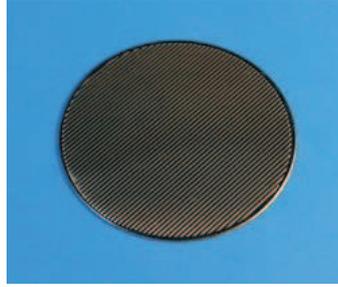


# THz Diffractive Optical Elements

Beam handling is required in many THz applications. Currently it is carried out by parabolic mirrors and refractive optics. However diffractive optics opens up new, basically different opportunities of beam handling since it allows realizing spatial transformation of THz beam.

To satisfy needs in diffractive optics for THz range we have developed calculation methods and manufacturing technology of the following diffractive optical elements (DOE):

- THz Fresnel lenses,
- THz beam dividers.



Common specification:

Parameters	Type of DOE	
	THz Fresnel lens	THz beam divider
Material	HRFZ-Si	HRFZ-Si
Mechanical diameter, mm	to 55	to 55
Optical diameter, mm	to 50	to 50
Thickness, mm	1	1
Operating wavelength range, $\mu\text{m}$	60-250	60-250
Diffraction efficiency*, %	40	80
Coating	two-side antireflection	two-side antireflection

\*Diffraction efficiency is the ratio of the diffracted light intensity, of a given order, to the incident light intensity.

Developed DOEs have two-level relief. Currently we are working at technology of DOE manufacturing with four- and eight-level relief. Multilevel relief will increase diffraction efficiency up to 96%.

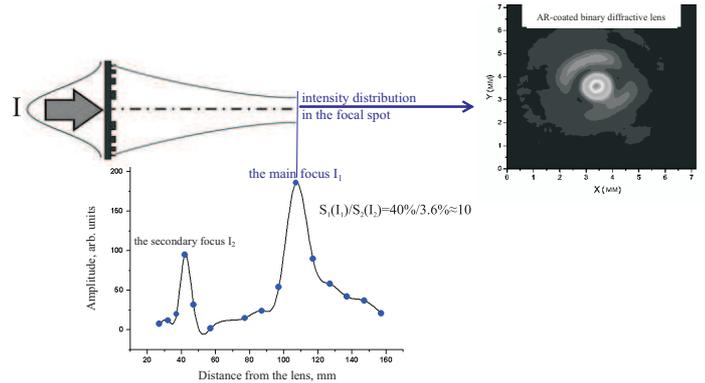
## THz Fresnel Lenses

Fresnel lens is the simplest diffractive element for focusing monochromatic beam. It has no spherical aberrations in comparison with refractive lenses.

There are two focal lengths of diffractive lens: the main one and the secondary one. Diffraction efficiency of the main focus  $I_1/I$  is 40% and of the secondary one  $I_2/I$  is <3.6% that has been confirmed experimentally\*\*. Optical characteristics have been investigated using free electron laser, radiation has been detected by matrix microbolometer.

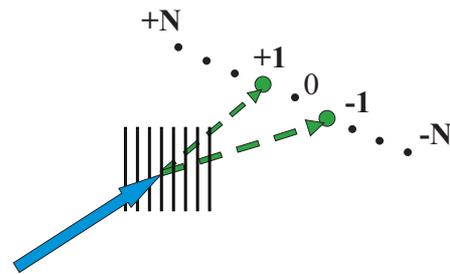
It's possible to produce the lenses with focal length from 100 mm and more. Focal length tolerance is 5%.

Dimension of Airy disk can be calculated using the following equation:  $X=1.22*\lambda*F/D$ , where  $\lambda$  - operating wavelength,  $F$  - focal length, and  $D$  - optical diameter.



## THz Beam Dividers

Beam divider transforms incident beam into spatially spaced several beams with specified power distribution. Diffraction efficiency of the operating orders (+1 and -1) is 40(+/-2)% and of other orders <5%. Value of the angle between operating beams can be from 20deg to 80deg.



Diffractive optical elements are manufactured upon request.

For price quotation and delivery please fax or e-mail us.

\*\* B. A. Knyazev, Yu. Yu. Choporova, V. V. Gerasimov, M. G. Vlasenko, V. S. Pavelyev, B. O. Volodkin, A. N. Agafonov, K. N. Tukmakov, A. K. Kaveev, G. I. Kropotov, E. V. Tsygankova, M. F. Stupak, I. G. Palchikova, Study of Diffractive Optical Elements Using High-Power Radiation of Novosibirsk Terahertz Free Electron Laser, Proceedings of IRMMW-THz 2012



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