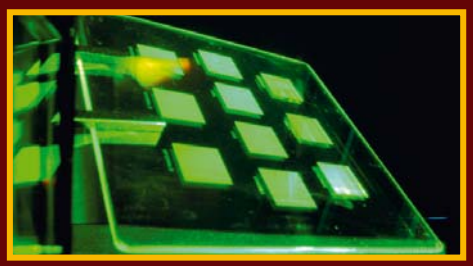
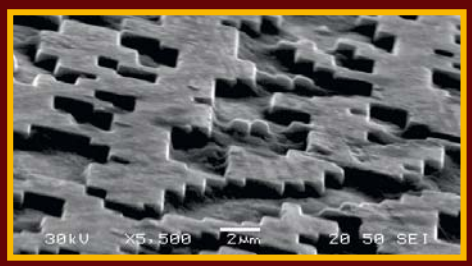
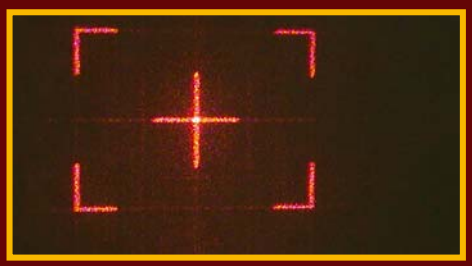
DOE

Customized Diffractive Optics







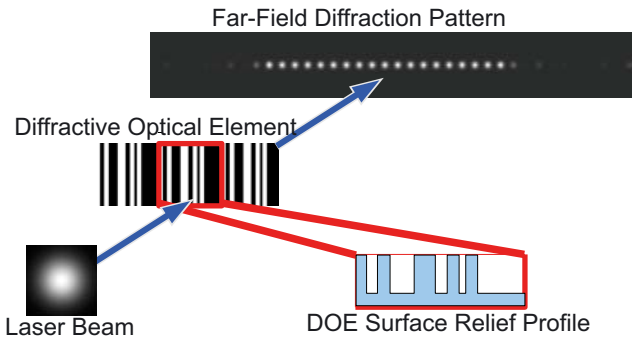
HOLOEYE **Systems, Inc.**

Diffractive Optical Elements - DOE

HOLOEYE designs, develops, and commercializes Diffractive Optical Elements specifically for the fields of technical optics and lasers. Since inception, HOLOEYE has established a full service design and development technology cycle that provides its customers with a fully integrated closed-loop development process. HOLOEYE´s array of products and services ranges from standard DOE development to large-scale complex bilateral joint DOE projects.

Functionality of Diffractive Optical Elements

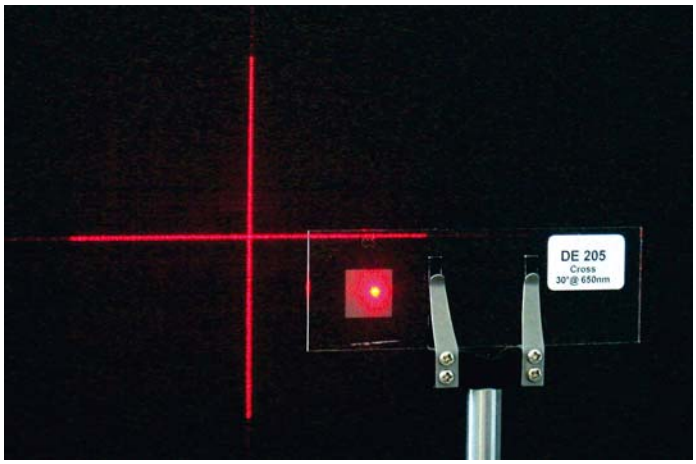
A Diffractive Optical Element (DOE) utilizes a surface with a complex microstructure for its optical function. The micro-structured surface relief profile has two or more surface levels. The surface structures are either etched in fused silica or other glass types or embossed in various polymer materials.



Properties of Diffractive Optical Elements

The different types of DOEs (beam splitters, Fourier holograms, beam shapers, diffusers and various grating structures) act like optical processors, splitting or reshaping light to almost any desired distribution.

Additionally, diffractive optics can realize almost the same optical functions as refractive optics such as lenses, prisms or aspheres, but they are much smaller and lighter. DOEs are not limited to laser applications; partially coherent light from LEDs or other light sources can also be modulated.



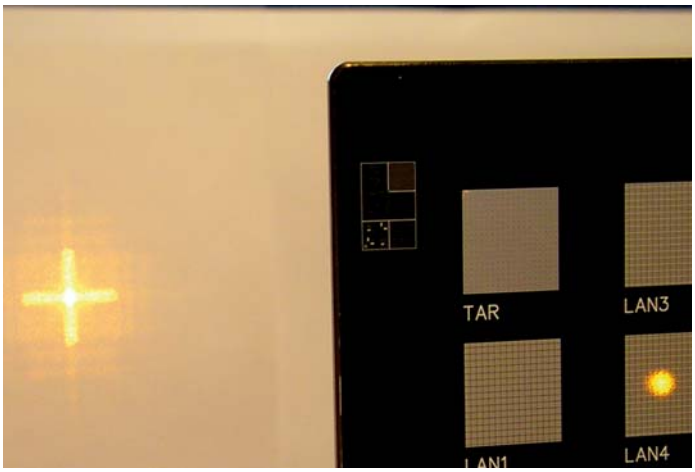
Diffractive Optical Elements Provided by HOLOEYE

- Beam Splitting Elements: Fan-out-elements, Pattern Generators
- Line Generators, Crosshair Generators
- Beam Shaping Elements
- Diffractive Lenses (Fresnel Zone Lenses, Lens Arrays, Cylindrical Lenses)
- Gratings (Amplitude, Phase, Blazed)
- Random Phase Plates
- Wave-Front Generators

Problem Analysis & Feasibility Studies

After the identification of a possible field of application for a diffractive optical element, it is often necessary to do a feasibility study. HOLOEYE offers a range of sample diffractive optical elements which are helpful for proof-of-concept experiments and permit a detailed analysis and definition of the specifications that need to be met in a DOE development.

HOLOEYE also has the capability to demonstrate experimentally optical functions of DOEs using Spatial Light Modulator devices as switchable optical elements.



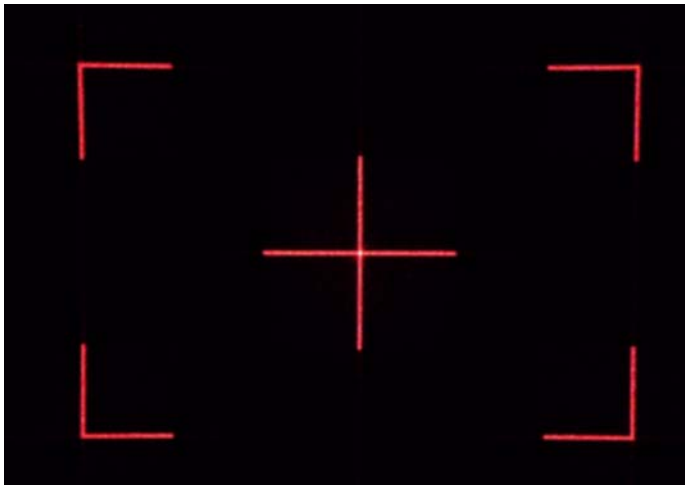
Order Processing

- Custom design of diffractive elements according to customer specifications
- Fabrication of master structures
- Tooling for DOE replication
- Replication of diffractive elements
- Optical performance tests

Design & Simulation

HOLOEYE offers custumized design of diffractive optical elements. Among the computational design methods used are Iterative Fourier Transform Algorithms (IFTA), direct binary search (DBS) algorithms, gradient search algorithms and methods based on the determination of geometrical map transformations. We have capabilities for designing DOEs for projecting patterns on inclined surfaces and with arbitrary angles of diffraction. This allows us to precisely place diffraction spots freely on a surface of interest and to thereby realize very complex patterns with precision.

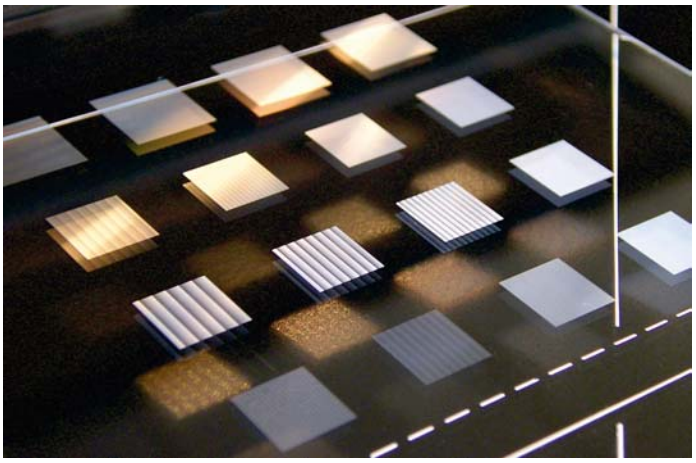
During the design process, the parameters from the application are taken into account. The obtained element design will be tested in wave-optical simulation prior to fabrication. The customer will receive detailed information about parameters of concern, like exact diffraction angles, diffraction efficiency, signal-to-noise ratio and energy distribution uniformity.



Master Fabrication

The design data is optimized for minimum fabrication error dependency and the data conversion for the fabrication facilities is monitored to ensure maximum performance of the master elements. The fabrication technology will be chosen to meet specifications on the one hand and to minimize cost on the other hand.

HOLOEYEs customized DOE solutions are based on its ability to communicate with customers, evaluate their needs, analyze the problem at hand, and then manufacture a solution using an array of master fabrication and volume replication technologies at HOLOEYE´s disposal.



Replication Service

Replication technologies represent a major economic success factor in diffractive optics because replication significantly reduces the cost of each single optical element.

The fabrication of a master component with an optical microstructure can be very cost-intensive. With a replication method the optical structure of a master component can be copied in high quantities onto different optical media, thus reducing the effective cost per element significantly. Using distinctly-manufactured master structures, HOLOEYE can add value by its own replication methods to improve the performance of diffractive elements with respect to specific merit parameters.

HOLOEYE offers high-precision replication of small quantities for applications in technical optics at reasonable cost. Replication is possible in almost 50 different materials for:

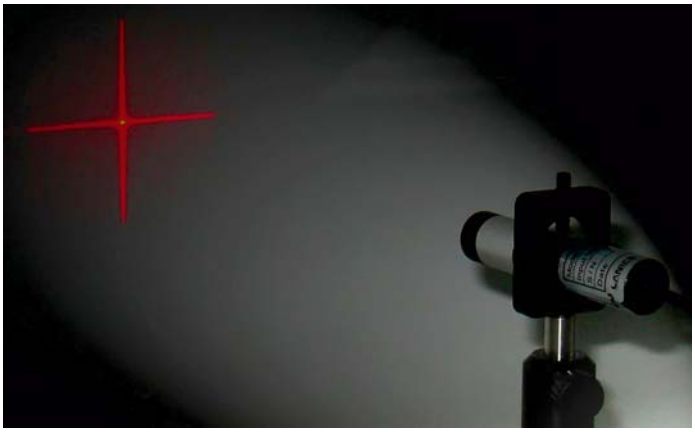
- Different material requirements
- Varying wavelengths (for optimum diffraction efficiency)

-Index of refraction (for optimum diffraction efficiency)
-Replication on surfaces of different media
-Different environmental conditions (temperature, humidity)
HOLOEYE also offers high precision mass replication on glass substrates.

The diffractive optical elements are delivered in customers' requested shape and size or integrated with a customized mechanical holder.

System Design & Analysis

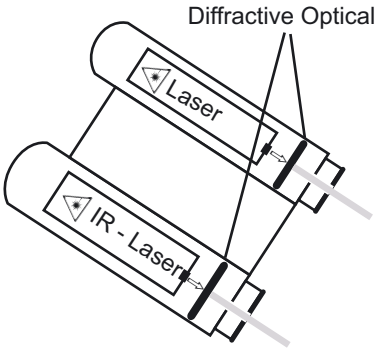
Upon costumers´ request, we may review and discuss the existing or intended optical system in order to determine whether, and in which way, micro-optical or diffractive optical elements can be used to provide a solution and how they should be incorporated. Theoretical analysis of the systems and simulations can be accompanied by tests at HOLOEYEs optical laboratories, taking advantage of the availability of HOLOEYEs Spatial Light Modulator technology.

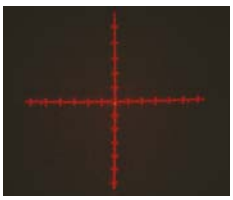


Implemenation Support
Upon customers´ request, we are ready to visit the customer´s implementation laboratories and provide assistance regarding the actual implementation of the microoptical component into the customer´s system.

We also offer integrated solutions where the optical elements are delivered on a mount, a holder or other optomechanical component. For complex development efforts, we offer support through the iterative design phases that may be required to finalize a solution.

Application Example:
DOE Based Laser Aiming Device
DOEs realize a non imaging pattern generation which yields high sharpness at any position of a beam. This qualifies DOEs to be the perfect solution for any laser aiming application in which a display of a specific pattern is needed. Moreover the same aiming pattern can be produced for different wavelengths (e.g. for daylight and IR for nightvision)





Advantages
DOE´s guarantee a distinct aim pattern at any position of the target field because the pattern is produced by the diffraction of laser light and not by projecting an image.

Pattern generating Diffractive Optical Elements can be produced for different wavelengths. Thereby DOE´s provide a unique solution for combined visible and infrared targeting devices.

DOE´s enable an easy and cost effective customization of targeting patterns.

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