LASER-ASSISTED MACHINING
LASER-ASSISTED CUTTING

The ever higher demands placed on technical products are increasingly leading various industries to utilize high performance materials, but machining these materials is not really an economic matter. Heating these materials with the aid of a laser beam during machining opens up a whole new range of efficient cutting options. Localized heating directly in front of the cutting tool and the resultant reduction in material strength significantly increase the suitability of these materials for cutting. Titanium, nickel and cobalt based alloys can all already be machined to high standards and, for the first time, silicon nitride ceramics can also be milled and turned.

The advantages of laser-assisted cutting

- Efficient cutting of materials that are difficult to machine – significantly higher cutting volumes and longer tool life times
- Considerably shorter manufacturing times and lower costs
- Elimination of cooling lubricants (dry machining)
- Geometrically flexible, economic manufacture of complex components made from technical ceramics (silicon nitride ceramics)
- Highly reproducible manufacturing quality due to very good control of the laser source

Our expertise

- Comprehensive technological expertise in the design of laser-assisted cutting processes for metals and ceramics that are difficult to machine
- For the first time, it has become possible to machine complex silicon nitride ceramic components from the rod via laser-assisted cutting
- Modular tool system for all machining operations without the need for re-clamping.

Our offer

- Feasibility and cost-benefit studies
- Development of laser-assisted turning and milling processes
  - Analysis of customer-specific requirements in terms of the product and the process
  - Process design and optimization
  - Initial component manufacture to qualify the process
  - Analysis of component quality
  - Support for the implementation of processes within industrial production operations
- Contract manufacture of prototypes as well as small and medium-sized batches
TOOLING SYSTEMS FOR LASER-ASSISTED MACHINING

The use of laser technologies in machine tools necessitates the development of modular tooling systems with which to flexibly and automatically utilize cutting, forming and laser tools. The Fraunhofer IPT has developed a commercially available tooling system consisting of a tool turret with standardized tool holders for laser-assisted turning/milling. These can be equipped with any cutting and laser tools required, making it possible to combine conventional and laser-assisted cutting and laser surface treatment processes in a single machine tool. The relevant tooling system for laser-assisted metal spinning is currently being developed by the Fraunhofer IPT and qualified for industrial use.

Advantages of modular tooling systems

- Complete machining of geometrically complex components made from high performance materials without the need for re-clamping
- Extremely short tool exchange and set-up times
- Laser integration does not restrict the original functionality of the machine tool
- Shorter process chains due to the integration of laser surface treatment processes (hardening, alloying, dispersing, deposition welding) in conventional machine tools
- Shorter manufacturing throughput times

Our expertise

- Many years of experience in the integration of various laser technologies into new or existing manufacturing processes
- The tooling systems developed by the Fraunhofer IPT are easy to retro-fit into conventional machine tools
- User-friendly operation and maintenance of the tooling system – no laser-specific skills required

Our offer

- Development and implementation of concepts for integrating laser technologies into machine tools
- Development and design of the relevant laser tools for specific machining operations
- Integration of laser technologies into existing production processes taking up- and downstream processes into account
- Design of entire process chains for complete machining
LASER-ASSISTED METAL SPINNING

Metal spinning makes it possible to easily, quickly and cost-effectively manufacture complex, rotationally symmetrical components. Components made in this way have excellent mechanical properties, high surface qualities and good concentricity. Conventional metal spinning is, however, not ideal for materials such as titanium and nickel alloys that are difficult to machine. Localized heating in the deformation zone via a laser improves the formability of a material. The complementary use of the laser makes the machining of these materials more efficient.

Advantages of laser-assisted metal spinning

- Considerably higher deformation degrees and higher deformation rates compared to cold working
- Complete machining without the need for re-clamping through the elimination of intermediate annealing stages
- Specific, localized heating within the forming zone significantly reduces the diffusion processes in the surface layers
- Highly reproducible manufacturing quality due to very good control of the laser source
- Components without safety-relevant welds

Our expertise

- Comprehensive process expertise in the design of machining strategies for the laser-assisted spinning of metals that are difficult to machine, e.g. titanium, nickel or iridium
- Development and design of tools for laser-assisted spinning
- Prototype machine tool for laser-assisted metal spinning based on an industrial spinning lathe (Leifeld PNC 75)

Our offer

- Feasibility and cost-benefit studies
- Development of laser-assisted metal spinning processes
  – Analysis of customer-specific requirements in terms of the product and the process
  – Process design and optimization
  – Initial component manufacture to qualify the process.
  – Analysis of component quality
  – Support for the implementation of processes within industrial production operations
- Contract manufacture of prototypes and individual components
Fraunhofer Institute for Production Technology IPT
Steinbachstrasse 17
52074 Aachen
Germany
Phone +49 241 8904-0
Fax +49 241 8904-198
info@ipt.fraunhofer.de
www.ipt.fraunhofer.de

Contact
Dr.-Ing. Kristian Arntz
Phone +49 241 8904-121
Fax +49 241 8904-6121
kristian.arntz@ipt.fraunhofer.de

Dipl.-Ing. Christoph Brummer
Phone +49 241 8904-244
Fax +49 241 8904-6244
christoph.brummer@ipt.fraunhofer.de

The images on pages 1, 2, 3 and 4 appear with the kind permission of A. Monforts Werkzeugmaschinen GmbH & Co. KG