Fraunhofer
IPT

FRAUNHOFER INSTITUTE FOR PRODUCTION TECHNOLOGY IPT

Integrated inline measurement system for an adaptive laser based cutting of complex surfaces

PROCESS MONITORING FOR LASER BASED MANUFACTURING

Fraunhofer Institute for Production Technology IPT

Steinbachstrasse 17
52074 Aachen
Germany

Contact

Rouwen Kunze M.Eng.
Phone +49 241 8904-573
Fax +49 241 8904-6573
rouwen.kunze@ipt.fraunhofer.de

Dipl.-Phys. Niels König
Phone +49 241 8904-113
Fax +49 241 8904-6113
niels.koenig@ipt.fraunhofer.de

metrology@ipt.fraunhofer.de
www.ipt.fraunhofer.de

WZL | RWTH AACHEN UNIVERSITY

The Challenge

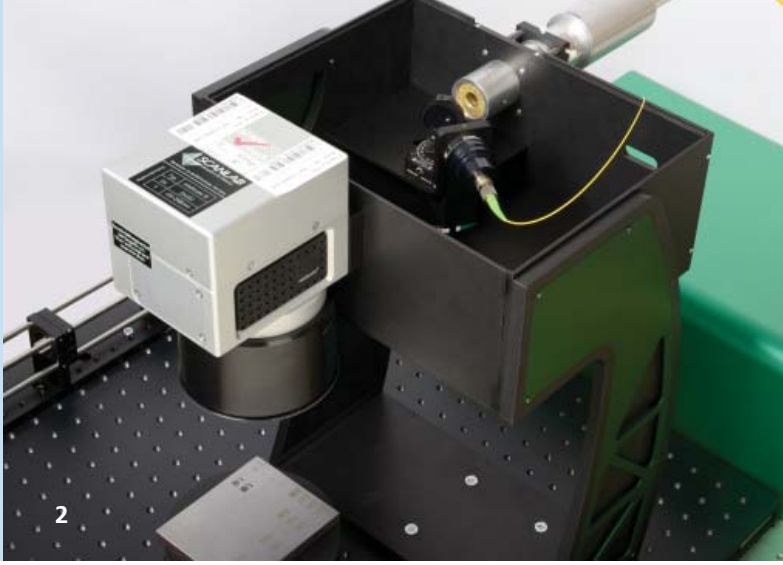
The industrial use of laser processing systems in the micro- and macro-production becomes more important in different industries and applications. Therefore, it has established itself as one of the most important tools of production technology. Technical characteristics, such as high precision, reliability, material variety and low thermal load as well as good automation reinforce this development.

However, low component tolerance and short cycle times in this area confront laser processing with new challenges. Considering that laser processes are influenced by different machine, workpiece and environment-related factors, small parameter changes can already cause the produced components to miss the specified tolerances. Therefore, the stability of the process parameters plays an important role. Particularly in the production of precision components, the process window, i.e. the range of allowable parameter deviations, is extremely tight. Thus, monitoring and its consequent regulation is indispensable.

Our Solution

The solution pursued by the Fraunhofer IPT is based on the integration of measurement systems based on the low coherence interferometry, characterization of process related emissions (based on camera and photodiode), laser triangulation and chromatic confocal distance measurement. These systems are further used for direct process adaptation and control. The measurement systems can use the same beam path of the laser beam or be incorporated with an offset or angle. Here, the modular inline measurement systems can analyze the process before, during and after processing,

1



2

depending on the measuring principle applied. These solutions provide a precise and robust monitoring and enable a control solution for laser processes which is able to cope with complex tasks.

Measurement principles

- Low coherence interferometry
- Characterization of process related emissions using laser induced breakdown spectroscopy, cameras and/or photodiodes
- Laser triangulation (coaxial and offset)
- Chromatic confocal distance measurement

Technical possibilities

Before machining
- Characterization of the workpiece's position and topography for machine aligning as well as adjustment of the machining strategy/CNC code
- Automatic process initialization (laser parameter setting)

During the machining
- Inline measurement of ablation depth
- Detection of process deviations and control
- Inline monitoring the focus position
- Early identification and correction of manufacturing defects

After the machining
- Quality assurance directly in the machine (using machine coordinates)

Possible use in the following processes

- Laser cutting
- Laser welding
- Laser transmission welding (polymer-polymer/hybrid welding)
- Laser micromachining/structuring
- Laser cladding
- Additive manufacturing (Selective laser melting)

Our service

- Development of special measuring systems and needs-based measurement software
- Project management, requirements analysis, design and implementation
- Integration into your production
- Validation and characterization

AKL ARBEITSKREIS LASERTECHNIK e.V.

Innovation Award
Laser Technology 2014
2nd Place

»Penetration Depth and Topography Measurement in Laser Materials Processing using Low Coherence Interferometry«

1 *Inline measuring system for the process monitoring based on a chromatic confocal distance measurement*

2 *Integrated inline measurement system for an adaptive laser based micro structuing of complex surfaces*