Faculty of Electrical Engineering & Computer Science
Master Degree Course Electronics Engineering, MSc EE

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Optimization for Micro structuring of Metal Surface with Ultra-short Laser Pulses.

ABSTRACT - Masterthesis

Lasers can be used to deliver large amounts of energy into confined regions very accurately in order to achieve the desired response. Because of this advantage lasers find an immense application in the fields of laser cutting, bending, drilling and ablation etc. Especially, pulsed lasers have been proved to be more effective than continuous wave lasers due to their beam exposure to the material with high intensity for very short time. Pulsed lasers can be classified into two categories, short and ultra-short pulsed lasers. Short pulsed lasers are in the order of micro to nano-seconds and ultra-short pulsed lasers are in the range of pico to femtoseconds.

The advantage of using ultra-short pulsed laser over short pulsed laser is that the laser energy burst duration is less compared to the thermal diffusion time of the material, there is no thermal equilibrium, and more importantly, there is no time for heat to diffuse outside the absorption volume of the laser pulse. This temporal focusing of laser energy creates a much more localized interaction where the material is ionized, leading to ablation with minimal impact on the adjacent matter.

The objective of this thesis is to study the laser-matter interactions as well as an understanding of materials in relation to the processing conditions and the result in the material properties mainly due to short time energetic excitation and relaxation.

The tasks in this thesis include laser processing parameter study using ultra-short pico-second pulsed laser for metals (Nickel & Copper) by varying the different parameters at processing; documentation; laser processing parameter characterization; Imaging with an optical microscope & SEM and evaluation of results (tendency, correlation, best parameters). The laser used in the tasks will be pico-second pulsed laser with two different wavelengths of 355 nm & 1064 nm at a repetition rate of 100 kHz and 500 kHz. The parameters changed are generally the pulse energy and the pulse number at a particular frequency. Microscope analysis is to be done to analyze the Gaussian beam quality, diameter & depth of the modification made by the laser pulse.