Diffractive Optics in Coherent Automotive Lighting

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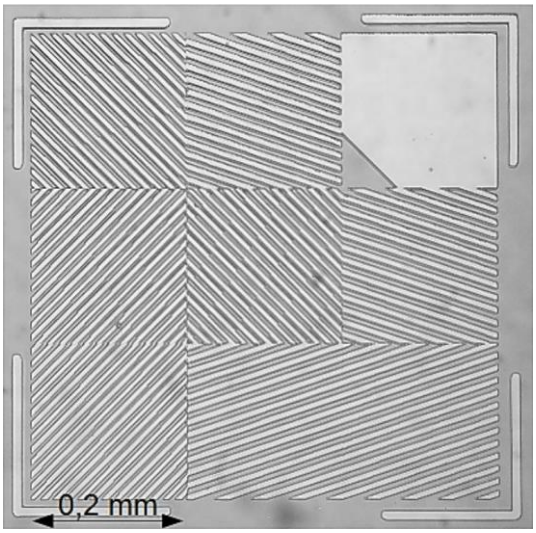
Recent trends in automotive lighting make large steps towards laser driven illumination technologies. While there already exist commercially available products for laser operated front lights, where a phosphor layer is illuminated by a blue laser and converted into a broadband spectrum, less attention has been paid to rear or even brake lights. A tremendous advantage of coherent laser based light sources over conventional halogen lamps or LEDs is the feasibility to employ diffractive optical elements (DOE) rather than bulky refractive optical systems to spatially tailor light distributions. DOE provide a larger flexibility in terms of optical design due to their capability to diffract light in larger angles compared to their refractive counterparts.



Diffractive optical element designed to project the letter “H” and created by maskless lithography at HOT

The aim of this project is to develop specific designs and concepts for laser based lighting systems including back and brake lights as well as design elements frequently used in higher class cars to project information relevant for passengers and driver. The optical design is carried out by wave-optical simulations utilizing either commercial software such as VirtualLab by LightTrans or by software tools to be implemented in Python or Matlab also taking advantage of parallel computing and graphical processor units. The designed elements are created in a second step through a lab-made maskless lithography setup. It is based on a DMD projector, which is capable to project a bitmap of the desired element to be fabricated into photoresist such as the one shown in the picture. After development of the resist, a negative copy of the developed microstructure obtained by electro plating or copying the structure in silicone is utilized as master for reproduction in polymers. The latter process step is performed either by hot embossing or micro injection molding at the Hannover Centre for Optical Technologies. The created optical elements are subsequently characterized in terms of optical performance such as diffraction efficiency, transmittance and stray light among others.

Prospective PhD candidates should have a strong background in optics and/or micro-fabrication technology and basic experience in software development.

This is a PhD-project of Tailored Light. Tailored Light is a coordinated PhD-programme of the Hanover Centre for Optical Technologies from the Leibniz Universität Hannover together with the Hochschule Hannover, the Laser Zentrum Hannover, the HAWK Hildesheim/ Holzminden/ Göttingen, the TU Braunschweig and the TU Clausthal.

Students interested in this or another project of Tailored Light can apply for fellowships. Have a look at www.tailored-light.uni-hannover.de for details.