Beam Splitting

Beam Splitting elements are diffractive optical elements (DOE) used to split a single laser beam into several beams, each with the characteristics of the original beam.

FEATURES

Accurate angle separation

Insensitive to X-Y-Z displacements

Custom separation angle and shape

Any input beam shape

High power threshold

Wavelengths from UV to IR

Optional AR/AR coating

APPLICATIONS

Parallel material processing

Medical/aesthetic treatment

Laser scribing (solar cells)

Glass dicing (LCD displays)

Laser display & illumination

Machine vision & 3D sensors

Fiber optics

DOEs can generate unique optical functions that are not possible by conventional reflective or refractive optical elements, providing greater flexibility in system configuration. Among the few advantages are: small footprint, fast/high throughput thanks to simultaneous processing, tailored energy distribution, etc. The operational principle is quite straightforward; from a collimated input beam, the output beams exit the DOE with a predesigned separation angle and intensity. Several examples are presented in Fig.1.
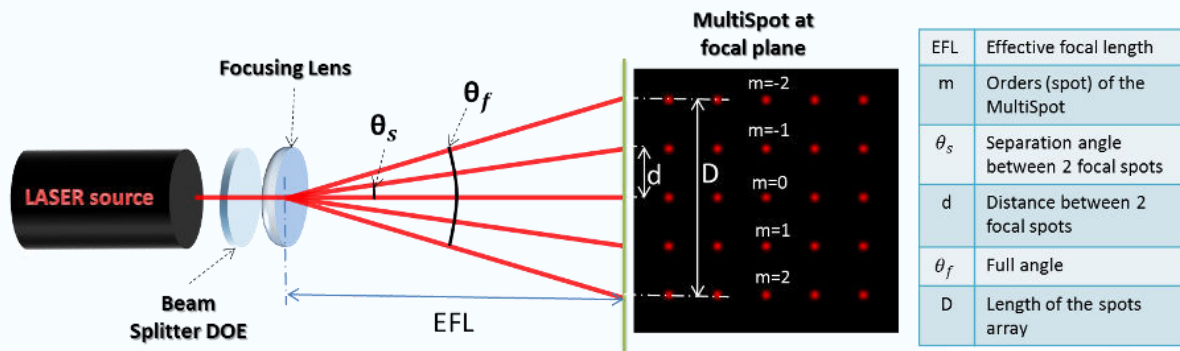
Figure 1 Examples of Multi-spot DOEs
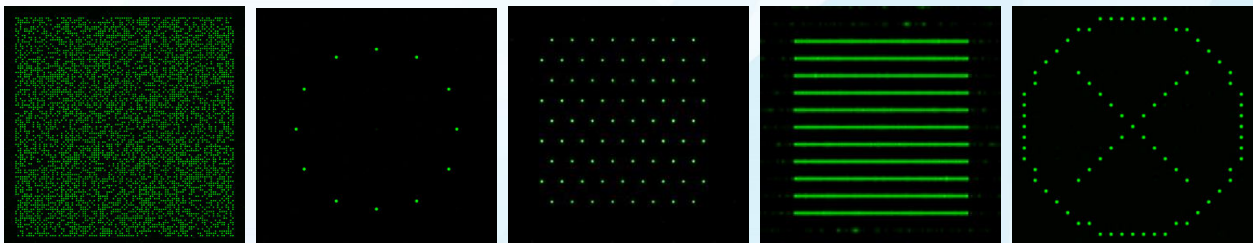
DESIGN CONSIDERATIONS

1. In order to achieve well-focused spots at a certain distance, one needs to add a focusing lens after the DOE, as shown in figure 2 below.

   Figure 2 Schematic set-up

2. In order to obtain the right lens, use the following mathematical relationship between the effective focal length (**EFL**), separation angle (**θ_s**), and inter-spot distance/ pitch (**d**):

   $$d = EFL \times \tan(\theta_s)$$

3. In double-spot configuration, **power efficiency** can reach ~80%, and for multi-spot (>2) 85% is achivable, for a **binary (2 level)** etching process. In **multi-level** etching, efficiency can reach up to 95%. The remaining power is distributed among the other (parasitic) orders.

4. Energy distribution can be designed for either **spot uniformity** or for any non-uniform distribution meeting the application's requirements.

5. The **minimum input beam size** should generally be <u>at least</u> 3 times the size of the **period** in the DOE. The **period** is given by the grating equation:

   $$\Lambda = \frac{m\lambda}{\sin\theta}$$

   Where, Λ=period of DOE, m =diffraction order, λ = wavelength, θ= Separation angle between beams

SPECIFICATION RANGE

Materials	Fused Silica, ZnSe, Plastics
Wavelength range	193 nm to 10.6 um
Separation angle	0.001˚ to 60˚ (larger angles require additional optics)
DOE design	Binary, 8-level, 16-level, and more
Diffraction efficiency	64%-98%
Element size	2mm to 100mm
Coating (optional):	AR/AR
Custom Design:	Almost any symmetry or arbitrary shape