

Lecture on Laser Material Processing

Prof. Dr. Harald Riegel

Vice President of Aalen University,
Institute of Optical Technology
Head of Laser-Application-Center
www.hs-aalen.de/laz



Aalen, Germany

Introduction

Laser-Material-Processing (LMP) is an advanced production processing technology with a bright future. Laser cutting, laser welding and laser marking are wide spread technologies in industry. Many further laser based material processes like laser brazing, powder bed fusion (3D - Printing / Additive Manufacturing) or drilling are commonly used technologies. The big advantage of using the contact-less laser technology is a small heat affected zone at the work piece with high process speed and low distortion. No (or almost no) rework of processed parts even in optical critical areas are necessary. The future of laser material processing is characterized by many new advanced processes like polishing, special types of brazing or in-process-cleaning. The costs of lasers are decreasing dramatically offering savings or competition with currently more cost attractive industrial processes. New types of lasers for example ultra-short-pulsed laser or lasers with special wavelength offer new types of technologies like material processing without any molten material or heat effected zone in the process.

Content of class at Elite Undergraduate Program of Chien-Shiung Wu College (Honors)

The class consists of three blocks each block has a duration of four teaching hours (4 x 45 min = 180 minutes).

1st lecture: Introduction to Laser

In the first block the students understand the physical principles of LASER. They know the basic components of a laser light source and the typical lasers used in mechanical and automotive industry. The students can distinguish the main operational modes like continuous wave (cw) or pulsed wave (pw).

2nd lecture: beam quality and propagation

Students are taught in the second lecture beam quality, beam propagation and beam guidance. They know how to calculate characteristic laser parameters and can cope with focal diameter, divergence, beam-parameter-product, beam caustic and Rayleigh length. Students will get basic physical equations and by doing exercises they will be able to know the interdependence of the basic parameters. A brief look inside the intensity distribution of a laser beam will finish the second lecture.

3rd lecture Laser Material Processing

The students will understand the physical principles and the technical features of laser material processes, like brazing, cleaning, remelting, polishing, cutting, welding, drilling, structuring and marking

4th lecture (optional) Energy Absorption during cutting and welding

The students will understand that process efficiency is the key to predict suitable laser parameters for processes. Students will study examples in Laser cutting and Laser welding.

4th or 5th lecture Presentation