Faculty of Electrical Engineering & Computer Science
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Large Area Fabrication in a True Three Dimensional Laser Lithography System.

ABSTRACT - Masterthesis

The development and manufacturing of novel and innovative micro- and nano-optics is a forward looking industrial sector. The modeling of three dimensional structures in the nanometer range represents a progressive technology. A direct laser writing (DLW) process utilizes the two photon absorption to fabricate such structures. The lithographical system used in this research allows writing of high resolution true three-dimensional nanostructures in photo resists.

The lithographical setup consists of a fs- laser as the exposure unit. A standard core glass can be used as the substrate A specific challenge is the finding and alignment of the interface between the glass and the resist.

To write three dimensional structures in the resist, the substrate is fixed in tandem to a linear motor stage and a piezo-cube. These two stages have to be controlled by a software. The piezo-cube has a displacement range of 300μm x 300μm x 300μm with a resolution of 4nm. For larger areas the linear stage, which has a range of 100mm x 100mm in X and Y direction with a resolution of 1μm, must be utilized in the movement process. The structures which has to be written an the photo resist is first expressed in terms of the 3 coordinates namely X,Y,Z. The exposure of the photoresist is controlled by several parameters such as intensity, exposure time, writing speed, etc.

Goal of this master thesis is the optimization of DLW process to produce highresolution 3D nanostructures in a large area (> 300μm). A combined movement of the piezo-cube and the linear stage results in some inaccuracy. The piezo crystal is prone to vibrations due to the linear stage movement and the resolution of the linear stage is insufficient. To achieve better results, strict recipes for various steps must be followed for the control of such a precise manufacturing process. Another challenge which has to be overcome in the fabrication of structures greater than 300μm is the tilt of the substrate. The tilt correction has to be accurate for the structures to adhere to the surface of the substrate.