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

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Selective Laser-Induced Etching using Scanner Optics with Low Numerical Aperture.

ABSTRACT - Masterthesis

Glass cutting and drilling in transparent dielectrics using ultrashort pulse lasers are important development for glass manufacturing industries and future technologies. The treatment of dielectrics with focused ultrashort pulse laser radiation allows the in-volume modification of the material and as a result processing of 3D micro and nano structuring, waveguides and micro fluidic systems. The structuring induces a permanent refractive index change.

Usually the ultra-short pulse lasers are below 10 picosecond and these ultra-short pulse lasers are specialized lasers used to create high intensity pulses and these ultra-short pulse lasers interacts with transparent dielectric for in-volume modification and this modification is caused by nonlinear photoionization process.

The aim of this thesis is to work with a technique called selective laser induced etching (SLE) and it is a new method for creating micro fluidic devices or micro components in transparent dielectrics e.g. fused silica, sapphire etc. The Tightly focused ultra-short pulsed laser beams of high intensity beneath the surface of a dielectric are absorbed through nonlinear photoionization mechanism giving rise to a permanent structural modification. Afterwards the sample is etched for few hours to several days in HF/KOH to remove the modified material. Due to non-linear absorption process in the transparent materials a complete variability in 2D and 3D is given.

In this work feasibility of SLE with optics of low NA 0.09 in willow glass of thickness 130 µm is being investigated by varying several parameters such as pulse duration from 540 fs to 1 ps, pulse energies from 2 µJ to 20 µJ, scanning speeds 300 mm/sec to 1500 mm/sec, Z gaps Δz = 9 to 617 µm and repetition rates 456 KHz to 18.9 MHz respectively. Hypothesis of selectivity is being investigated.