



## MULTI-SENSOR PROCESS MONITORING FOR ADDITIVE MANUFACTURING

### Task

When components with high geometric and technical complexity need to be manufactured, additive manufacturing processes offer new degrees of freedom in design and construction. Most importantly, they can be used to integrate a large number of functions in a single component. Selective laser melting (SLM) of metals from a powder bed can generate innovative components whose properties can be determined as needed. The product quality is ultimately determined during the course of the process by the interaction of the laser with the metal powder.

### Method

Today, in a typical production system with a metallic powder bed process, the laser beam is positioned in the process chamber with a mirror deflection system and positioned according to the component geometry. The laser radiation melts the powder, creating a melt pool whose emitted heat radiation is detected in terms of magnitude and extent with pyrometers, photodiodes and fast cameras. The coaxial coupling of suitable sensors with the optical system permits the properties of the interaction to be determined in-situ. The radiation emitted

by the melt pool is guided along the same optical path as the processing radiation and can thus be related to the exact location on the component. The analysis of the process results can thus be correlated with local events in the component.

### Results

The multi-sensor process monitoring allows the recording of process sequence maps during processing. They represent the result of the interaction with the properties of the melt pool, while the information is located directly in the component. Typically different sampling rates are related by a robust temporal correlation in such a way that a consistent and usable result is available after the data have been condensed.

### Applications

The system can be used for process control for the additive manufacturing of components generated by laser radiation from a powder bed. In the future the aim will be, in addition to monitoring, to control the process on this basis.

### Contact

Dipl.-Ing. (FH) B. Eng. (hon) Ulrich Thombansen M.Sc.  
Telephone +49 241 8906-320  
ulrich.thombansen@ilt.fraunhofer.de

Dipl.-Ing. Peter Abels  
Telephone +49 241 8906-428  
peter.abels@ilt.fraunhofer.de

1 Emission map of the thermal emission from the melt pool.

2 Melt pool in the infrared range.