Faculty of Electrical Engineering & Computer Science
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Photolithography on non-planar surfaces.

ABSTRACT - Masterthesis

As opposed to planar optical lithography, the application on non-planar substrates is not yet satisfactory evolved. Diffractive optical elements (DOEs) offer a promising approach towards implementing optical lithography on non-planar surfaces as they allow to generate arbitrary intensity patterns in a predefined plane.

In this work fundamental investigations of the optical properties were carried out in a systematic matter. This includes the stepwise progression of system complexity, hence the research is focussing on the image reconstruction an tilted planar surfaces as a first approach.

Basic process factors were identified and addressed accordingly, the employed photoresists were characterised systematically. The optical properties of the DOEs were investigated and a comparison of two different diffractive structures was carried out. Negative influence on the pattern fidelity by non-perpendicular illumination of the DOEs was shown. Furthermore the diffraction efficiency was determined and incorporated in the comparison. The basic investigations were carried out employing DOEs that require a condenser lens for the image reconstruction on a plane perpendicular to the optical axis. Afterwards, a DOE that allows for image reconstruction on an inclined plane without the use of a condenser lens was investigated. The DOE was designed for one particular test pattern and a predefined angle. By means of the aforementioned DOE a photoresist coated sample was successfully patterned while tilted under the design angle. The resulting pattern in the resist showed consistent behaviour and fidelity which is in accordance with the design pattern and its optical properties.

In this work, the principle of operation and applicability of DOEs to address the issue of non-planar surfaces has shown promising results that stimulate further investigations and efforts in this field.