

Compact Tunable Lens

Diffractive Optical Elements (DOEs) with continuously adjustable optical power

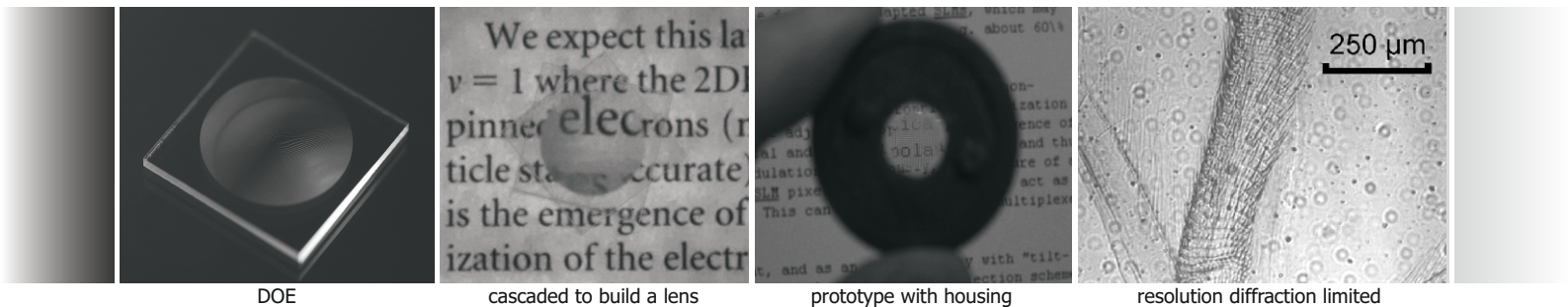


Two specifically structured DOEs are cascaded to obtain various optical elements like **lenses**, axicons or spiral phase plates.

Their optical power is continuously adjustable, simply by rotating the DOEs with respect to each other.



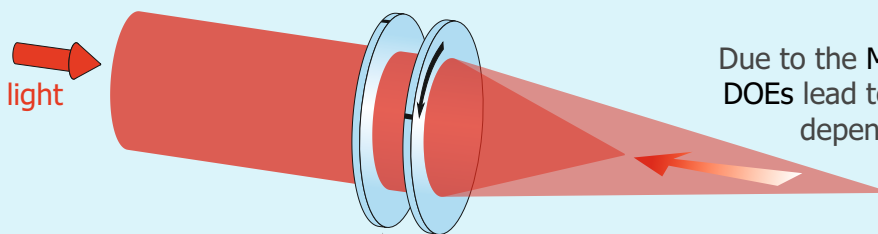
- + Flexible lens material
 - Low fabrication costs
 - High power applications
- + Focal spot stays on optical axis
- + Compact design (thin and lightweight)
- + Scalable in size, wavelength and power
- + Diffraction limited resolution (monochromatic light)
- + Continuous, simple and exact variation of optical-properties within a wide range (e.g. $D = \pm 20$ dpt)



Application: Tunable Lens

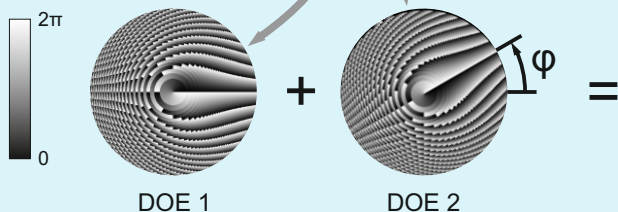
Protected under patent family WO 2009/012789 A1

USA: granted
RUSSIA: granted
JAPAN: granted
EUROPE: pending

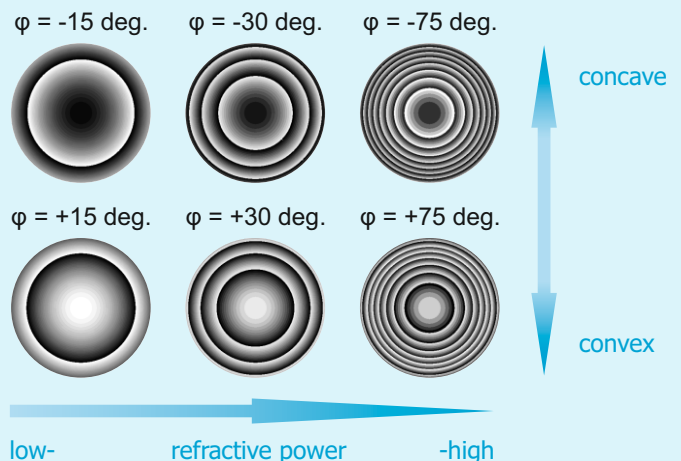


Due to the Moiré effect a mutual rotation of the DOEs lead to a lens of certain refractive power, depending on the rotation angle φ .

Principle:



The DOEs possess a surface structure that shifts the phase of monochromatic light in the range between 0 and 2π . The superposition of the complementary structured DOEs have the same effect as a corresponding Fresnel lens.



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Application fields & Markets

Imaging

lightweight & compact zoom optics for cameras, mobile phones or microscopes, adjustable eyeglasses, human eye like imaging systems

High Power

laser-engraving, -marking & -cutting, scanheads for highpower applications

Beam projection

adjustable illumination systems, lamps & headlights, varifocal automotive lighting, scanners, projectors, printers, etc.

Laboratory equipment

adjustable multipurpose devices for optical prototyping, etc.

Scientific and front-end

laser beam shaping & modulation, production of doughnut beams in optical tweezers & interferometers, etc.

Further applications

thermography, infrared imaging, applications for terahertz radiation, varifocal ultra-sound lenses

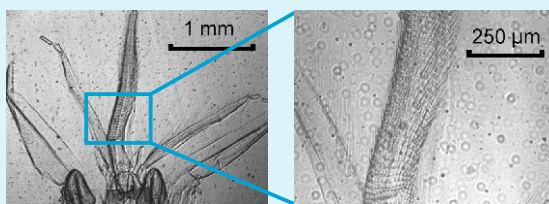
Summary: Special high-end applications as well as numerous low-end mass products



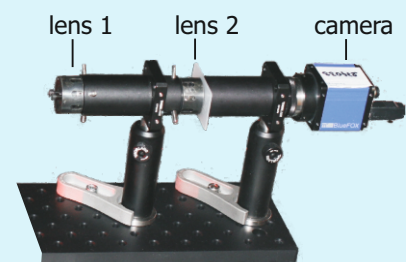
offset optical power can be implemented, optical efficiency up to 90%, chromatic aberrations computationally reducible, combination with "standard" optics (e.g. glass lenses) permits compensation of dispersion effects

Realization of Zoom Optics without Lens Translation

Results:



Setup:



Test image at different magnification factors

$M = 1,35$

$M = 2,71$

$M = 4,11$

$M = 6,92$

