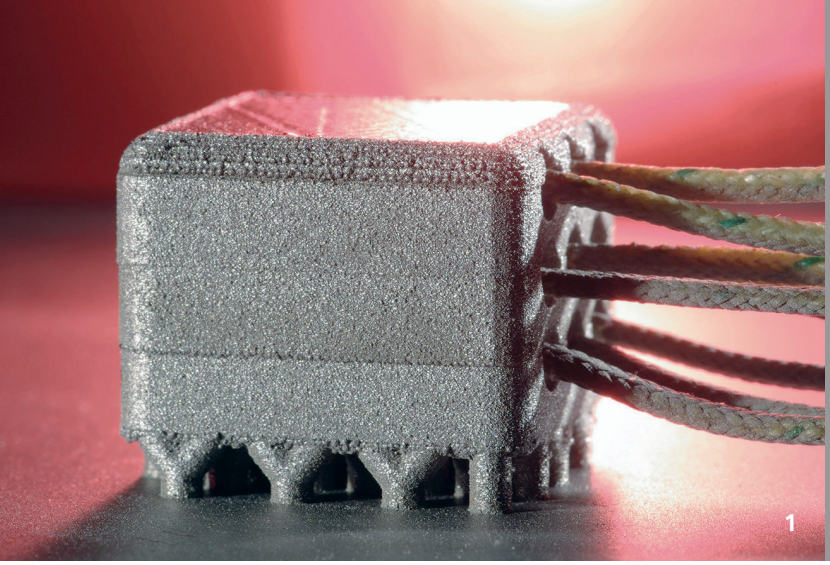

SENSOR INTEGRATION BY MEANS OF SLM

Task

Intelligent components that provide data on their production status and condition in the field of application are a central component of current developments in Industry 4.0. Additive manufacturing can be used to break new ground for the production of such »smart parts« with integrated electronics and sensors. The layer-by-layer manufacturing process, for example, allows sensors to be integrated and positively bonded at almost any point in the component's volume during the build process.

Method

Fraunhofer ILT develops process chains for the integration of sensors that measure temperatures and mechanical stresses in metallic components during assembly with the additive manufacturing process Selective Laser Melting (SLM), also known as laser beam melting or Laser Powder Bed Fusion (LPBF). For this purpose, the process is interrupted at a certain height and the sensor placed manually in a prefabricated cavity in the component. The sensor data is transmitted via cable. The cables are routed to the outside through channels located in the component. The sensor is connected metallurgically and positively to the component by the process laser beam source. Subsequently, the construction process is continued, whereby the cavity is closed and the sensor is completely integrated into the component.

1 Additively manufactured demonstrator with integrated thermosensors.
2 Additively manufactured bending beam with integrated pressure sensor.

Results

The developed method enables sensors to be integrated in SLM-built components both in a position-correct and process-reliable manner. This has been successfully tested for temperature and pressure measurements. Especially for temperature measurement, a shorter response time compared to conventionally introduced temperature sensors could be detected. In addition, the fully integrated sensors are better protected against external influences. The knowledge gained here forms the technical basis for the integration of further electronics, e.g. for component identification (RFID chips).

Applications

The combination of additively manufactured components with complex geometries in small numbers and integrated sensors is particularly interesting for the production of prototypes and experimental components, e.g. for tool making as well as for turbomachinery and internal combustion engines. This way, the condition data of the components can be recorded and significantly extended in test bench operation.

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Contact

Dipl.-Ing. Simon Vervoort
Telephone +49 241 8906-602
simon.vervoort@ilt.fraunhofer.de

Dr. Sebastian Bremen
Telephone +49 241 8906-537
sebastian.bremen@ilt.fraunhofer.de

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