COMPONENT AND SYSTEM DEVELOPMENT FOR SELECTIVE LASER MELTING

Fraunhofer ILT - Short Profile

The Fraunhofer Institute for Laser Technology ILT is worldwide one of the most important development and contract research institutes of its specific field. The activities cover a wide range of areas such as the development of new laser beam sources and components, precise laser based metrology, testing technology and industrial laser processes. This includes laser cutting, caving, drilling, welding and soldering as well as surface treatment, micro processing and rapid manufacturing.

Furthermore, the Fraunhofer ILT is engaged in laser plant technology, process control, modeling as well as in the entire system technology. We offer feasibility studies, process qualification and laser integration in customer specific manufacturing lines. The Fraunhofer ILT is part of the Fraunhofer-Gesellschaft.
COMPONENT AND SYSTEM DEVELOPMENT FOR SELECTIVE LASER MELTING

Thanks to its roughly 20 years of experience in the additive manufacturing with Selective Laser Melting (SLM) of metal components, the Fraunhofer ILT has become the world’s leading research institute in this area. Our experts deal with the actual process development, expand the materials that can be processed as well as adapt the process for new applications. Our work focuses on developing individual components for systems engineering as well as overall system integration.

Foundations of Systems Engineering

Nearly all of the SLM plants currently available have a movable building platform, upon which a powder layer is applied with an application unit. Subsequently, the surface of the powder bed is melted according to the component geometry needed. The laser beam is guided by a galvanometer scanner and focused with an F-Theta lens or a vario-optic system. Metal components are processed in an inert-gas atmosphere, with the gas circulation taking on the additional task of removing flue gas and splatters from the process.

The components used (beam sources, optics, powder application unit, axis system, etc.) influence various aspects of the overall system, such as process speed, non-productive time, component quality and degree of automation. The suitable choice and combination of individual components for the intended use are decisive for the economical use of Selective Laser Melting.

Trends and Challenges

To use SLM economically in industrial or series production, operators need higher productivity in the process, increased flexibility in view of available building space as well as reproducible component quality. The productivity is determined, on the one hand, by the achievable melting rates and, on the other, by the non-productive time of the process.

In addition, researchers have still not mastered how to process materials that are difficult to weld and susceptible to cracking. For applications where safety plays a critical role, an inline process control or such a strategy is necessary so that an assessment can be made about the quality of the component without it needing subsequent testing.

To increase both productivity and available building space, the industry is currently pursuing several approaches. For example, the Fraunhofer ILT uses a two-beam optical system; it developed, which has different laser power outputs (up to 2 kW) and beam diameters for various component areas. This system allows the build rate to be increased significantly, but requires the optical system as well as the control software to be adapted.

Larger building space, in turn, can be achieved by arranging several optical systems in parallel or using a single, movable optical system, whereas the specific consequences – higher costs due to additional optical components or longer building time for large parts with a single optical system – have to be taken into consideration. Moreover, more complex gas flow systems have to be developed to sustain a sufficient protective atmosphere.

Individual material classes, for example heat-resistant nickel and cobalt base materials as well as hard metals can only be processed crack-free when the building platform is preheated to high-temperatures. Such temperatures range from 800 to 1200 °C and can only be reached by the facilities in the laboratory of the Fraunhofer ILT.

Key Research Areas

The Fraunhofer ILT developed the SLM process in the middle of the nineties, and since then has constantly refined it in close cooperation with leading industry companies and research institutions while taking the whole process chain into consideration. Thanks to our expertise and many years of experience, our experts can assist you individually from the very first idea, through feasibility studies, process and system development all the way to implementing the results into your production chain. You can fall back upon our experience with comprehensive range of equipment, consisting of various commercial systems and highly flexible laboratory plants, but also upon our know-how in the area of laser beam source and optics development. Thanks to our close cooperation with other Fraunhofer Institutes, the FH Aachen University of Applied Sciences, the University Hospital RWTH Aachen and the RWTH Aachen University, you can also profit from the bundled competence this location, Aachen, offers in the sector of additive manufacturing. The Fraunhofer ILT is your qualified partner in all areas of SLM-based additive manufacturing.

Scope of Services

As far as plant engineering is concerned, our services encompass, among others:

- New development and adaptation of optical systems (beam sources, beam guiding and forming)
- Preheating systems for different temperature ranges (up to 1700° C)
- Optimization of protective gas supply systems (simulation, design engineering, installation and testing)
- Development of customized plants
- Integration of SLM plants into existing production environments
- Development of highly flexible laboratory systems with their own software for research and development

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1 New exposure concept for SLM – detailed view.
2 Multi Scanner Laboratory SLM system.
3 New exposure concept for SLM – total view.
4 Coaxial process monitoring.